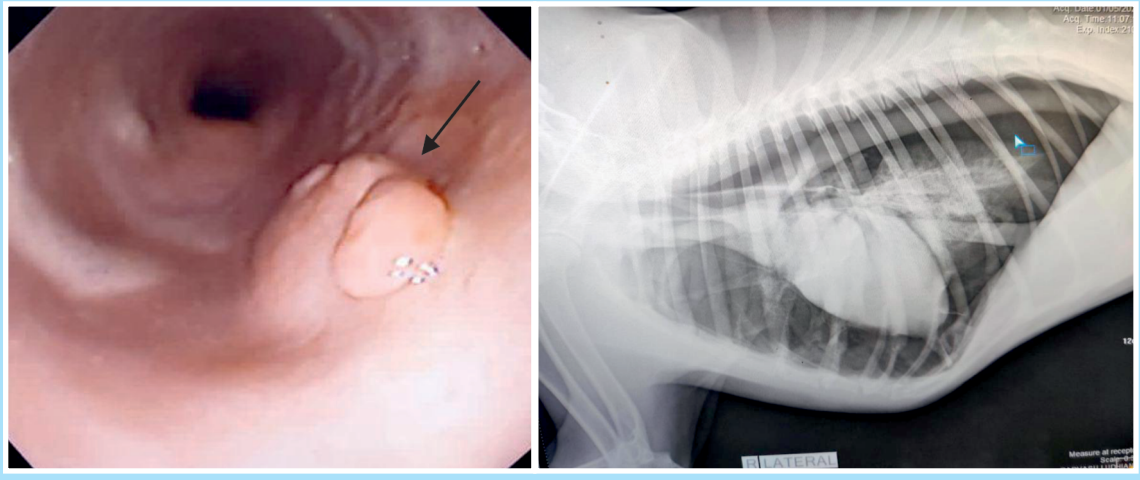
ISSN No. 0970-051X

Indian Journal of VETERINARY MEDICINE

Vol. 43 No. 1 June 2023



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Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 1-11

Review Article

Chronic Gastroenteropathies in Dogs: A Review

Swaran Singh Randhawa[1], Gurpreet Singh Preet[1], Raj Sukhbir Singh[1], Jasnit Singh[2],*

[1]Department of Teaching Veterinary Clinical Complex, Department of Veterinary Medicine
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana-141004

Abstract

Chronic gastrointestinal problems in dogs can occur due to dietary discrepencies, toxins, medications, infections and underlying diseases in other organs resulting in intestinal dysbiosis. Inflammatory bowel diseases (IBD) are common, involving a complex interplay of factors like genetics, immune response, and intestinal environment. These diseases often lead to symptoms like vomiting, diarrhea, and weight loss. Diagnosing these conditions is difficult, usually involving a process of elimination. Tests typically include blood work, fecal analysis, imaging, ultrasound and endoscopic biopsy. Differentiating small and large bowel disorders help in guiding the diagnostic process and undulating treatment based on the specific diagnosis. Managing these conditions often requires tailored diets, sometimes with added supplements and medications to control inflammation or modulate the immune response and/or surgery. However, the severe cases may require parenteral nutrition sometimes to provide essential nutrients.

Keywords: Chronic Gastroenteropathies; Dogs; Hypoallergenic diets; IBD; Probiotics.

Introduction

Dogs presented with typical clinical signs of continuous or intermittent vomiting, diarrheoa, weight loss for more than three weeks duration are considered to be suffering from chronic gasteroenteropathies (Randhawa and Singh, 2018). Potential causes of chronic gastroenteropathies include dietary indiscretion/food allergy, toxin ingestion, non-steroidal anti-inflammatory drug usage, foreign body, Inflammatory bowel disease (IBD), infections (viral, bacterial, protozoal, fungal and helminth), lymphoma besides secondary involvement of GI in renal, hepatobiliary, exocrine pancreatic disorders (Weese *et al*., 2001, Leib *et al*., 2010) and diseases of cardiovascular and nervous system (Hall and German, 2010; Marks, 2013).

Chronic gastroenteropathies are assumed to involve a complex interrelationship among immune system, host genetics and the intestinal environment (i.e; bacteria and dietary constituents) (Ribaldone *et al*., 2019). Among most of the dogs suffering from primary enteropathies, the major cause of disease is inflammatory, followed by infectious and neoplastic. In dogs suffering from secondary enteropathies, the major cause is exocrine pancreatic, endocrine and least due to hepatic, renal and cardiac (Volkmann *et al*., 2017). Inflammatory bowl disorder is the major cause of disease largely affecting most of the dogs and cats. The exact aetiology is not so far known but it is assumed to be caused most often than not due to allergy with diet, parasitic infestation, disturbance in the intestinal bacterial microflora and predisposition in certain breeds (Yogeshpriya *et al*., 2017).

Most of these chronic gastrointestinal conditions are grouped under canine idiopathic inflammatory bowel disease (IBD) characterized by persistent or recurrent clinical signs of vomiting and/or diarrhoea along with histological evidence of inflammation in the lamina propria of small intestine, large intestine or both. These diseases are classified according to the predominant type of inflammatory cell present (CD4+, CD8+, CD3+, T-lymphocytes/ eosinophils/ plasma cells/ macrophages/ neutrophils) in the intestinal biopsy (German *et al*., 2003). Increased numbers of lymphocytes and plasma cells have been noted in lymphoplasmacytic enteritis which is the most frequent form of IBD with a prevalence of 56.2 percent (Kawano *et al*., 2016, Simpson and Jergens, 2011; Washabau *et al*., 2010).

The diagnosis and treatment of canine GEP have historically been challenging due to the lack of standardized clinical, diagnostic, histopathologic, and therapeutic guidelines. To address this issue, the World Small Animal Veterinary Association (WSAVA) and the International GI Standardization Group have developed standards for various aspects of the diagnostic process and management of GI diseases in dogs and cats for history taking, physical examination, laboratory diagnostic tests, imaging procedures and reports, endoscopic

*Corresponding author: drswaran68@gmail.com

procedures and reports, biopsy procedures and reports, histopathologic interpretation, immunohistochemistry (IHC), treatment trials, and patient response and outcome in dogs and cats with GI disease (Washabau *et al*., 2010). The diagnosis is based on exclusion of any other causes for chronic diarrhoea, and endoscopy followed by histopathological findings of intestinal mucosal biopsies confirming lymphoplasmacytic, eosinophilic or mixed inflammation (Allenspach *et al*., 2019).

Etilogy/Causes

A variety of infectious agents can affect the GI tract. Viruses (Rotavirus, coronavirus), bacteria (Campylobacter spp., Clostridium spp., Escherichia coli, Salmonella spp., Helicobacter spp.), parasites, protozoa, (Ascarids, Hookworms, Strongyloides stercoralis, Coccidiosis, Giardia, Tritrichomonas, Balantidium coli), and fungal, algal, and oomycoses (Histoplasmosis, Protothecosis, Pythiosis) have been shown to cause gastroenteritis of varying severity (Trotman, 2015).

Gastroenteritis caused by ingestion of toxins (i.e., organophosphates), foreign materials, or garbage is common in dogs, and less so in cats. Some toxins lead directly to inflammation of the GI tract, although ingestion of other foreign materials may lead to direct GI trauma or an osmotic diarrhea secondary to nondigestible substances within the intestinal tract. The diet containing a high amount of fat causes delayed gastric emptying and hyperacidity in the stomach, which in alone or associated with the physiological reaction of stress (increasing the level of serum cortisol level), may influence GI ulceration in animals (Davis *et al*., 2003). Administration of a diversity of NSAID drugs (e.g. piroxicam) including steroidal anti-inflammatory drugs used for treatment of spinal and vertebral diseases, are also reported as cause of gastric ulceration (Gralnek *et al*., 2008). Animals with mastocytosis may have numerous all over gastric ulcers (Ozaki *et al*., 2002). Helicobacter spp. populations are mostly found in the fundus and body of the stomach (Anacleto *et al*., 2011). The larvae of Spirocerca lupi have the capability to penetrate the protective gastric mucosal barrier, resulting in pronounced mixed inflammatory and neoplastic-like reactions. This leads to the formation of nodular foci commonly identified as granulomas (Van der Merwe et al. (2008). During the initial phase of inflammation, the larvae find themselves surrounded by loosely arranged connective tissue that is highly vascularized and contains fluid rich in fibrin, neutrophils, and areas of necrosis. The larvae induce subsequent stages marked by fibroblast proliferation, resembling embryonic tissue and occasionally sarcoma.

Primary chronic GEP can be further categorized based on their clinical manifestations, including regurgitation, vomiting, chronic small bowel diarrhea, and chronic large bowel diarrhea. Regurgitation in dogs is typically caused by various factors such as oesophageal foreign bodies, vascular ring anomalies, esophagitis (inflammation of the oesophagus), oesophageal strictures (narrowing of the oesophagus), intrathoracic neoplasia (cancerous growths within the chest cavity), congenital megaoesophagus (enlarged oesophagus from birth), and acquired megaoesophagus (developed later in life due to conditions like Myasthenia Gravis, secondary to oesophagitis, polymyositis, etc.). These conditions can impede the proper passage of food through the oesophagus, leading to regurgitation of undigested food or fluids. On the other hand, chronic vomiting could be a dietary problem (sudden change, indiscretion, intolerance, allergy) or may occur due to gastritis, gastric ulceration, gastric neoplasia, gastric outflow obstruction, motility/functional disorders, gastric or high duodenal foreign body, IBD, intestinal or intraabdominal neoplasia, intestinal foreign bodies, intussusception, enteritis/enteropathy, functional disorders, and drugs such as intravenous medications (e.g. digoxin, chemotherapy, xylazine, NSAIDs etc.) (Nixon *et al*., 2019).

Furthermore, chronic small bowel diarrhea in dogs often has dietary origin or may occur in conditions such as IBD (including eosinophilic enteritis, lymphocytic plasmacytic enteritis, and granulomatous enteritis), lymphangiectasia, bacterial overgrowth, Giardia infection, gluten enteropathy, histoplasmosis, lymphosarcoma or other tumors, lactose (milk) or other nutrient intolerance, and intestinal obstruction. On the other hand, chronic large bowel diarrhea in dogs can be caused by whipworm infestation, eosinophilic colitis, ulcerative colitis, histoplasmosis, Prototheca infection, polyps, neoplasia, and foreign bodies. It is important to consider these potential causes when investigating chronic diarrhea in dogs, as proper diagnosis and targeted treatment are crucial for effective management. Clinicopathologic variables, fecal parasite examination, and diagnostic imaging play crucial roles in differentiating between various etiologies of canine GEP that present with similar clinical symptoms (Rutherford and Lee, 2015).

Exact etiology of inflammatory bowl disease is

unknown however onset of clinical signs may be due to change in the diet or dietary patterns/ behaviour. This leads to disruption of mucosal barriers causing dysregulation of gut associated lymphoid tissue and disturbances in the intestinal microflora resulting in immunological intolerance to dietary or endogenous antigens (Hall and German 2010). Although IBD can affect any age group but middle or old aged dogs are more predisposed to this disease. Similarly, this disease can affect any breed but more predisposition is reported in purebred dogs. Neurological disorders or environmental stress are also reported to be amplify this disease but the exact role of this condition in the pathogenesis of this disease is still unknown (Washabau *et al* 2010).

Dogs suffering from gluten sensitivity, bacterial overload, intestinal ischemia and non-steroid anti-inflammatory drug induced injury have been reported to have increased intestinal permeability due to inflammatory cascade leading to bi-directional loss as there is protein loss as well as increased assess of microflora to sub epithelial tissue which further adds to the inflammatory process (Irvine and Marshall, 2000).

In cases of IBD in dogs there is delayed emptying of gastric contents regardless of the location of inflammatory foci and in cases of colitis ingesta causes excess migrating contractions leading to increased frequency of defecation (Neiger and Salavati, 2020).

Diagnosis

Diagnosis is always challenging in these disorders because the veterinarian needs to eliminate other systemic infections, intussusception, tumor, poisoning, exocrine pancreatic insufficiency (EPI), hypoadrenocorticism and chronic liver disease. It is also crucial to eliminate causes of secondary gastrointestinal diseases, associated with renal, adrenal, and thyroid disorders, or other underlying diseases (Berghoff and Steiner, 2011).

Usually non-invasive tests are carried out first to rule out the possibility of bacterial, parasitic and allergic causes (Hall and German, 2010), accomplished by collecting a minimum database, which includes a complete blood count (CBC), serum biochemistry profile and urinalysis.

Generally, CBC is mostly normal except certain conditions in which you may find abnormalities such as eosinophilia in patients suffering from eosinophillic gastroenteritis or due to parasitic infestation. In patients with protein losing enteropathies (PLE), there is neutrophilia occasionally and lymphopenia and in patients suffering from chronic Gastrointestinal (GI) bleeding, anaemia may be a significant finding (Berghoff and Steiner, 2011).

In case of patients suffering from hepatic or renal failure, there is disturbed serum biochemistry profile which helps in assessing possible causes as in both cases, clinical signs are presented in gastrointestinal form. Even in absence of primary liver diseases, there may be mild to moderate increase in liver enzyme levels (alkaline phosphatase, alanine aminotransferase) which may be observed in patients due to reactive hepatopathy in patients suffering from chronic intestinal disorders (Hall and German, 2010)

In case of diarrhea, initial diagnosis involves differentiation of large and small bowl diarrhea that helps in differential diagnosis and setting up of diagnostic plans (Fogle and Bissette 2017).

Differentiation of small and large bowl diarrhea based on general clinical signs (Allenspach 2013)

Characteristics	Small intestine	Large intestine
Volume	+++	+
Mucus	-	+++
Frequency	+	+++
Tenesmus	-	+++
Dyscheezia	-	+
Weight loss	++	+
Vomiting	+	+
General condition	+	-

Non-invasive diagnostic testing includes complete blood cell count (CBC), serum chemistry and electrolytes, urinalysis, faecal examination, faecal culture and ELISA, cytology of rectal scrapings, abdominal radiography and ultrasonography. Intestinal wall thickness is often used as a criteria for diagnosis of IBD in humans but measurement of intestinal wall thickness has not been found specific or sensitive for diagnosis of inflammatory bowel disease (IBD) in dogs (Gaschen *et al*., 2007). A marked elevation in the C- reactive protein (CRP) and serum amyloid A (SAA) concentrations was noted in dogs with chronic IBD (Jergen *et al*., 2003).

Basic approach for diagnosis of chronic diarrhea (Simpson & Jergens, 2011)

Characteristics	Tests or information to be collected
Integrate signalment, history, and physical examination	History regarding age, breed, sex, environment, diet, other clinical signs, duration of disease, previous treatments and responses.
Detect endoparasites and enteric pathogens	Fecal analysis (eg, Giardia)
Perform clinic-pathologic testing	
Detect non-GI disease	Complete blood counts, serum biochemical analysis profile (LFT/RFT), uric acid, cTLI, cPLI, ACTH stimulation test, freeT4/TSH levels, bile acid levels, lactate
Detecting and characterizing GI diseases	Hypoproteinemia, hypocalcemia, hypocholesterolemia, leukopenia, leukocytosis, low cobalamin or folate levels
Perform diagnostic imaging	
Detecting non-GI disease	Radiography and ultrasonography of kidney, liver, spleen, pancreas, lymph nodes, tumors, and abdominal effusions/peritonitis.
Detecting as well as characterizing GI disease	Radiography and ultrasonography to rule out intestinal obstruction or intussusception, masses/tumors, thickening or loss of layering, or any other architectural abnormalities. Endoscopy of the GIT to rule out mucosal abnormalities of the GIT

Diagnostic tests used to assess the cause of chronic gastroenteropathies in dogs (Berghoff and Steiner, 2011)

Tests	Material required	Diagnosis	DD	Part effected
Fecal flotation with centrifugation	Fecal sample	Hookworms Whipworms	Helminths	Intestines
Fecal flotation with centrifugation with $ZnSO_4$		Giardia	At least 3 fecal samples for three days should be checked before declaring it negative.	Duodenum
Modified Ziehl-neelsen acid-fast staining, Direct immunofluorescence assay	1 Fecal sample At least 2 or 3 different fecal samples	Cryptosporidium spp.		villus atrophy, villus fusion, and inflammation
Fecal culture and PCR	Fecal sample	Campylobacter Spp.	Nonpathogenic strains and Helicobacter spp.	small and large intestine
ELISA	Fecal sample	Clostridium spp.	Rule out whether they are primary, secondary or commensal organisms	small and large intestine
Fecal culture, Fluorescent in-situ hybridization (FISH)	Fecal sample	Escherichia coli	They are normal commensals of duodenum so they should be further analyzed to identify the specific genera of E coli.	histiocytic ulcerative colitis (granulomatous colitis)
Wright-Giemsa–type stains and cytology Enzyme immunoassay Fungal culture (confirmatory)	peripheral blood smear, rectal scrapings or imprint cytology specimens from colonic mucosal biopsies, fine needle aspiration	Histoplasma spp.	cross-reactivity between Blastomyces and Histoplasma antigens	granulomatous infiltrate in both small and large intestine

Immunoblot assay and ELISA Culture	Blood samples Tissue sample	Pythium	Only effects young large breed dogs	any part of the gastrointestinal tract, as well as surrounding organs.
Cobalamin estimation	Serum sample	Cobalamin	Exocrine pancreatic efficiency (EPI)	distal small intestine
Folate estimation	Serum sample	Folic acid	Correlation with cobalamin	Proximal small intestine
ELISA	Serum	CRP	This is non-specific for intestinal tract	IBD canine IBD

Promising new tests for diagnosis of gastrointestinal disease

Tests	Material required	Diagnosis	DD	Part effected
Immunoassay measurement	Serum and fecal samples	Canine calprotectin (Neutrophilic infiltration)	Calprotein is inducible in epithelial cells also so in normal cases with IBD it can show false positive neutrophilic infiltration	Intestinal mucosa
N-methylhistamine (NMH) concentrations	Urine sample	Mast cell degranulation and gastrointestinal inflammation	Active Crohn Disease and ulcerative colitis	Intestinal mucosa

Radiography

Survey abdominal radiographs are rarely effective in identifying the cause of persistent vomiting, unless there is a radio dense foreign material present. In such cases, a barium upper GI series is typically recommended. Contrast radiography offers several advantages over endoscopy and laparotomy, including its non-invasiveness, ability to visualize the duodenum, assessment of gastric size and position, qualitative evaluation of gastric motility and liquid emptying, and detection of extra luminal and submucosal/muscular masses (Lieb, 2010).

Ultrasonography-

Ultrasonography is the most commonly used method for identifying intestinal disorders in canines. Recent studies have focused on its application in differentiating between inflammatory and neoplastic infiltrative conditions. When individuals present with symptoms such as vomiting or diarrhoea, it is recommended to perform both abdominal radiography and ultrasonographic examination. Barium examinations of the GI system are still useful for detecting foreign objects in vomiting animals and determining GI emptying and transit periods. However, ultrasonography is preferred for identifying infiltrative intestinal disorders (Sharma *et al*., 2011). Ultrasonography can also be used to rule out extra intestinal disorders like enlarged lymphnodes, narrowing of lumen due to pre stenotic dilatation, abscesses or fistulas (Parente *et al* 2004).

It helps in differentiating inflammatory layering from neoplastic growth and neoplastic growth from granulomatous infiltrates (Penninck *et al*., 2003). Distinguishing between inflammatory and neoplastic small intestinal infiltration in dogs and cats is crucial for selecting the appropriate treatment options. Ultrasonography is one of the initial diagnostic techniques commonly employed for this purpose. However, a clear diagnosis can be challenging due to the overlapping sonographic appearances of inflammatory and neoplastic infiltration. Nonetheless, understanding the characteristics of both conditions is essential for interpreting the sonographic data accurately. While a full-thickness intestinal biopsy remains the gold standard for distinguishing between the two types of illnesses, ultrasonography plays a valuable role in the initial diagnosis (Gaschen, 2011).

Endoscopy

Nonresponsive or severely affected dogs usually require further evaluation using more expensive and invasive procedures such as endoscopy and intestinal

biopsy (Lidbury *et al* 2009). It can be helpful to evaluate the mucosa of oesophagus, stomach, small intestine and colon. Obstruction, ulceration, depigmentation of mucosa, rigidity of mucosa or loss of architectural detains are the common findings in dogs with IBD (Ferguson and Gaschen 2009). Histopathologic evaluation of intestinal biopsy specimens is further required to differentiate small bowel disease from large bowel (Fogle and Bissett 2007).

Gastroduodenoscopy or colonoscopy with endoscopically guided biopsies is one of the most effective methods for identifying chronic inflammatory diseases of the digestive system in dogs (Fefferman and Farrell, 2005; Jergens and Simpson, 2012). This procedure allows for a macroscopic evaluation of the GI tract and the collection of biopsy samples from various areas, including the mucous membranes of the oesophagus, stomach, and intestines. During the endoscopic examination, common lesions observed include mucosal edema, thickening, hyperemia, extravasations, and erosions in different sections of the GI tract (Rychlik *et al*., 2007; Jergens *et al*., 2010).

Biopsy samples collected using the endoscope's operating channel are essential for histopathological investigations. These samples help assess the level of inflammation, differentiate between inflammatory and neoplastic lesions (benign and malignant), and evaluate the effectiveness of treatment. It is recommended to collect six to eight specimens from each portion of the GI tract since mucosal lesions can be patchy, and not all biopsies may be sufficient for diagnosis (Day *et al*., 2008). Histological examination, which includes evaluating the epithelium, lamina propria, crypts, and intestinal villi, as well as analyzing the degree of inflammatory cell infiltration, is crucial for determining the type and extent of the inflammatory process (Jergens & Simpson, 2012). In addition to standard histopathological evaluation, the collected samples can be used for electron microscopic analysis, immunohistochemical testing, cytological tests, and other specialized examinations (Rychlik, 2010).

Clinical scoring systems, such as the clinical inflammatory bowel disease activity index (CIBDAI) and canine chronic enteropathy clinical activity index (CCECAI) has also been used to assess fecal consistency (Gaschen *et al*., 2007) and the effect of therapy (Jergens *et al*., 2003; Allenspach *et al*., 2007; Washabau *et al*., 2010; Collins, 2013).

Applications of gastrointestinal endoscopy (Wahabau and Day, 2013)

Clinical Problem	Endoscopic technique
Regurgitation	Oesophagoscopy
Oesophageal foreign body	
Stricture	
Haematemesis	Gastroscopy
Gastric foreign body	
Feeding tube placement	
Vomiting	
Malena	
Small bowel diarrhoea	Duodenoscopy
Vomiting	
Malena	
Large bowel diarrhea	Colonscopy
Tenesmus	
Haematochezia	
Malena	

Faecal culture

In dogs with chronic diarrhea, assessing the fecal microbiome using fecal culture profiles and standard fecal panels has been studied to determine its diagnostic value. In one study by Werner *et al*. (2021), the fecal microbiomes of 18 dogs with chronic diarrhea group (CDG) and 18 healthy control group dogs (HG) were compared using fecal culture profiles. The dysbiosis index, which indicates an imbalance in the gut microbiota, was found to be significantly higher in CDG compared to HG. However, the only possible enteropathogen identified on culture was hemolytic *Escherichia coli,* and there was no discernible difference between CDG and HG in this aspect. Overall, the fecal cultures were unable to effectively differentiate between sick and healthy dogs, and there was significant variability in results between different laboratories.

Rectal brush cytology

Rectal brush cytology has been identified as the gold standard technique for diagnosing rectal diseases like protothecosis, rectal inflammation/hyperplasia and rectal neoplasia. In this technique, a rectal brush is used to collect samples from the affected area, and smears are made on the glass side. Routine Leishman staining is done and cytology is performed for the diagnosis of rectal diseases (Vince *et al*. 2014; Dogra *et al*. 2022).

Treatment

Gastrointestinal tract functioning or dysfunctioning is markedly effected by the type of diet. So in order to improve the recovery of gastrointestinal tract, dietary modifications are done to utilize the beneficial effects of diets (Rémond *et al*., 2015).

Oesophageal Disorders- The best recommended method to feed food and water to dogs suffering from megaoesophagus is to offer them feed at an elevated place with the assumption that gravity will assist swallowed food reach stomach. Some dogs are able to swallow gruel feeds while other can swallow dry foods, meat balls or small chunks with less regurgitation reflexes (Datta *et al*., 2020). This swallowing is bolus dependent and if these boluses are not sensed by oesophagus then there is no initiation of secondary peristalsis. In malnourished dogs with megaoesophagus gastrotomy feeding tube is indicated as it helps in reducing the oesophagitis as well as to regain the function of oesophagus (Figueiredo, 2022). High fat diets should be avoided in cases of oesophagitis as they can further deteriorate the condition of oesophagitis due to the release of cytokines leading to reduction in the sphincter tone (Herdiana, 2023).

Gastric Disorders

Dogs with delayed gastric emptying should not be fed high fat diet as they further delay gastic emptying. Preferably they should be given liquid diets as the physiology of emptying of liquid diet is less complicated and easy as compared to solid diets (Herdiana, 2023). Enterostomy tube of parenteral nutrition is more recommended in dogs suffering from gastric disorders or frequent vomiting (Larsen, 2023).

Chronic Small Bowl Diarrhoea

Dogs with chronic bowl diarrheoa should be fed good palatable and highly nutritious diet, highly digestible, hypoallergic, low fat, low lactose and moderate amount of fibres. Along with this potassium, water and fat soluble vitamins should be added in double quantity than the recommended doses (Valdez Lumbreras, 2017). In order to eliminate diarrhea due to gluten, wheat gluten should be excluded from diet. High fat diets lead to delay absorption and gastrointestinal dysfunctioning, leading to osmotic diarrhea. Due to the binding and gelling properties of fiber, they help in countering small bowl diarrhea. They prevent the colonic mucosal barrier from the effects of malabsorbed ingesta and also reduce severity of fecal incontinency (Fiber, 2012).

GI disorders in response to food sensitivity

Any part of GIT from oral cavity to large intestine can be affected by allergens that lead to manifestation of clinical signs in the form of GI disorders (Strobel and Hourihane, 2001). Most of the times allergens are proteins, with majority of them being glycoproteins of molecular weight ranging from 10000-40000 Daltons. All proteins are antigenic but out of all only a small part of food protein are allergic which produce type I hypersensitivity response (Platts-Mills & Woodfolk, 2011). Treatment of food allergens depends on identification of etiological agent, followed by eliminating diet. Novel protein should be added in diet after considering the previous dietary history and it should be balanced and palatable. The protein in question should be eliminated from diet for at least for a period of 6 months (De Boer and Aiking, 2019).

Food Intolerance

Non immunogenic adverse reaction to food like feed additives, fats, lactose, or aminoacids is known as food intolerance (Muthukumar *et al*., 2020) and its management includes reduction in the quantity of additives causing problems. Inclusion of highly digestible carbohydrates, fats, reduction in use of additives for only preservative purposes (Adhikari, 2021) are some of the strategies.

Inflammatory Bowel Disease

In cases with IBD, hypoallergic, highly digestible ingredients should be included in diet. Managing IBD presents challenges due to its unclear causes. Dogs with mild symptoms often receive a tailored di*et al*ong with immune-modulating or probiotic treatments. For moderate progression, derivatives of 5-aminosalicylic acid (such as mesalazine or olsalazine) might be prescribed. Severe cases typically involve a combination of immunosuppressive drugs, antibiotics, and an elimination diet for treatment (Malewska *et al*., 2011). In these cases either parenteral or tube enteral feeding method can be implicated for their nutritional management (Chan *et al* 2002).

Dietary therapy (adapted from Boyle and Bissett, 2007)

Diet Characteristics- Diet shoud be low fat and highly digestible. Ideally it should have single-source novel or hydrolyzed protein and single-source carbohydrate that

Several standard drug treatments employed in the management of irritable bowel disease. (adapted from Hall, 2005; German, 2011)

Antimicrobials	*Immunosuppressive therapy*	*Other*
Metronidazole	Corticosteroids	Heparin is recommended for individuals with severe hypoproteinemia
	Chlorambucil	Cobalamin, also known as vitamin B12, is administered to patients with hypocobalaminemia.
	Azathioprine	Fenbendazole, an anthelmintic, is used for empirical deworming purposes.
Probiotics	Cyclosporine	Cyclosporine is administered to patients who have not shown improvement with glucocorticoid therapy.
		Administering plasma or hetastarch is recommended for patients experiencing severe hypoalbuminemia.

is gluten free

Protocol- Strict elimination diet, fed for a minimum of 4 weeks to determine if the disease is diet responsive

Drug therapy duration varies from case to case. In some cases of lymphocytic-plasmacytic enetropathy or hypoproteinemia duration of therapy can last from 6 months to 1 year but in some cases drug therapy can continue lifelong (Tams, 2014).

Standardized treatment of dogs with lymphoplasmacytic IBD (Simpson and Jergens 2011)

Empirical treatment for Giardia and helminths if not already initiated. Prophylactic anthelminthics such as oral fenbendazole @ 50mg/kg PO every 24 hours for 5 consecutive days is administered. Cobalamin and folate supplementation in subnormal cases. Concurrent dietary modification (hydrolyzed or antigen-restricted diet) is required along with antibiotics (eg, tylosin), and immunosuppression (glucocorticoids and/or azathioprine). In cases with poor response, reappraise all findings before considering escalating immunosuppression (eg, cyclosporine). Injectable prednisolone should be preferred instead of oral medication due to poor absorption through oral route. In dogs suffering from ascites, dexamethasone is preferable over prednisolone due to the property of later for increased fluid retention.

Protein Losing Enteropathies

In dogs and cats, enteropathy with PLE presents diagnostic challenges but recent studies highlight α1-antitrypsin levels exceeding 22 mg/dL in affected dogs versus 18 mg/dL in healthy canines. Alpha-1 antitrypsin functions as a natural inhibitor of proteases like trypsin and shares a similar size with albumin. In cases where albumin is lost into the GI tract, α1-antitrypsin is co-excreted with it in the feces without undergoing degradation. Consequently, this serves as an indicator of PLE. A therapeutic protocol involving trometamol, Xylat, Disparkol, Voluven, Reopoliglukin, Maropitant, prednisolone, α-lysine escinat, albumin, Presorb, and nutritional supplements such as Vivonex Ten Elemental and Royal Canin Recoveri hasten the recovery of dogs and prevent mortality in dogs with PLE. There is no partical way to assess the amount of protein lost in faeces except debilitation. It is generally assumed that patients with PLE require at least 150-200% of basal protein requirements. High fat diets are also restricted as high fat diet can also lead to the leakage of protein rich lymph through dilated lymphatics (Mostovyi *et al*., 2020). Elemental diets and partial parenteral nutrition are indicated in dogs that have severe protein-losing enteropathy (Simpson and Jergens 2011)

Large bowel diseases

Non fermentable fiber plays an important role in the managements of dogs suffering from large bowel disorders by binding with various nutrient materials, diluting the colonic contents (Guilford and Matz, 2003).

Butyrate produced from fermentable fibers has its beneficial effect in maintaining the intestinal mucosal integrity and health (de Brito *et al*., 2021). Prebiotics should be included in diet having beneficial effect as they stimulate the growth and activity of a certain type of bacteria that are beneficial for the colon (Buddington, 2009). For managements of colitis in dogs, it is generally recommended to provide hypoallergic diets with good

quality fermentable fibers such as psyllium, beet pulp or soya fibers (Lieb, 2000; Krecic, 2001).

Dogs with chronic idiopathic bowel diarrhea should be fed highly digestible diets along with large quantities of fermentable fibers, psyllium (2 table spoon full) (Lieb, 2000).

Borborygmi and Flatulence

Major causes of intestinal gas production are either aerophagia or bacterial gas production due to degradation of unabsorbed nutrients (Flickinger *et al*., 2003). Diets associated with gaseousness in dogs are soybean, wheat products, bran, lactose, and fat. Dietary management of these diets includes highly digestible, low fiber diets with moderate amount of fat and protein contents (Rudinsky *et al*., 2018).

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Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 12-16

Research Articles

Diabetes mellitus induced reactive hepatopathy in dogs

Ankur Sharma, Des Raj and Ajay Katoch
Department of Veterinary Medicine, DGCN COVAS, CSKHPKV Palampur (H.P)

Abstract

The present study was carried out on dogs presented with history of clinical signs as anorexia, fatigue, polydipsia, polyuria, polyphagia, exercise intolerance, jaundice, ascites, cachexia, seizures etc. The haematological parameters in affected dogs varied non significantly as compared to healthy animals except MCV and MCH which increased significantly. The mean values of ALT, AST, ALP, GGT, Glucose, BUN and Creatinine were significantly increased whereas mean values of albumin were significantly decreased compared to healthy animals indicative of altered liver and renal functioning. On the basis of detailed clinical and haemato-biochemical examination, out of a total of 54 dogs with reactive hepatopathy, 8 dogs suffered from Diabetes Mellitus leading to concurrent liver disorder. The dogs suffering from diabetic hepatopathy were in the age group of 4 – 14 years with maximum incidence in 6-8 years of age. It was concluded that apart from varied causes of reactive hepatopathy in dogs, Diabetes Mellitus was an important cause of liver disorder.

Key words: Reactive hepatopathy, Diabetes mellitus, Diabetic dogs, Hyperglycaemia, Liver enzymes

Liver is the largest parenchymal organ which is involved with almost all of the biochemical pathways that allow growth, fight diseases, supply nutrients, provide energy and aid reproduction. It is vital and complex organ of the body which is susceptible to many adverse effects of drugs, chemicals, infectious agents, autoimmune disease, along the idiopathic occurrence (Ahmedullah *et al*., 2008). Thus, maintaining a healthy liver is crucial for the overall health and well-being of life of animals (Aashish *et al*., 2012). Any factor that significantly alters the physiology will often produce hepatic damage. Such damage may result from infectious, metabolic, toxic, degenerative, congenital or neoplastic diseases which further may be because of many reasons or diverse sources.

Reactive hepatitis is an inflammatory disorder of the liver induced by an extra hepatic process. It is associated with disorders of many other organs apart from the liver including gastrointestinal and respiratory diseases, heart failure and diseases of the urinary and reproductive system (Negasee, 2021). Different inflammatory mediators cytokines such as Interleukin-1 (IL-1), Interleukin-6 (IL-6) and Tumor Necrosis Factor- (TNF-) are released as lipopolysaccharide (LPS) can activate kupffer cells in the liver parenchyma. A consequence of this activation is the release of pro-inflammatory cytokines that induces leukocyte migration and therefore induces reactive hepatitis results excessive damage of liver cells (Elhiblu *et al*., 2015).

*Corresponding author: drankur.vcm @gmail.com

Endocrine diseases are imbalances in hormone levels which can affect pet's health in many ways. Diabetes mellitus, hyperadrenocorticism (Cushing's disease), and hyperthyroidism can all cause impaired liver function because of their effects on the organ (Ming et al. 2015). In view of unscientific feeding, ever increasing environmental pollution and abuse of common therapeutic agents and stress, like human beings, the animals are also becoming more susceptible to hepatic dysfunction. The perusal of records of Veterinary Clinics, DGCN COVAS reveals that clinical cases of diabetic hepatopathy in dogs are also presented. Thus, the present study on haematobiochemical alterations in diabetes induced reactive hepatopathy in dogs was undertaken for better management of this condition.

Materials and Methods

The present study was carried out on dogs presented during the period of August, 2016 to April, 2019 in the Department of Veterinary Medicine in Veterinary Clinical Complex of College of Veterinary & Animal Sciences, CSKHPKV Palampur (H.P). Preliminary screening was done on the basis of the patient's history and information provided by the owner and presenting clinical signs as anorexia, fatigue, polydipsia, polyuria, polyphagia, exercise intolerance, jaundice, ascites, cachexia and seizures. Besides this, haemato-biochemical estimation and imaging techniques (radiology and ultrasonography) were used for confirmatory and

Table 1. Classification of hepatic dysfunction cases in dogs

S. No.	Etiology	Total no. of cases	% out of total cases
I.	Hepatic Diseases / Primary Hepatitis	102	(65.38%)
II.	Extrahepatic diseases/ Reactive Hepatitis	54	(34.62%)
	Total Cases	156	
	Reactive Hepatic Diseases	54	
	Diabetes mellitus	8 (14.82%)	5.13%

differential diagnosis of hepatic dysfunction. On this basis, a total of 156 dogs suffering from hepatic dysfunction were included in the present study. A total of 12 clinically healthy adult dogs formed the control group. Dogs presented for regular vaccination, routine health check-up and elective surgery were included in this group irrespective of age, sex and breed.

Results and Discussion

Of all the cases presented during the above period, a total of 156 dogs suffering from various hepatic dysfunctions were included in the present study. Out of these cases, a total of 102 dogs were found to be suffering from Primary Hepatic diseases representing a total of 65.38% cases. Another 54 dogs suffered from Reactive Hepatic diseases representing a total of 34.62 % cases. Out of these 54 reactive hepatopathy cases, 8 dogs suffered from Diabetes Mellitus representing 14.82% of reactive cases and 5.13% of total hepatopathy cases (Table 1).

Induced reactive hepatitis in this study was also composed of endocrine disorders, mainly diabetes mellitus. The results are in accordance with Neumann and Danner (2012) who also found reactive hepatitis in patients with endocrine disorders. The possible mechanism in these cases could be the accumulation of glycogen and lipids, which may induce cell degeneration with secondary infiltration of inflammatory cells.

The most common clinical signs observed were inappetance, anorexia, polydipsia, polyuria, whereas vomiting was lesser commonly observed. These signs are similar to those observed by Neumann and Danner (2012) and Jena *et al*., (2019) who observed inappetence, polyuria/polydipsia, vomiting or diarrhea in 55 and 34 clinical cases of reactive hepatitis and diabetic dogs respectively.

The mean values of rectal temperature, respiration rate and heart rate are presented below in Table 2. The mean values of rectal temperature and respiration rate varied non significantly whereas heart rate was significantly higher than healthy animals.

The age wise distribution of canine cases suffering from reactive hepatic disorders and Diabetes mellitus is listed below in Table 3. The dogs suffering from diabetic hepatopathy were in the age group of 4 – 14 years with maximum incidence in 6-8 years of age.

The mean values of haematological parameters in dogs with diabetic hepatopathy are presented below in Table 4. The haematological parameters in affected dogs varied non significantly compared to healthy animals except MCV and MCH which increased significantly. These findings are in accordance with those observed by (Jena *et al*., 2019). Contrary to this Hiblu *et al*., (2015) observed absolute neutrophilia with moderate left shift and marked toxic changes in neutrophils, microcytic hypochromic anemia with some evidence of regeneration on haematological examination in diabetes induced hepatopathy dogs.

The mean values of biochemical parameters in dogs with diabetic hepatopathy are presented below in Table 5 and Figures 1-5. The mean values of ALT,

Table 2. Mean values of clinical parameters in dogs with Diabetes Mellitus

Parameters	Healthy Control (n=12)	Diabetes mellitus (n=8)
Rectal Temperature (°F)	101.53 ± 0.21	101.36±0.41
Heart rate (per min.)	78.71 ± 2.28	109.33±6.17**
Respiration rate (per min.)	30.42 ± 2.49	28.85±3.57

* Significant at 5% (P<0.05); ** Significant at 1% (P<0.01)

Table 3. Age wise distribution of canine cases suffering from reactive hepatic disorders and Diabetes mellitus

Condition	Age group						Total Males	Total Females	Age Range
	< 2 years	2- <4 years	4- <6 years	6- <8 years	8 - <10 years	> 10 years			
Reactive Hepatitis (n = 54)	28	7	9	6	1	3	42	12	3 Months – 14 years
Diabetes mellitus (n=8)	Nil	Nil	2	4	Nil	2	5	3	4 years - 14 years

AST, ALP, GGT, Glucose, BUN and Creatinine were significantly increased whereas mean values of albumin were significantly decreased compared to healthy animals indicative of altered liver and renal functioning. These findings are in accordance with Hiblu *et al*., (2015) and Jena *et al*., (2019) who observed markedly increased levels of Alkaline phosphatase (ALP), Alanine transaminase (ALT) and Aspartate aminotransferase (AST) in diabetic dogs suggestive of hepatic involvement in Diabetes Mellitus. Diabetic dogs often show increased alkaline phosphatase and Alanine aminotransferase (Jena *et al.,* 2019, Rucinsky *et al.,* 2010, Behrend *et al.,* 2018 and Huang, 2012).

It is found in the present study that there is hyperglycemia in diabetic dogs in comparison to healthy dogs. Regardless of the underlying etiology, diabetic dogs are hyperglycemic and glycosuric. Increased fat mobilization leads to hepatic lipidosis, hepatomegaly, hypercholesterolemia, hypertriglyceridemia, and increased catabolism (Behrend *et al.,* 2018, Rucinsky *et al.,* 2010; Sridhar *et al*., 2005 and Huang, 2012). These increments may reflect mild liver cell damage that is related to decreased blood flow due to dehydration. Alterations in lipid metabolism because of diabetes may also contribute to increases in these liver enzymes.

Diabetic dogs may also be associated with other diseases like hepatic necrosis and hepatic enlargement (Hiblu *et al*., 2015). Serum creatinine and BUN are insignificantly increased in the diabetic dogs, as compared to healthy. Evidence for renal failure in diabetic dogs reveals azotemia, increased serum creatinine and BUN (Huang, 2012 and Jena *et al*., 2019).

Liver enzymes ALT and AST are routinely used to obtain information about the integrity of liver cells and the degree of cell destruction. Furthermore, ALP is used as a marker of cholestasis. Because the degree of liver cell destruction correlates with the elevation of the liver enzymes, the results of this study showed that liver cell destruction is not severe in reactive hepatitis. Given that

Table 4 : Mean values of haematological parameters in dogs with diabetic hepatopathy

Parameters	Healthy Control (n=12)	Diabetes mellitus (n=8)
Hb (g/dL)	13.42 ± 0.41	14.14 ± 1.28
PCV (%)	42.17 ± 1.23	41.92±3.63
TEC ($\times10^{12}$/L)	6.58 ± 0.22	5.95±0.51
TLC ($\times10^{9}$/L)	10.42 ± 0.61	12.10±2.33
N (%)	67.83 ± 1.76	73.50±3.17
L (%)	26.70 ± 2.18	20.38±3.46
M (%)	2.83 ± 0.38	3.55±0.71
E (%)	1.85 ± 0.29	1.72±0.38
B (%)	0.79 ± 0.21	0.86±0.42
MCV (fL)	63.95 ± 0.76	68.92±1.80*
MCH (pg)	20.36 ± 0.41	22.74±0.86*
MCHC(g/dL)	32.03 ± 0.69	32.88±0.64
Platelets ($\times10^{9}$/L)	304.70 ± 21.37	346.80±62.32

* Significant at 5% (P<0.05); ** Significant at 1% (P<0.01)

Table 5. Mean values of plasma biochemical parameters in dogs with diabetic hepatopathy

Parameters	Healthy Control (n=12)	Diabetes mellitus (n=8)
ALT (U/L)	24.77 ± 3.83	158.54 ±**20.11****
AST (U/L)	33.04 ± 3.69	113.36 ± 13.19**
ALP (U/L)	62.75 ± 6.18	335.93 ± 39.04**
GGT (U/L)	2.65 ± 0.48	9.30 ± 2.15*
Total Protein (g/dL)	6.59 ± 0.23	5.85 ± 0.36
Albumin (g/dL)	3.55 ± 0.20	2.76 ± 0.28*
Globulin (g/dL)	3.04 ± 0.28	3.09 ± 0.19
A/G ratio	1.22 ± 0.17	0.89 ± 0.12
Total Bilirubin (mg/dL)	0.39 ± 0.07	0.72 ± 0.24
Direct bilirubin (mg/dL)	0.15 ± 0.03	0.31 ± 0.11
Indirect bilirubin (mg/dL)	0.24 ± 0.05	0.42 ± 0.16
Glucose (mg/dL)	93.91 ± 3.83	501.28 ± 41.10**
BUN (mg/dL)	17.56 ± 1.31	42.76 ± 5.87**
Creatinine (mg/dL)	0.82 ± 0.08	1.93 ± 0.19**

* Significant at 5% (P<0.05); **Significant at 1% (P<0.01)

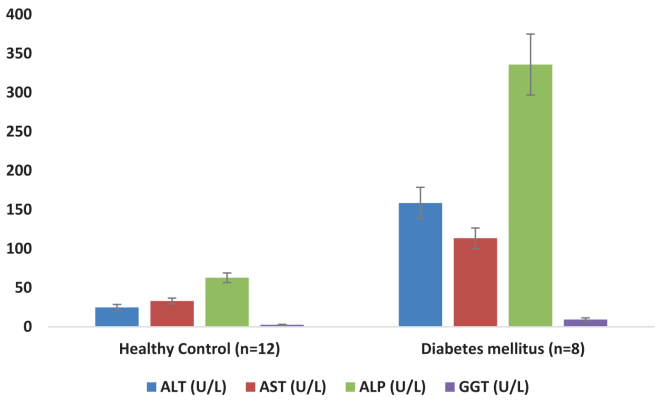

Fig. 1. Plasma levels of liver enzymes in diabetic dogs

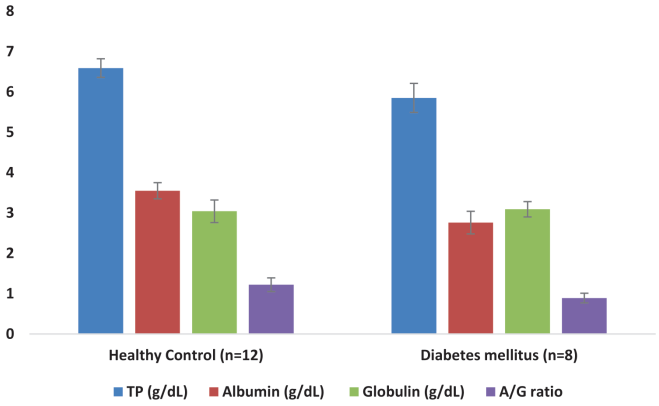

Fig. 2. Plasma Protein levels in diabetic dogs

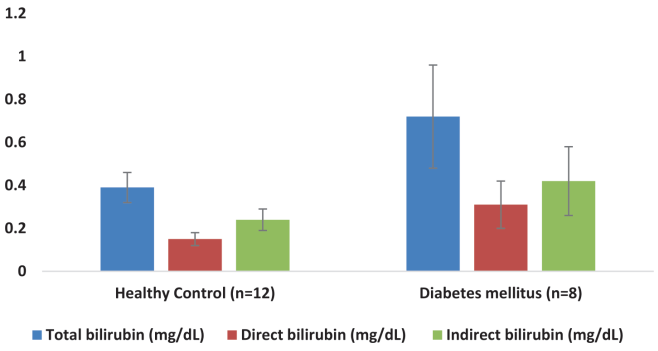

Fig. 3. Plasma Bilirubin levels in diabetic dogs

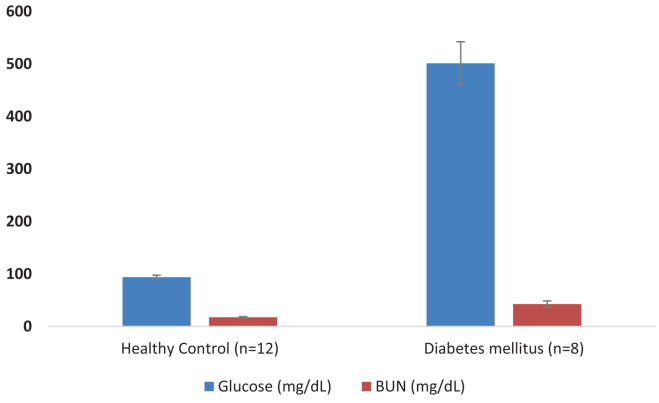

Fig. 4. Plasma Glucose and BUN levels in diabetic dogs

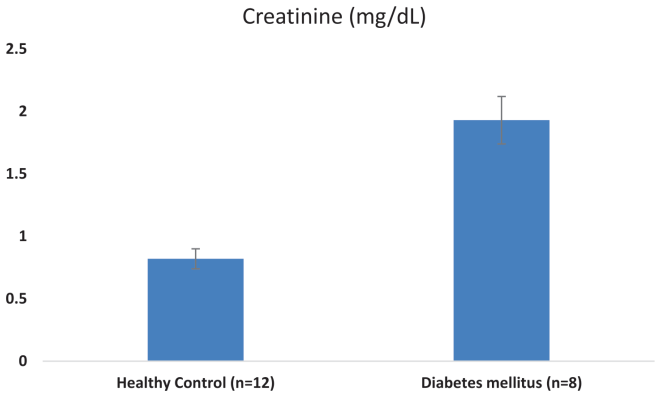

Fig. 5. Plasma Creatinine levels in diabetic dogs

ALP is a marker for cholestasis, we can conclude that reactive hepatitis is not associated with cholestasis in many cases. This is plausible because disturbance of the architecture of the organ, which may cause cholestasis, fails to occur in many cases of reactive hepatitis including diabetes mellitus.

Reactive hepatitis has been found to be associated with disorders of many other organs apart from the liver. Gastrointestinal diseases, heart failure, diseases of the urinary and reproductive system, especially endometritis, were associated more frequently with reactive hepatitis. Apart from this, neoplasia, haemoprotozoan/ rickettsial diseases and endocrine diseases specially Diabetes Mellitus has also been reported to cause reactive hepatopathy in dogs.

In conclusion, the results of our study depicted Diabetes Mellitus as an important cause of reactive hepatitis in dogs and that for diabetic dogs liver enzymes should invariably be measured so as to assess the effect of Diabetes mellitus on Liver which further can help in timely management so as to avoid the hepatopathic effects of this endocrinal disorder.

Acknowledgment

Authors are thankful to the facilities provided by CSKHPKV Palampur to the department of Veterinary Medicine which helped in completing above study.

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Received : 12.01.2023
Accepted : 16.04.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 17-22

Clinical aspects, diagnosis and therapeutic management of otodectosis in dogs

Sarita Devi, Shyma K. P.[1], A. R. Parikh, R.V. Salvi, M. P. Parmar, M.V. Bharai and J. R. Patel*
Department of Medicine, [1]Department of Parasitology, College of Veterinary Science and Animal Husbandry, Kamdhenu University (KU), Sardarkrushinagar-385506, Gujarat, India

Abstract

The present study was undertaken to study clinical aspects, diagnose and manage otodectosis (otocariosis) in dogs. A total of 25 dogs of mainly mixed breed, aged between 1.5 and 7 years old showing clinical signs of otitis externa consistent with *Otodectes cynotis* (*O. cyanotis*) infestation were included in the study. Parasitological examination of swabs collected from both the ears of each animal was performed for the presence or absence of mites. The prevalence of *Otodectes spp*. in the present study was found to be 48% (12/25). Significantly (P<0.01) reduced Hb, TEC, and total protein values and, increased TLC count with neutrophilia and eosinophilia were the recorded in hemato-biochemical alterations in the affected dogs. Weekly twice topical application of amitraz solution (12.5 % w/v) in combination with systemic as well as otic antibacterial agents was the treatment followed. The response to the therapy was achieved two weeks post-treatment with the disappearance of clinical signs and microscopic absence of mites in the ear wax. It is concluded that topical application of acaricide along with systemic antibacterial therapy and instillation of auricular antibacterial preparations was found efficacious in managing otodectosis in dogs .

Keywords: Amitraz, Dogs, Ear mites, Otodectosis, *Otodectes cynotis*

Otodectes cynotis (*O. cynotis*) also known as ear mite or ear canker mite, having cosmopolitan distribution, inhabits the external ear canal of dogs, foxes, cats, ferrets and other carnivores (Wall and Shearer, 2001). Other than external auditory canal these mites have also been found on head, neck, shoulder blade, feet, and tail region of the body (Scott and Horn, 1987). The infestation with *O. cynotis* mite is termed as otodectic mange (Soulsby, 2005). It is a highly contagious mite and spreads through direct contact between affected animals. These mites are considered as the most important agent for the development of otitis externa in dogs (Curtis, 2004) having 5 to 10% of otitis externa cases related to it with no sex or breed predisposition (Rodriguez *et al*., 2003). Discomfort, head shaking, intense pruritus provoking rubbing in the affected animals that might be leading to self mutilation of the base of ear pinnae and subsequent aural haematoma, and even hearing impairment, depending on the degree of parasitism are the recorded clinical manifestations (Arthur *et al*., 2015 and Gotthelf, 2000). In spite of having a cosmopolitan distribution, reports on occurrence of otodectes is mainly focused in adult cats and kittens. Scarce information is available on otodectes from India, and it dates back to management of *O. canis* in two dogs (Sivajothi and Reddy, 2016) and the recent one in a Persian cat from Hisar (Punia *et al*., 2021). Hence, the present communication describes the clinical aspects, diagnosis and therapeutic management of otodectosis in dogs.

*Corresponding author: saritadevi@kamdhenuuni.edu.in

Materials and Methods

Animal selection criteria

A total of 25 dogs (18 males, 7 females) of mainly mixed breed, aged between 1.5 and 7 years old presented at College Clinics, Sardarkrushinagar with otitis externa, clinically manifested as rubbing and pawing behind the ears and, head shaking were enrolled in the present study. Ten apparently healthy dogs brought for routine checkup and vaccination were kept as control.

Clinical examination and diagnosis

In all the presented dogs detailed clinical examinations were performed. Both the external ear canal of all the 25 dogs was examined using an otoscope in order to identify the presence of otodectes in the ear canal.. Further, ear swab samples from dog's upper portion of the vertical ear canal using separate sterile cotton swabs before performing the otoscopic examination were collected from all the dogs.

Microscopic examination of the collected ear swabs to determine the parasitism by *Otodectes spp*. mite using a microscope (10x and 40x objective) was performed. Identification of the mites was carried out according to the protocol of the identification of external

parasites (Scott *et al*., 2001; Wall and Shearer, 2001 and Campbell, 2005). In confirmed cases of *Otodectes spp*. mite infestation, bacteriological cultural examination was performed as per the method described by Quinn *et al*. (1994).

Antimicrobial susceptibility test and hemato-biochemical examination

Further, isolated bacteria were used for antimicrobial susceptibility test to fix the rationale therapy. Following antibiotic discs were used in antimicrobial susceptibility test: amikacin (30 µg), amoxicillin/clavulanic acid (20/10 µg), ampicillin/cloxacillin (6.69/18.31 µg), ceftriaxone (30 µg), cephalothin (30 µg), chloramphenicol (30 µg), doxycycline (30 µg), enrofloxacin (5 µg), gentamicin (10 µg) and tobramycin (10 µg). Inhibition zone of all of antibiotics were interpreted according to Clinical and Laboratory Standards Institutes (CLST).

About three ml of blood sample was obtained from both healthy and diseased dogs following statndard protocols from saphenous vein of confirmed cases of mite infested dogs of which one ml is transferred in the EDTA vials for hematological examination using automatic veterinary hematology analyzer (Exigo haematology analyzer, Boule Medical AB, Sweden) and rest was transferred in clot activator vial and, harvested serum was processed for estimation of total protein and albumin using specific ready to use test kits using biochemical analyzer (RANDOX-RX Monaco, United Kingdom).

Treatment protocol

Treatment was initiated with mechanical cleaning of debris and hairs from the affected ear canal and cleaning with 2% salicylic acid (ceruminolytic agent). After instillation of the solution into the ear, the vertical canal was gently massaged for one minute. External application of amitraz (12.5%) @4 mL of solution in 1 L of water all over the body was done twice weekly for three weeks. Otic preperation containing gentamicin (3 mg), betamethasone (1 mg) and clotrimazole (10mg) was instilled as ten drops daily for five days in dogs. Along with it Tab. amoxyciline @5mg/kg., b.wt., OD, for 5 days was given to control seconadary bacterial infection systemically. The response to the treatment was assessed on the basis of disappearance of clinical signs and microscopic absence of mites in the ear wax which was achieved at around two weeks of treatment.

Statistical analysis

For statistical analysis, the data were tabulated and the mean scores of the control and diseased groups were compared using independent-samples T test. All analyses were performed with significance set at 5% ($p < 0.05$) (Snedecor and Cochram, 1994).

Results and Discussion

Out of the 25 dogs examined, 12 were found to be infected (48.00%) with *Otodectes spp*. mites. Bilateral infestations occurred in 75.00 % (9/12) and unilateral infestations in 30.76 % (3/12) of the positive dogs. Ear infections are one of the most frequent reasons for dogs to be presented to veterinarians affecting up to 20% of dogs (Cole, 2004). *O. cynotis* mite is considered a primary cause of 5.9% of otitis externa cases in dogs (Rosser, 2004). The prevalence of *O. cynotis* in dogs from different areas include 33.3% (34/102) from Brazil (da Silva *et al*., 2020), 7.17% (16/223) from Egypt (Salib and Baraka, 2011) and 4.3% (25/581) from Greece (Lefkaditis *et al*., 2021) with no detailed information on epidemiological aspect of *O. cynotis* in dogs from India. Detailed clinical examination of affected ears revealed presence of thick brownish waxy/ceruminous material inside the ear canal and canal erythema (Fig. 2) which is a characterstic feature of *O. cynotis* mite infestation. Clinical signs of otitis externa included head shaking, ear scratching and pain on palpation of ear. Malodorous smell due to pruritis was coming from the affected ears of canines. The clinical signs observed in the study were in agreement with the findings of Salib and Baraka (2011). *O. cynotis*, feed on superficial debris and cerumen, causes irritation of the ear canal, allergic reaction, erythema, pruritus and a dark brown ceruminous secretion (Miller *et al.,* 2013). The presence of the mites may lead to a higher activity of ceruminous glands (Taenzler *et al*., 2017).

Dark brown ceruminous secretion examined microscopically revealed the presence of *Otodectes spp.* mite (Fig. 1). Direct otoscopic examination didn't revealed presence of mites but canal erythema and dark chocolate brown exudate as the clinical signs indicating presence of mite was able to be visualized more clearly. Examination of cerumen/exudate is considered to be the gold-standard diagnostic technique, demanding availability of a microscope for the diagnosis of *O. cynotis* infestations (Souza *et al*., 2004). While, mites visualization by both otoscopic examination of the external

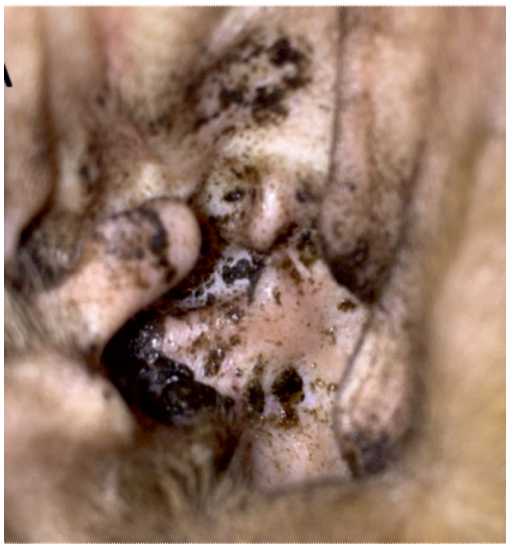

Fig. 1. *Otodectes spp*. found in the ear swab of an affected dog

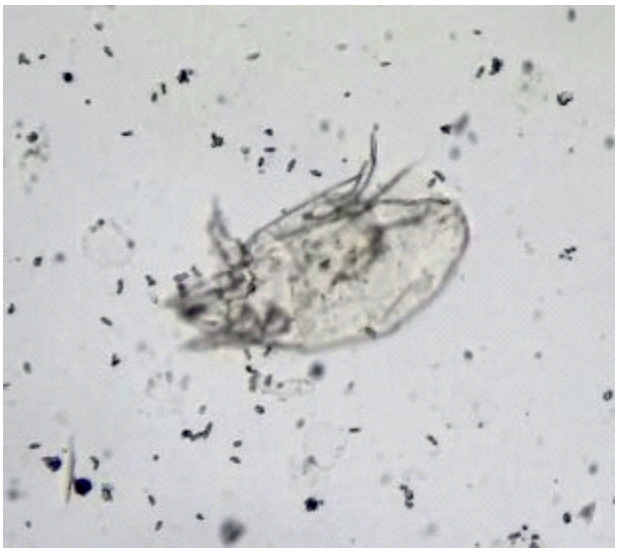

Fig. 2. Presence of thick brownish waxy/ceruminous material inside the ear canal of a mite infested dog

ear canal and microscopic examination of exudate are the recommended techniques/procedures for the diagnosis of *O. cynotis* infestation (Rosychuk, 1994), otoscopic examination has been proved to have high specificity low sensitivity in diagnosing canine otoacariasis when compared with microscopic examination of cerumin/ exudate (Souza *et al*., 2004). The culture of ear swabs of 12 confirmed cases of otodectus yielded coagulase positive *Staphylococci spp*. (n=10) and *Escherichia coli* (n=2) in both the ears in the present study. Wide variety of pathogens is reported in otitis and in apparently healthy ear canals of dogs (Tang *et al*., 2020). Park *et al*. (2017) reported that the most common species recovered from 60 dogs with chronic otitis externa were *Staphylococcus spp*. (51%), followed by *Pseudomonas spp.* (15%) and *Enterococcus spp*. (14%). Microorganisms associated with otitis externa are considered opportunist and not the primary pathogens, where any predisposing or primary cause will make them to participate in the disease process (Rosser, 2004 and Scott *et al*., 2001).

Results of antimicrobial susceptibility testing showed sensitiveness to amoxicillin, ampicillin, getamicin and amikacin in decreasing order by the isolated two bacteria in the present study. Near to similar antimicrobial susceptibility pattern is reported by Lyskova *et al*. (2007) and Malayeri *et al.* (2010) on bacteria and yeast isolated from dogs affected with otitis externa. The era of antibiotic resistance, necessitates antibiotic susceptibility tests to be done for the successful treatment and management of otitis externa associated with Otodectus. Bacterial and yeast infections are important secondary, perpetuating factors that complicate and exacerbate the disease process (Bugden, 2013 and Bajwa, 2019) and hence, prevents resolution and triggers recrudescence.

Significantly ($P<0.01$) reduced Hb, TEC, and protein values and, increased TLC count with neutrophilia and eosinophilia were the recorded in hemato-biochemical alterations in the affected dogs (Table 1). The reported hemato-biochemical alterations might be due to the presence of mites causing inflammation, allergic reactions and precipitation of secondary bacterial infection in the ear canal. Along with this anorexia and distress associated with mite infestation might also contribute to the found alterations. Almost similar alterations are reported in dogs affected with *Demodex spp*. and *Sarcoptes spp*. mite infestation due to the antigenic stimulation and hypersensitivity reaction (Sharma *et al*., 2018 and Gupta and Prasad, 2001).

Weekly twice topical application of amitraz solution (12.5 % w/v) in combination with systemic as well as otic antibacterial agents was administered as the treatment. The successful treatment of the disease requires proper medications including anti-inflammatory drugs, antifungal agents and chemotherapeutics in relation to the sensitivity of the aetiological agents (Greene, 2006). Cleaning of the ear canal with cleaner having 0.2% salicyclic acid was found effective. Besides the antiseptic action, the ceruminolytic effect helps to remove bacterial toxins, cell debris and free fatty acids that could serve as stimuli for further inflammation

Table 1: Mean values (+SE) of haemato-biochemical parameters in mange infested dogs (n=12) and healthy control dogs (n=10).

Parameters	Healthy Control (n=6)	Diseased (n=12)
Hb (g/dl)	12.69±0.20	11.47±0.17**
TEC ($\times 10^6$/µl)	5.80±0.10	5.05±0.04**
TLC ($\times 10^3$/µl)	6.63±0.26	14.02±0.42**
Lymphocytes (%)	27.50±0.02	23.00±0.07**
Monocytes (%)	1.00±0.09	1.00±0.02
Neutrophills (%)	69.00±.02	73.00±0.13**
Eosinophils (%)	2.40.±0.00	3.00±0.04**
Basophills (%)	0.10±0.02	0.10±0.03
Total protein (gm/dl)	6.90±0.13	5.60±0.23**
Albumin (gm/dl)	2.07±0.11	1.23±0.21**

** Highly Significant (P<0.01)

(Nuttall and Cole, 2004). Cleaning of ears at regular, but not frequent intervals is needed to control ear mite infestation in canines. Ear cleaners containing 0.1% salicylic acid have reported to have good activity against *S. intermedius*, *P. aeruginosa*, *Proteus* spp. and *M. pachydermatis* pathogens in vitro and in vivo (Reme *et al*., 2006). The presence of exudates impairs otoscopic examination and, prevents efficacy of given therapy due to inactivity of some medications in the presence of pus/exudates and incomplete contact with the epithelial lining of the ear (Nuttall, 2016) and favours secondary infections (Taylor *et al*., 2015). Otic preparation (antibacterial+anti-inflammatory+antifungal) used in the present study were reported to be efficacious in the management of otoacariasis in dogs which is in agreement with Engelen and Anthonissens (2000) whom reported that auricular preparations with such combinations will reduce the inflammation and load of secondary microorganisms and, in-turn will speed up the recovery process. Weekly twice topical application of amitraz solution (12.5 % w/v) was pivotal in treating otocarioisis. The concurrent use of a topical insecticide on the body of affected and other in-contact animals is frequently recommended in the treatment of *O. cynotis* infestations (Grant, 1985; Gram *et al*., 1994 and Rosychuk, 1994). Topical medication is reported as the first line therapy for otitis externa with requirement of systemic medications including antibiotics in chronic cases (Jacobson, 2002). Even though this ear mite infestation is most frequently diagnosed in cats, the trend of keeping dogs as pets more commonly in India and the infrequent but possible occurrence of this mite in humans (Wiwanitkit, 2011) emphasizes the screening of this mite in every case presented. The response to the therapy was achieved two weeks post-treatment with the disappearance of clinical signs (Fig. 3) and microscopic absence of mites in the ear wax. Despite the importance of mites as causative agents of otitis externa in majority of dogs, information regarding their prevalence and the factors affecting their survival is lacking (Gram *et al*. 1994 and Sotiraki *et al.,* 2001). Hence, it is recommended to examine the ears of dogs at intervals and to further carry out more studies with larger sample size to define the precipitating factors involved. Also, it was concluded that treatment of ear mite with topical application of acaricide along with systemic antibacterial therapy and otic preparations was found effective.

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Received : 15.11.2022
Accepted : 19.04.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 23-25

Effect of chronic fluoride toxicity on blood parameters of cattle and buffaloes in brackish water zone of Punjab, India

Sushma Chhabra, Nasheema Siddique, Sar Narinder Singh Randhawa and Sanjeev Kumar Uppal*
Department of Veterinary Medicine, COVS, GADVASU, Ludhiana, Punjab, India

Abstract

Chronic fluoride intoxication is a worldwide health problem in humans and animals. The present research work was aimed to assess the effect of fluorosis on blood parameters of fluorotic cattle and buffaloes in brackish water zone of Punjab. The study was conducted in villages of district Muktsar, a brackish water zone, of Punjab state. Cattle(n=103) and buffaloes (n=42) showing signs of dental lesions or lameness, from the villages with water fluoride concentration more than 1 ppm, were selected for the study whereas cattle (n=98) and buffaloes (n=48) from villages with water fluoride concentration less than 1 ppm and with no clinical signs served as control. Blood samples collected from both the groups were analysed for blood parameters viz., haemoglobin (Hb), total erythrocytic count (TEC), total leucocytic count (TLC), packed cell volume (PCV) and erythrocytic values viz., mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). Lower haematological values were observed in cattle from hydrofluorotic areas, except MCV. Comparison among the two groups revealed significant variation in PCV and MCV and non-significant variation in Hb and TEC. Similarly, lower haematological values were observed in buffaloes from hydrofluorotic areas though the variations in all the haematological parameters were non-significant. Present study indicated anaemia in animals of fluorotic region and such changes might have occurred due to decrease in erythropoietic activity as a result of the damage to bone marrow and/or reduced blood folic acid activity resulting from prolonged exposure to increased fluoride concentration in serum.

Keywords: Blood parameters; Buffaloes; Cattle; Fluorosis.

Chronic fluoride intoxication is a worldwide health problem and is endemic in those areas where the fluoride content in drinking water is relatively high. Cattle and buffaloes reared in fluoride enzootic areas of India for a long time show clinical signs of osteo- and dental-fluorosis (Choubisa *et al.*, 2011). Mechanisms of chronic toxicity are not clearly understood. Many studies on fluoride intoxication in experimental and naturally affected animals have revealed alternation in blood minerals and blood parameters (Ranjan *et al*., 2008; Rao and Vidyunmala, 2010; Vinay *et al*., 2009) but there seems to have paucity of reports on the status of blood parameters of buffaloes and cows naturally affected with chronic fluoride toxicity in brackish water zone. Brackish water is water that has more salinity than fresh water, but not as much as seawater. Salinity of water and water logging are common problems especially in southwestern districts of Punjab (Rahi, 2011). The present research work was aimed to assess the status of blood parameters viz., haemoglobin, total erythrocytic count, total leucocytic count, packed cell volume and erythrocytic values viz., MCV, MCH and MCHC of fluorotic dairy animals in brackish water zone of Punjab.

*Corresponding author: chhabrasushma@rediffmail.com

Materials and Methods

The study was conducted in villages of district Muktsar, a brackish water zone, of Punjab state. Fluoride concentration of drinking water of different villages was estimated and buffaloes of the region were examined for various signs of fluoride toxicity. The villages with water fluoride concentration more than 1 ppm and buffaloes showing signs of dental lesions or lameness were considered enzootic for fluorosis whereas villages with water fluoride concentration less than 1 ppm and buffaloes with no clinical signs were considered fluorosis free.

For the estimation of Hb, PCV, TEC and TLC two ml of blood was collected in plastic vials containing K_3 EDTA as anticoagulant from buffaloes (n=42) and cattle(n=103), showing signs of fluorosis, in heparinised mineral free glass vials. Similarly, blood samples were collected from apparently healthy buffaloes (n=48) and cattle (n=98) reared in villages free from fluorosis, with no signs of fluorosis, to serve as control. Red cell parameters

of haemoglobin was estimated by cyanomethaemoglobin method, PCV by microhematocrit, TEC, TLC and erythrocytic values viz., mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) were calculated as per standard methods (Marjory et al., 2022).

F levels in plasma and water samples were estimated by using Digital Ion-analyzer (Orion 4 Star pH. ISE Benchtop) equipped with fluoride specific electrodes. The statistical significance of the differences among mean was compared by using SPSS for Windows (version 16.0; Microsoft).

Results and Discussion

South-western region of Punjab in India is known for its brackish water and high fluoride content in underground water (Sharma *et al*., 1995). In the present study, high water fluoride concentration was recorded in hydrofluorotic block (1.447 ± 0.03 ppm) of the district whereas lowest concentration (0.727 ± 0.004 ppm) was recorded in non-hydrofluorotic block (Fig. 1). Intake of fluoride from water led to high plasma fluoride in cattle and buffaloes of the region. Significantly higher fluoride concentrations were observed in cattle and buffaloes of fluorotic region in comparison to healthy control animals (Fig. 1).

Mean Hb, PCV and TEC values were lower in cattle of hydrofluorotic region in comparison to healthy control animals (Table 1) whereas MCV concentrations were significantly higher in the former group. Comparison among the two groups revealed significant variation in PCV and MCV and non-significant variation in Hb and TEC. Similarly, lower haematological values were observed in buffaloes from hydrofluorotic areas though the variations in all the haematological parameters were non-significant (Table 1).

Variations in fluoride concentrations from block to block may be due to various causes for such variations such as use of phosphate fertilizers, different geo-chemical conditions. Moreover, fluoride concentrations were also reported to increase with salinity (WHO, 2002). Serum fluorine reflects the fluorine status of current diet rather than cumulative effect of fluorine exposure (Suttle, 2010).

Significant decrease in PCV was observed in cattle from hydrofluorotic region in comparison to those from non-hydrofluorotic regions. The decreased hematocrit levels may be attributed to decrease in size of erythrocytes due to stressful conditions (Soivio *et al*., 1974). Varying degrees of anaemia had been reported in fluorotic mice, cattle and humans (Machalinski, 2000; Rao and Vidyunmala, 2010; Sharma *et al*., 1995). Anaemia in fluoride intoxication might have occurred due to decrease in erythropoietic activity as a result of the damage to bone marrow resulting from prolonged exposure to increased fluoride concentration in serum (Wheeler & Fell, 1983). Reports have also shown disorders in human hematopoietic progenitor cells due to fluoride toxicity (Machalinski *et al*., 2000).

In the present study, increased total leucocytic count has been observed in both cattle and buffaloes. This increase in TLC might have occurred as fluoride being a foreign body evoked the immune response through the lymphocytes (Kumari and Kumar, 2011).

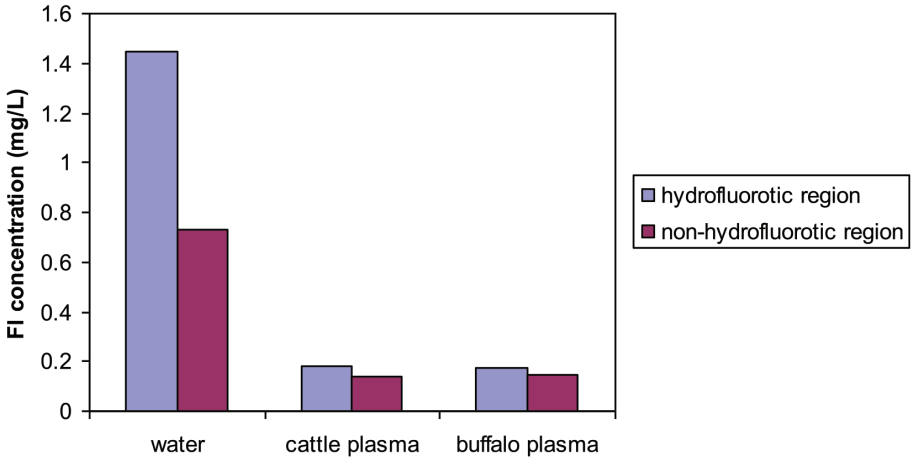

Fig. 1. Water and plasma fluoride levels

Table 1. Haematological values in cattle and buffaloes from hydrofluorotic and non- hydrofluorotic areas of Muktsar district

Parameter	Cattle Non Hydrofluorotic area (N= 98)	Cattle Hydrofluorotic (N= 103)	Buffaloes NonHydrofluorotic area (N= 48)	Buffaloes Hydrofluorotic area (N= 42)
Hb (g %)	9.44 ± 0.14	9.13 ± 0.21	11.11 ± 0.24	11.00 ± 0.27
PCV (%)	25.60 ± 0.39	24.22 ± 0.57 *	30.22 ± 0.75	28.62 ± 0.69
TEC (x 10^6/µl)	6.06 ± 0.10	5.93 ± 0.14	6.60 ± 0.18	6.30 ± 0.16
MCV (fl)	40.72 ± 0.56	42.23 ± 0.45*	45.17 ± 1.08	45.21 ± 0.68
MCH (pg)	15.55 ± 0.22	15.91 ± 0.17	17.82 ± 0.41	17.75 ± 0.31
MCHC (g/dl)	37.80 ± 0.19	37.31 ± 0.14	38.58 ± 0.29	38.70 ± 0.21
TLC (× 10^3 µ/L)	8.44 ± 0.27	8.83 ± 0.25	9.38 ± 0.27	9.74 ± 0.35 **

* Significant difference ($P < 0.05$)
** Significant difference ($P < 0.01$)

Increase in MCV was recorded in the cattle and buffaloes of hydrofluorotic region and it might be due to the fact that one of the adverse reactions of fluoride consumption known to occur in cells and tissues is reduced blood folic acid activity (Susheela, 2010) and elevation of MCV is the earliest sign of folic acid deficiency (Aslinia *et al*., 2007).

Thus, it can be concluded that chronic fluorosis has adverse effects on various blood parameters in dairy animals and such changes might have occurred due to decrease in erythropoietic activity as a result of the damage to bone marrow and/or reduced blood folic acid activity resulting from prolonged exposure to increased fluoride concentration in serum.

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Received : 11.01.2023
Accepted : 22.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 26-33

Evaluation of efficacy of evaporative cooling in mitigation of heat stress in crossbred cattle

Ravinder Singh, S.T. Singh, B.K. Bansal, G. Filia and R.S. Grewal*

Department of Veterinary Medicine, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana-141004, Punjab, India

Abstract

Heat stress exerts direct and indirect effects on the physiology, metabolism, hormones, and immune system of dairy cows, hence affecting their health. It can affect all ages and classes of cattle. Cattle attempts to maintain normal core body temperature by changing dry matter intake, respiration rate, pulse rate, blood metabolite concentration, sweating and panting, and so on. Efforts have been made to minimise heat stress in cattle by modifying housing and management practises. The present study was conducted to evaluate the efficacy of evaporative cooling (Sprinklers and forced airflow) in crossbred cattle. 20 crossbred cattle of parity 1 to 3 and mid stage of lactation (4-6 months) were selected and randomly divided into two groups. In the group provided with evaporative cooling there was significant increase in eating time and rumination time. There was also significant increase in milk yield, milk fat, milk solid-not fat, milk protein in group provided with evaporative cooling. There was significant decrease in rectal temperature, respiration rate and heart rate in group II provided with evaporative cooling. The levels of malondialdehyde (MDA) which is a measure of oxidative stress was significant lower in the group provided with evaporative cooling. Although there was significant decrease in serum Non esterified fatty acids (NEFA) in group provided with evaporative cooling but there values were within normal range during whole study period. From the findings of our study, it can be concluded that evaporative cooling is effective in providing comfort and increasing the productivity in crossbred cattle.

Key Words: Heat Stress, Evaporative cooling, Eating time, Rumination time, Milk yield, Milk composition

Introduction

Global warming is endangering humans and all other forms of life on the Earth. Increased emissions of heat-trapping greenhouse gases are responsible for this problem. This had a considerable impact on the ecology, as seen by the melting of glaciers and ice sheets, the shifting of plant and animal ranges, and the early flowering of plants. According to IPCC report IPCC (2022), human activities have led to about 1°C increase in the global average temperature since pre-industrial times. If the current pace of the warming persists, the global temperature is anticipated to increase by 1.5°C between the years 2030 and 2052. Heat stress causes the largest economical losses to the world dairy sector that is even more than mastitis and low fertility (St. Pierre *et al*., 2003).

Any combination of environmental elements, such as atmospheric temperature, air humidity, air velocity and sun radiation that raises the environment's effective temperature above animal's thermoneutral zone is known as heat stress (Herbut and Angrecka, 2018). Heat stress exerts direct and indirect effects on the physiology, metabolism, hormones, and immune system of dairy cows, hence affecting their health. It can affect all ages and classes of cattle. Cattle attempts to maintain normal core body temperature by changing dry matter intake, respiration rate, pulse rate, blood metabolite concentration, sweating and panting, and so on. This leads to development of lethargy, quick shallow breathing, and decreased feed intake, milk production and fertility (De Rensis *et al.*, 2015).

The most fundamental effect of heat stress on cattle physiology is on the appetite centre of the hypothalamus, which decreases feed intake. The process of metabolizing nutrients generates heat and to limit this heat input, the cattle reduce feed consumption to cope with environmental heat rise (Kadzere *et al*., 2002). There is also evidence of increase in rectal temperatures during the hot environmental conditions. Increase in the rectal temperature by 1°C or more is sufficient to decrease performance in the majority of livestock species (McDowell *et al*., 1976). Hyperthermia induces oxidative stress, which may be a result of an increase in reactive oxygen species production (Flanagan *et al*.,

*Corresponding author: sikhtejindersingh@yahoo.co.in

1998). These reactive oxygen species induce damage to mitochondria and this dysfunctional or damaged mitochondria, as a result of either the direct impacts of heat or an increase in oxidative stress, may contribute to metabolic changes (Bernabucci *et al*., 2002). In addition to lower feed intake, there is decreased nutrient absorption, rumen function alteration, and hormonal imbalance, all of which contribute to lower milk production during heat stress (Pragna *et al*., 2017). A positive correlation exists between milk production and heat production; therefore, the high yielding cows are more prone to heat stress (Spiers *et al*., 2004). Heat stress affects milk yield and quality w.r.t. milk fat, solid non-fat (SNF), protein, casein, and lactose content (Joksimovic-Todorovic *et al*. 2011). It has been reported that heat-stressed cows had increased standing and reduced lying time and walking activity in order to expose more contact area for heat dissipation, sensible water loss, radiating surface area, and air flow via convection. This increase in total daily standing time, raises the incidence of lameness in cattle (Cook *et al*. 2007).

Efforts have been made to minimise heat stress in cattle by modifying housing and management practises. Protecting the cow from direct and indirect solar radiation is one of the first steps that should be taken to mitigate the stressful effects of hot climate. Shading is one of the most easily adopted and cost-effective ways to reduce the heat from solar radiation. On the principals of convection, conduction, radiation, and evaporation, there are a variety of dairy cow cooling methods. Installations of fans, which improve airflow and convection, have been utilised to reduce environmental temperatures and relieve heat stress by decreasing respiratory rate and rectal temperature and raising DMI (Armstrong, 1994). Evaporative cooling utilises high-pressure mist fed through fans or water droplets from low-pressure sprinkler systems. Both methods have been demonstrated to decrease rectal temperatures and increase DMI, conception, and live calf birth rates (West, 2003).

Materials and Methods

Experimental Design

The study was conducted from May to august 2022.The crossbred lactating cattle (Holstein Friesian × Sahiwal, n=20) of parity 1 to 3 and mid stage of lactation (4-6 months) were selected from the dairy herd of the Directorate of Livestock Farms, Guru Angad Dev Veterinary and Animal Sciences University. The selected cattle were divided randomly into 2 equal groups. Group I (n=10) were kept as control and this group was provided with forced airflow without sprinklers during the study period. Group II (n=10) was provided evaporative cooling by using sprinklers and forced airflow during the study period.

Physiological Parameters

Physical examination of the selected cattle was performed fortnightly, and the rectal temperature, respiration rate and heart rate were recorded twice in a day (9:00-10:00 am and 2:00-3:00 pm). Data of the selected crossbred cattle w.r.t. eating time (minutes/ day), rumination time (minutes/ day) and period of inactivity (minutes/ day) was recorded daily by the precision dairy farming system.

Environmental Temperature

The daily data of air temperature (°C) and relative humidity (%) of the place of the study was obtained from the School of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana, India.

The temperature - humidity index (THI) was calculated from the data of ambient temperature and relative humidity by using the equation given (Ravagnolo and Misztal, 2000) as follows, THI = (1.8 ×Ta + 32) - [(0.55-0.0055×RH) ×(1.8 × (Ta - 26)] where Ta = Air temperature (°C) and RH = Relative humidity (%).

Sample Collection

Composite milk samples were collected in 30 ml sterilised vials after wiping the teat orifice with a swab drenched with 70% alcohol and removing a few streaks of milk fortnight.

Blood samples (2 ml) were collected in clot activator vials and heparinised vials vials for haemogram analysis, serum non-esterified fatty acids (NEFA), β-hydroxylbutyrate (BHBA and for the estimation of oxidative stress parameters respectively every fortnight.

Oxidative Stress

The Placer *et al*. (1966) method was used to assess the erythrocytic LPO/ MDA concentrations. This technique is based on the idea that when malondialdehyde (MDA), an end product of lipid peroxidation, reacts with Thiobarbituric acid, the result is trimethine, a compound that is pink in colour and is measured at 548 nm. The results were expressed as nmol MDA/ g Hb.

Table 1. Average ambient temperature, relative humidity, and temperature-humidity index during the study period

Month	Average temperature (°C)	Average Relative Humidity (%)	THI
May, 2022	32.69±0.57[a]	39.67±1.66[a]	79.60±0.56[a]
June, 2022	32.90±0.66[a]	47.60±3.40[b]	81.00±0.58[a]
July, 2022	30.65±0.13[b]	71.46±1.46[c]	82.61±0.30[b]
August, 2022	30.70±0.03[b]	72.26±0.90[c]	82.67±0.21[b]

Values with atleast one common superscript do not differ significantly (p>0.05)

The method of Hafeman *et al*. (1974)was used for estimation of erythrocytic reduced glutathione (GSH-Px). The absorbance at 420 nm was measured and results were expressed as mM.

Serum NEFA and BHBA

Bovine non-ester fatty acids ELISA kit (Biocodon technologies) was used for the measurement of serum NEFA concentrations. Bovine BHBA ELISA kits (Biocodon technologies) were used for estimation of serum BHBA levels. The results were expressed in µmol/L.

Milk Composition

The milk analyzer Lactoscan LA from Milkotronic Ltd., Bulgaria, was used to determine the biochemical composition of the milk, including fat, SNF, protein and lactose.

Statistical analysis

The data was analyzed by using Statistical Package for Social Sciences (SPSS) for Window version 29.0.0.0(241)©SPSS Inc., USA computer software programme. The means of various variables was calculated and analysed using independent samples t-test.

Results and Discussion

Environmental parameters

Average ambient temperature, relative humidity, and temperature-humidity index during the study period is presented in Table 1. The average THI values during the study period were higher than comfortable limit of THI as categorised by de Rensis *et al*., (2015). The THI values of May and June differed significantly (p<0.05) from July and August.

Behavioural Parameters

The average eating time (minutes/day) are presented in the table 2 for both the treatment and control group. The average eating time (minutes/day) of the control group and treatment group was 263.63±6.35 and 284.24±6.75 respectively during the study period. The statistical analysis of the data showed significant (p<0.05) increase in the eating time of the treatment group.

The average rumination time (minutes/day) are presented the Table 2 for both control and treatment groups. The average rumination time (minutes/day) of the control group and treatment group was 418.32±8.87 and 470.28±9.00 respectively during the study period. The statistical analysis of the data showed significant (p<0.001) increase in the rumination time of the treatment group.

The average period of inactivity (minutes/day) are presented the Table 2 for both control and treatment groups. The average period of inactivity (minutes/day) of the control group and treatment group was 822.39±9.16 and 780.08±12.68 respectively during the study period. The statistical analysis of the data showed significant (p<0.05) decrease in the period of inactivity of the

Table 2. Effects of evaporative cooling on eating time, rumination time (minutes/day), period of inactivity (minutes/day) in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE)

Groups	Eating time (minutes/day)	Rumination time (minutes/day)	Period of inactivity (minutes/day)
Group I (n=10)	263.63±6.35[p]	418.32±8.87[p]	822.39±9.16[p]
Group II (n=10)	284.24±6.75[q]	470.28±9.00[q]	780.08±12.68[q]
	p<0.05	p<0.001	p<0.05

Values with atleast one common superscript do not differ significantly (p>0.05)

treatment group.

The climate change poses formidable challenge to the development of livestock sector in India (Das, 2018), where the summer temperature goes beyond 45°C which is 18°C above the upper critical temperature of dairy cattle. When the temperature exceeds 27°C even with low humidity, the temperature is above the comfort zone for the high producing dairy cows (Pandey, 2008). So there is need to provide cattle with a method of evaporative cooling for comfort and optimum productivity.

When dairy animals are exposed to high ambient temperatures in tropical and subtropical climates, their main response is a decrease in feed consumption (Tapki and Şahin, 2006). The forced airflow and sprinklers inside the shed created a comfortable environment that reduced heat exhaustion and biological fluctuations that enhanced dry matter intake.

According to the study's findings, cooling treatment increased feed intake in crossbred cattle by successfully reducing their thermal load. The current study agreed with (Suadsong, 2013) and (Corazzin *et al*., 2021), who observed a significant increase ($p<0.05$) in feed intake in cooled cows compared to non-cooled cows. There was also increase in rumination time in cattle provided with evaporative cooling in group II which can be due to cooling effect of sprinklers. Boonsanit *et al*. (2010) also reported similar findings of rumination time of 576.7±4.3 and 448.3±12.8 minutes/day in dairy cows housed under evaporative cooling housing system and open housing system, respectively. The findings of Honig *et al*. (2012), who reported rumination times of 440.1 and 409.6 minutes per day in dairy cows allowed for 45 minutes of cooling respectively support the findings of the current study. There was significant ($p<0.05$) decrease in the period of inactivity of the treatment group. This could be attributed to a reduction in heat stress generated by the cooling effect of sprinklers and forced airflow.

Milk yield and Milk composition

The average milk yield (kg/day) are presented the Table 3 for both control and treatment groups. The average milk yield (kg/day) of the control group and treatment group was 17.37±0.33 and 19.45±0.34 respectively during the study period. The statistical analysis of the data show There was significant ($p<0.001$) increase in the Milk yield of the treatment group. This could be attributed to a reduction in heat stress generated by the cooling effect of sprinklers and forced airflow in comparison to group I, increased feed, and water intake as well as improved milk production.

The effect of evaporative cooling on milk compostion are presented in Table 7. The average milk fat significantly increased ($p<0.05$) on the day 45, 60 and 90th of the study period in the group II provided with evaporative cooling. The average SNF content of the milk also significantly increased ($p<0.05$) on the day 45, 60 and 75 of the study periods in the group II provided with evaporative cooling. The protein content of the milk significantly increased ($p<0.05$) on the day 90, 105 and 120 of the study periods in the group II provided with evaporative cooling.

The present findings are corroborated by the findings of Wolfenson *et al*. (1988), who reported similar results of increased milk production of 1.9 kg/d in dairy cows cooled by sprinklers and fans during the summer, and by Boonsanit *et al*. (2010), who reported crossbred primiparous cows housed in open housing and evaporative cooling systems, respectively, produced 16.9 and 1.9 and 12.6 kg of milk per day. This increase in milk fat, SNF, protein could be attributed to decreased heat load in cattle as a result of efficient evaporative cooling by forced ventilation with sprinklers. In accordance with the current findings, Agarwal (2004) found that the milk fat and milk total solids in buffaloes housed with and without misters, respectively, were 6.92 and 7.42 and 17.41 and 18.23. Calegari *et al*. (2012) also showed similar results of higher milk fat (%) in dairy cattle housed under sprinklers (3.66±0.59) compared to fans (3.61±0.53), which support the current investigation.

Table 3. Effects of evaporative cooling on Milk yield (kg/day) in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE)

Groups	Milk yield (kg/day)
Group I (n=10)	17.37 ± 0.33^{p}
Group II (n=10)	19.45 ± 0.34^{q}
	$p<0.001$

Values with different superscript (p, q) in a column differ significantly ($p<0.05$)

Physiological Parameters

The effect of evaporative cooling on rectal temperature (°F) are presented in Table 4. The average rectal temperature was significantly decreased ($p<0.001$) on days 15, 60, 75, 90, 105 and 120th in group II

Table 4. Effects of evaporative cooling on rectal temperature (OF) in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range).

Days	Group I (n=10)	Group II (n=10)	Group I (n=10)	Group II (n=10)
	(9 AM)		(2 PM)	
1	101.73±0.13	102.09±.165	103.33±.233	102.79±.208
15	101.44±.1454	101.95±.156*	102.89±.14	102.09±.312
30	101.27±.150	102.06±.161*	102.85±.175	102.16±.284
45	102.13±.105	102.31±.215	103.28±.122	102.82±.175
60	101.79±.122	101.93±.143	103.33±.105	102.49±.111*
75	102.02±.111	101.8±.155	103.290±.105	102.08±.084
90	101.812±.166	101.9±.136	103.188±.166	102.41±.130**
105	101.75±.200	101.74±.170	103.36±.101	102.56±.189**
120	102.02±.159	102.06±.101	103.26±.151	102.46±.096**

(*p<0.05, **p<0.01)

provided with evaporative cooling at 2:00 pm. The effect of evaporative cooling on respiration rate (bpm) are presented in table 5. The average respiration rate (bpm) was significantly decreased (p<0.05) on days 15, 60, 75, 90, 105 and 120th in group II provided with evaporative cooling at 2:00 pm. The effect of evaporative cooling on Heart rate (bpm) are presented in table 6. The average respiration rate (bpm) was significantly decreased (p<0.05) on days 15, 60, 75, 90, 105 and 120th in group II provided with evaporative cooling at 2:00 pm.

Rectal temperature differences between the treatment and control groups showed that the treatment group's comfort level was higher. Boonsanit *et al.* (2010) observed rectal temperature readings of 38.5°C and 39.3°C in cows cooled with misty fan and without misty fan, respectively, corroborating the results obtained in the present study. Suadsong, (2013) reported that rectal temperatures in dairy calves provided with and without supplemental cooling systems were reported to be 39.3°C and 38.5°C, respectively, and agreed with the results of the current investigation. The key physiological reaction that was plainly visible and increased with heat stress was respiration rate. Boonsanit *et al.* (2010) reported respiration rates of 53±0.7 and 67±2.4 in crossbred cows kept under evaporative cooling housing system and open housing system, respectively, corroborating the present results. Lower heart rates in cattle subjected to cooling treatment could be attributed to decreased heat

Table 5. Effects of evaporative cooling on Respiration rate (bpm) in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range).

Days	Group I (n=10)	Group II (M) (n=10)	Group I (E) (n=10)	Group II (E) (n=10)
	(9 AM)		(2 PM)	
1	55.40±3.85	52.60±2.7	84.70±3.62	72.90±3.29*
15	50.10±2.90	55.30±2.25	77.40±3.23	61.00±3.23**
30	55.30±2.43	56.80±3.01	84.70±2.31	72.80±2.11**
45	53.30±2.19	51.10±2.35	80.70±1.73	72.50±2.52**
60	53.80±2.98	57.30±3.67	89.80±3.07	76.10±.823**
75	47.90±2.25	52.30±3.58	82.60±2.07	70.10±1.77**
90	51.50±3.18	58.40±3.15	68.12±2.56	63.50±2.97
105	58.62±2.75	61.33±2.32	88.88±2.97	75.67±3.89**
120	54.12±3.97	66.22±5.22	89.00±2.28	68.89±4.08**

(*p<0.05, **p<0.01)

Table 6. Effects of evaporative cooling on Heart rate (bpm) in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range).

Days	Group I (n=10)	Group II (n=10)	Group I (n=10)	Group II (n=10)
	(9 AM)		(2 PM)	
1	73.90±4.02	70.02±3.68	85.5±4.45	81.1±2.63
15	61.10±2.96	63.90±4.24	85.40±2.13	77.60±4.14
30	59.5±4.53	60.2±4.68	89.00±2.65	79.90±1.37**
45	66.50±4.18	63.30±3.54	88.30±2.19	77.50±1.09**
60	65.60±3.78	62.70±4.9	92.30±1.47	75.60±1.28**
75	62.90±4.77	61.20±4.21	93.90±1.88	76.50±1.39**
90	56.88±3.33	52.00±2.16	97.00±2.03	88.60±2.37**
105	67.00±1.70	64.44±2.81	97.22±1.71	81.67±2.17**
120	62.67±3.40	65.44±3.87	94.22±1.55	87.78±1.38**

(*p<0.05, **p<0.01)

load in cattle as a result of efficient evaporative cooling by forced ventilation with sprinklers. The present result was similarly finding of Bouraoui *et al*. (2002), Singh *et al*. (2014) and Ghosh et al. (2018) who reported that the heart rate was significantly lower (p<0.05) at afternoon in calves under cooling treatment as compared to control group.

Oxidative Stress

The effect of evaporative cooling on LPO (nmol/g Hb) and GSH-Px (mM) are presented in table 8. There was significant decrease in LPO concentrations on the day 75 of the study period in the group II provided with evaporative cooling. Also, significant decrease in GSH-Px concentration was found on day 75 of the study period in the group II provided with evaporative cooling. This decrease in LPO (nmol/g Hb) and GSH-Px (mM) could be attributed to decreased heat load in cattle as a result of efficient evaporative cooling by forced ventilation with sprinklers. The present study's significantly higher (p<0.05) erythrocyte glutathione peroxidase activity in the control group may have been brought on by summer's higher levels of reactive oxygen species, which may have stimulated the body's antioxidant system. Similar findings were made in the studies of Bernabucci *et al*. (2002) on Holstein cows, Trana *et al*. (2006) on Red Syrian goats,

Table 7. Effects of evaporative cooling on Milk composition in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range).

Parameter		Days of Experiment								
		1	15	30	45	60	75	90	105	120
Milk Fat (%)	Group I (n=10)	2.60± 0.36	2.68± 0.34	2.59± 0.32	2.58± 0.34	2.23± 0.27	2.63± 0.41	2.73± 0.11	3.36± 0.13	3.22± 0.08
	Group II (n=10)	2.94± 0.30	2.93± 0.29	3.28± 0.40	3.57± 0.2*	3.10± 0.2*	2.76± 0.38	3.50± 0.1*	3.10± 0.06	3.33± 0.09
Milk SNF (%)	Group I (n=10)	9.40± 0.17	9.43± 0.12	9.15± 0.14	9.09± 0.14	8.92± 0.09	9.16± 0.13	9.28± 0.10	8.66± 0.17	8.40± 0.09
	Group II (n=10)	9.45± 0.10	9.38± 0.12	9.41± 0.16	9.43± 0.1 *	9.60± 0.0*	9.66± 0.1*	8.92± 0.17	8.55± 0.04	8.71± 0.08
Milk Protein (%)	Group I (n=10)	3.46± 0.07	3.31± 0.08	3.45± 0.05	3.33± 0.08	3.47± 0.07	3.31± 0.08	3.27± 0.08	3.28± 0.06	3.22± 0.06
	Group II (n=10)	3.51± 0.03	3.4± 0.08	3.54± 0.08	3.84± 0.12	3.62± 0.12	3.83± 0.03	3.54± 0.07*	3.85± 0.18*	3.74± 0.12*

(*p<0.05, **p<0.01)

Table 8. Effects of evaporative cooling on LPO, GSH-Px in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range)

Parameter		1	15	30	45	60	75	90
LPO (nmol/g Hb)	Group I (n=10)	288.91± 31.07	328.02± 33.87	309.25± 30.92	303.53± 15.30	334.92± 17.97	366.39± 23.42	319.57± 24.50
	Group II (n=10)	286.87± 25.17	284.87± 20.22	306.73± 24.79	299.09± 30.35	301.11± 27.47	277.68± 27.25*	277.35± 14.48
GSH-PX (mM)	Group I (n=10)	4.13± 0.44	5.05± 0.72	4.43± 0.54	5.36± 0.56	4.92± 0.71	5.71± 0.66	6.11± 0.24
	Group II (n=10)	4.70± 0.40	4.22± 0.54	4.17± 0.69	5.16± 0.79	4.87± 0.60	3.33± 0.70*	5.77± 0.35

(*p<0.05, **p<0.01)

Table 9. Effects of evaporative cooling on NEFA, BHBA in crossbred cattle (Group I: control vs Group II: evaporative cooling) (Mean±SE, range).

Parameter		1	15	30	45	60	75	90
NEFA	Group I (n=10)	154.51± 39.63	95.62± 17.51	213.94± 67.00	137.79± 45.39	127.22± 4.26	131.60± 4.22	238.57± 20.89
	Group II (n=10)	98.23± 13.50	128.10± 49.46	111.65± 37.87	114.47± 45.51	115.93± 4.57	97.28± 3.7*	196.43± 16.70
BHBA	Group I (n=10)	147.64± 57.00	58.80± 14.19	130.77± 37.14	88.20± 14.33	93.32± 6.93	98.96± 7.29	83.64± 16.71
	Group II (n=10)	83.84± 21.20	100.01± 48.88	108.33± 25.75	74.23± 11.04	93.41± 7.11	97.48± 6.48	88.45± 5.30

(*p<0.05, **p<0.01)

and Chigerwe et al. (2013) on neonatal dairy calves.

Serum NEFA and BHBA

The effect of evaporative cooling on serum NEFA and BHBA (µmol/L) re presented in table 10. The results of serum NEFA and BHBA in current study was found within the normal range. There was significant decrease ($p<0.05$) in serum NEFA levels on day 75th of the study in the group provided with evaporative cooling.

Asl et al (2011) reported cut-off values of serum NEFA and BHBA for diagnosis of the sub-clinical ketosis as 400 and 1400 (µmol/L) respectively. The results of serum NEFA and BHBA in current study was found within the normal range. The results of current study are corroborated by Bernabucci *et al*. (2010) who also reported that despite the decrease in dry matter intake the heat stressed cattle does not have increas in their plasma NEFA levels.

Conclusions

Evaporative cooling with sprinklers and forced airflow is more effective in improving eating time, rumination time and health performance of crossbred cattle as compared to forced airflow only under stressful THI conditions.

Acknowledgement

Authors are highly thankful to the Dean, COVS, GADVASU, Ludhiana for providing necessary facilities for conducting the research work.

Conflict of interest

Authors declare there is no conflict of interest

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Received : 17.02.2023
Accepted : 23.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 34-41

Management of electrolyte imbalances in Canine Parvoviral Enteritis

Ishani Bhawani, Ajay Katoch, Des Raj Wadhwa, Ankur Sharma and Vinay Hosakulu Balakrishna*
Department of Veterinary Medicine, DGCN, COVAS, Palampur

Abstract

The present study was carried out from May 2021 to May 2022. During this period a total of 2276 dogs were presented. Screening was carried out on basis of history, clinical signs and confirmed by rapid diagnostic Parvoviral kit which revealed 82 Parvovirus positive dogs. The overall incidence of Canine Parvoviral enteritis was 3.60% (82/2276). Seventy eight 78%) of affected dogs were males while 22% were females. Young dogs (<1 year) had higher incidence of infection(68%) than the adult dogs.The most common clinical signs noted were vomiting (8.58% Haemorrhagic and 87.80% Non haemorrhagic), diarrhoea (Haemorrhagic 84.15% and Non- Haemorrhagic 14.63%), Anorexia (84.15%) and dehydration (mild 32.93%, moderate 54.88% and severe 12.20%).Haematological examination, biochemical analysis and electrolyte estimation were carried out in the affected dogs. The incidence of different electrolyte imbalancesobserved were hyponatremia 65.85% (54/82), hypokalemia 36.58% (30/82) and hypochloremia 24.39% (20/82).Specific therapeutic measures were advised based on electrolyte imbalances and hydration status of the dogs. Electrocardiographic studies of hypokalemic dogs was done on the day of presentation. Post treatment levels of different electrolytes were also estimated along with clinical recovery. Broad spectrum antibiotics,fluid and supportive therapy resulted in uneventful recovery in all the dogs under study by day 5 post treatment.

Keywords: Canine Parvoviral Enteritis, Hyponatremia, Hypochloremia and Hypokalemia

Canine Parvoviral Enteritis is one of the most common causes of morbidity and mortality in young dogs worldwide. Canine Parvovirus belongs to the genus Protoparvovirus, family Parvoviridae, a single-stranded DNA virus that infects rapidly dividing cells of the gastrointestinal tract, bone marrow, lymphoid tissue and cardiac myocytes (Mazzaferro, 2020).

Canine Parvovirus is a stable virus that can survive for up to five to seven months in the environment. The virus initially infects the lymphoid tissue in the pharynx before it enters the bloodstream and replicates in dividing cells, and thus typically causes symptoms of disease in tissue with rapidly dividing cells such as the gastrointestinal tract and bone marrow (Judge, 2015). Electrolytes are molecules that dissociate in water to their cation and anion equivalents. There are many important electrolytes in physiology, notably Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, and HCO_3^-. Disease of any kind which affect Sodium (Na+) and water homeostasis leads to alteration in the extracellular fluid (ECF) volume and/ or the concentration of sodium ions (Na+) in plasma resulting in imbalances in the body (Kamel and Halperin 2017).Sodium is the primary effective osmole of the ECF. It is pumped out of the ICF in exchange for potassium, which is the primary effective osmole of the ICF (Wellman *et al*., 2012). Hypokalemia may occur because of anorexia, excessive renal losses, transcellular shift due to chronic metabolic acidosis and activation of the renin-angiotensin-aldosterone system due to dietary Sodium restriction(Bartges, 2012).Hyponatremia, Hypokalemia and Hypochloremia occurs in animals suffering from parvoviral enteritis in dogs as stated by (Joshi *et al*.2012).

Materials and Methods

The present study was carried out in the dogs presented in the Department of Veterinary Medicine, Dr. G C Negi College of Veterinary and Animal Sciences, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh, India from May 2021 to May 2022. During this period a total of 2276 dogs were presented. Screening was carried outon the basis of history and clinical signs and confirmed by rapid diagnostic Parvoviral kit which revealed 82 Parvovirus positive dogs. Further detailed history, clinical manifestations, vaccination status and previous treatment if done were taken. Electrolyte, Haematogical, Biochemical and electrocardiographic studies were then carried out in affected dogs. Fluid therapy based on type of Electrolyte disorder along with broad spectrum antibiotics and supportive therapy was carried out for proper management of diseased dogs. (Table 1 and Table 2).

*Corresponding author: ishanibhawani0296@gmail.com

Table 1: Management of electrolyte imbalances in Parvoviral Enteritis Dogs

Disorder	Fluid	Dose	Duration
Hyponatremia	Inj 0.9% NaCl, Inj. Ringer's lactate I/V and Ordelyte (oral hydration).	As per deficit and extent of dehydration	3-5 days
Hypochloremia	Inj 0.9%NaCl,Inj. DNS I/V and Powder Ordelyte orally	As per deficit and extent of dehydration	3-5 days
Hypokalemia	Inj. KClin Inj. DNS 5% or Inj. N.S 0.9% I/V and Powder Ordelyte orally.	Inj. KCl @ 0.5 mEq/kg/ hr.	3-5 days

Table 2: Therapeutic management of Parvoviral Enteritis dogs

Categories	Drug used	Dose rate, route and schedule	Minimum days
Fluid Therapy	Inj. Ringer's Lactate , Inj. DNS or Inj. Denilyte P	Depending upon fluid deficit (20-25ml/kg)	5 days
Antibiotic	Inj. Ceftriaxone + Tazobactam and Metronindazole	15-25 mg/kg b.wti/v	5 days
Vitamin B complex	Inj. Tribivet	0.5-2 ml I/M or I/V depending upon body weight	5 days
Anti emetic	Inj. Ondansetron	0.1–0.15 mg/kg/24 hours IV	5 days

Results and Discussion

Overall Incidence

During the period, May 2021 to May 2022, a total of 2276 dogs were presented to the Department of Veterinary Medicine out of which 82 dogs were positive for Canine Parvoviral Enteritis. The overall incidence of Canine Parvoviral Enteritis was 3.60% (82/2276) (Table 3).

Table 3: Overall Incidence of Parvoviral Enteritis Dogs

S.No.	Name of disorder	Number of cases	Percentage affected out of total dogs presented (n= 2276)
1.	Parvoviral Enteritis	82	3.60% (82/2276)

b. Incidence of Electrolyte imbalances in Canine Parvoviral enteritis dogs

The incidence of different Electrolyte imbalances in 82 Canine Parvoviral Enteritis dogs are enlisted in Table4. The incidence of Hyponatremia, Hypokalemia and Hypochloremia was 65.85%, 36.58% and 24.39% respectively. Rest of the dogs were having normal levels of Sodium, Potassium and Chloride.

Table 4: Incidence of Electrolyte imbalances in Parvoviral enteritis dogs

S. No.	Electrolyte imbalance	Total number affected (n = 82)	Percentage affected
1	Hyponatremia	54	65.85 %
2	Hypokalemia	30	36.58 %
3	Hypochloremia	20	24.39%

Age and sexwise Incidence

Young dogs (<1 year) had higher incidence of infection (68%) than the adult dogs (Table.5). Male (78%) dogs were affected more than Females (22%) (Table 6).

Table 5: Age wise Incidence of Canine Parvoviral Enteritis dogs

S.No.	Age of dogs	Number Affected	Percentage affected
1.	<1 year	55	68%
2.	>1 year	27	32%

Table 6: Sex wise incidence of Parvoviral Enteritis dogs

S.No.	Sex	Number affected	Percentage affected
1.	Males	63	78%
2.	Females	19	22%

Clinical signs

A Total of 82 Parvoviral Enteritis positive dogs by Canine Parvovirus Test Kit (Fig 1) were taken into study.The clinical signs in Canine Parvoviral Enteritis dogs are listed in Table 7.

The most common clinical signs were vomiting (8.58% Haemorrhagic and 87.80% Non-Haemorrhagic), Diarrhoea (Haemorrhagic 84.15% and Non- Haemorrhagic 14.63%), Anorexia (84.15%) and Dehydration (mild 32.93%, moderate 54.88% and severe 12.20%) (Fig. 2 & 3).

Clinical Parameters

The clinical parameters in Canine Parvoviral Enteritis dogs are enlisted in Table 8.

The mean values of Rectal temperature, Respiration rate and Heart rate in dogs with Canine

Table. 7:Clinical signs in Parvoviral Enteritis dogs

S.No.	Clinical signs	Total number affected (n=82)	Percentage affected
1.	Vomiting		
	Haemorrhagic	7	8.54%
	Non-Haemorrhagic	72	87.80%
2.	Diarrhoea		
	Haemorrhagic	69	84.15%
	Non-Haemorrhagic	12	14.63%
3.	Dehydration		
	Nil	0	0.00%
	Mild	27	32.93%
	Moderate	45	54.88%
	Severe	10	12.20%
4.	Anorexia	69	84.15%
5.	General depression	63	76.83%

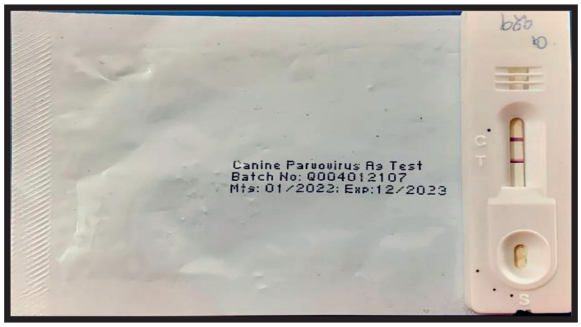

Fig. 1: Canine Parvovirus affected dog positive with test kit

Fig. 2. Bloody Diarrhoea

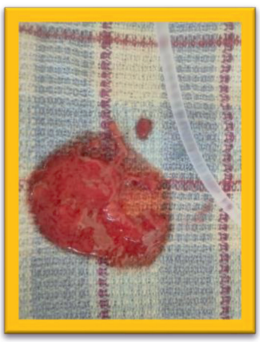

Fig. 3. Blood tinged vomitus

Table 8: Clinical Parameters in Parvoviral Enteritis dogs

S.No.	Parameters	Healthy dogs (n=15)(Mean SE)	Parvoviral enteritis dogs (n=82) (Mean SE)
1.	Rectal temperature (°F)	101.4 ± 0.2	102.92 ± 0.19**
2.	Heart rate (beats/min)	30.1 ± 1.07	112.34 ± 2.61***
3.	Respiration rate (breaths/min)	104.9 ± 3.25	39.1 ± 2.1 ***

*** Significant at 1% level (P<0.01),***Significant at 0.1% level (P<0.001)*

Parvoviral Enteritis were 102.92 ± 0.19 ºF, 39.1 ± 2.1/ minute and 112.34 ± 2.61/ minute respectively. All the above parameters were significantly higher than healthy animals.

Electrocardiographic studies

It was carried out in a total of six affected dogs. ECG examination demonstrated U wave which was significant for Hypokalemia , bipolar T wave , notched R wave indicative of heterogenous depolarisation of ventricles.Sodium, Potasium and Chloride levels in these dogs ranged from 130.5mmol/l - 136.0 mmol/l, 2.5mmol/l - 3.4 mmol/l and 95.5mmol/l - 100.2 mmol/l respectively.

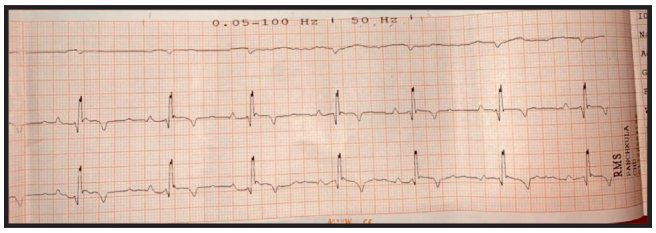

Plate 4: Electrocardiograph of Canine Parvovirus affected dog

Haematological parameters

The haematological parameters in Parvoviral enteritis dogs are enlisted in Table 9. The mean values of TEC,Hb and PCV were 7±0.27 x 10^{12}/L, 12.48 ± 0.53 g/dL and 38.35 ± 1.56 % respectively. The mean values of Hb, WBC and PCV were non significantly lower than healthy dogs.

Biochemical parameters

The plasma biochemical parameters of dogs suffering from Canine Parvoviral Enteritis are mentioned below in Table 10. The mean values of ALT, AST and ALP were 32.99 ± 5.62 U/L, 59.86 ± 9.38 U/L and 128.44 ± 32.61 U/L respectively. The mean values of above parameters were non-significantly higher than healthy animals.

The mean values of BUN, Creatinine and Glucose were 13.43 ± 1.95 mg %, 0.56±0.05mg % and 63.01±2.19 mg % respectively. The mean values of BUN were non-significantly higher than healthy animals whereas the mean value of Creatinine was comparable to healthy animals. The mean value of Glucose was significantly lower than the healthy animals on Day 0 . The findings are similar to those observed by Joshi *et al.* (2012) who observed that the puppies which were positive for Canine Paravoviral Enteritis showed significant hypoglycemia along with hypoproteinemia.

The mean values of Total Protein and Total Bilirubin were 4.56±0.37g % and 0.42 ± 0.09 mg %. The mean value of Total Bilirubin was comparable with healthy animals while the mean value of Total protein was significantly lower than healthy animals.

Plasma Electrolyte levels

The mean plasma electrolyte and mineral profile in Parvoviral Enteritis in dogs is enlisted in Table 11 . The mean values of Sodium, Potassium and Chloride were 141.84 ± 0.95 mmol/L, 3.38 ± 0.08 mmol/L and 103.74 ± 0.82 mmol/L, respectively. The mean value of Sodium, Potassium and Chloride was significantly lower than healthy animals. Hyponatremia, Hypokalemia and Hypochloremia occurs in animals suffering from parvoviral enteritis in dogs as stated by Joshi *et al.* (2012).

Hyponatremia and hypokalemia were common findings reflecting loss through vomiting and sequestration into the GI tract (Boag *et al.* 2005).

In cases where there was borderline or mild hypernatremia and hyperkalaemia, Inj. Dextrose 5% was instituted in fluid therapy.

Comparison of Pre and Post treatment parameter

a) Clinical Parameters

The mean pre and post treatment general clinical parameters in Canine Parvoviral Enteritis are mentioned in Table 11.The mean pre treatment values of Rectal Temperature, Respiration rate and Heart rate were 102.92± 0.19ºF, 39.1 ± 2.1per minute and 112.34 ± 2.61per minute. The mean values were 101.6 ± 0.2ºF, 32.6 ± 2.8per minute

Table 9: Haematological parameters of Parvoviral Enteritis dogs

Parameters	Healthy dogs (n = 15) (Mean ± SE)	Parvoviral enteritis dogs (n=82) (Mean ± SE)
WBC (x 10^9/L)	11.33 ± 0.43	10.13 ± 0.81
Lymphocyte (%)	14.92 ± 1.37	18.55 ± 1.46
Monocyte (%)	4.39 ± 0.43	3.25 ± 0.21
Granulocyte %	80.68 ± 1.41	74.61 ± 1.55
RBC (x 10^{12}/L)	6.56 ± 0.25	7.00 ± 0.27
Hgb (g/dL)	13.96 ± 0.62	12.48 ± 0.53
HCT (%)	39.87 ± 1.65	38.35 ± 1.56
MCV (fL)	60.86 ± 1.12	57.56 ± 0.51
MCH (pg)	21.21 ± 0.51	21.08 ± 0.59
MCHC (g/dL)	35 ± 0.7	35.71 ± 0.19
RDW (%)	13.5 ± 0.43	13.72 ± 0.29
PLT (x 10^9/L)	301.13 ± 24.7	215.66 ± 23.26
EOS (%)	1.85 ± 0.26	3.59 ± 0.67

and 107.56 ± 1.54per minute on Day 5. The mean values of Rectal temperature and Respiration rate showed non-significant difference on Day 0 and Day 5 whereas the mean value of Heart rate was significantly elevated at Day 0 and showed a gradual decrease on Day 5.

The mean pre and post treatment general clinical parameters in Canine Parvoviral Enteritis are mentioned in Table 12. The mean pre treatment values of Rectal Temperature, Respiration rate and Heart rate were 102.92± 0.19ºF, 39.1 ± 2.1per minute and 112.34 ± 2.61per minute. The mean values were 101.6 ± 0.2ºF, 32.6 ± 2.8per minute and 107.56 ± 1.54per minute on Day 5. The mean values of Rectal temperature and Respiration rate showed non-significant difference on Day 0 and Day 5 whereas the mean value of Heart rate was significantly elevated at Day 0 and showed a gradual decrease on Day 5.

Haematological Parameter

The mean pre and post haematological parameters in Canine Parvoviral Enteritis dogs are mentioned in Table 13.

The pre and post treatment mean values of TLC and Granulocyte in healthy dogs were 10.13 ± 0.81x 10^9/L,14.09 ± 1.57x 10^9/L and 74.61 ± 1.55% and 80.76 ± 2.17% respectively. There was a significant increase in pretreatment and post treatment values of TLC. There was a significant decrease in Lymphocyte and significant increase in Monocyte values of pre-treatment and post treatment values i.e. 18.55 ± 1.46 %, 10.99 ± 1.72% and 3.25 ± 0.21% , 4.61 ± 0.35%.

Table 10: Biochemical parameters of Parvoviral Enteritis dogs

Parameters	Healthy dogs (n= 15) (Mean ± SE)	Parvoviral enteritis dogs (n=82) (Mean ± SE)
ALT (U/L)	28.6 ± 1.55	32.99 ± 5.62
ALP (U/L)	66.8 ± 8.68	128.44 ± 32.61
AST (U/L)	38.13 ± 1.88	59.86 ± 9.38
Bilirubin (mg%)	0.37 ± 0.03	0.42 ± 0.09
Total Protein (g%)	6.37 ± 0.21	4.56 ± 0.37 **
BUN (mg%)	18.98 ± 1.45	13.43 ± 1.95
Creatinine (mg%)	0.8 ± 0.04	0.76± 0.05
Glucose (mg%)	77.86 ± 2.36	63.01 ± 2.19***

= p <0.01 (i.e confidence interval 99%),*= p<0.001(i.e. confidence interval 99.9%)

Table 11: Plasma Electrolyte levels in Parvoviral Enteritis dogs

Parameters	Healthy dogs (n = 15) (Mean ± SE)	Parvoviral enteritis dogs (n=82) (Mean ± SE)
Sodium (mmol/L)	154.3± 1.11	141.84± 0.95***
Potassium (mmol/L)	4.23± 0.12	3.38± 0.08***
Chloride (mmol/L)	107.3± 1.05	103.74± 0.82*

*= p <0.05 (i.e confidence interval 95%),***= p<0.001(i.e. confidence interval 99.9%)

Table 12: Pre and post treatment general parameters in Parvoviral Enteritisdogs

S.No.	Parameters	Healthy dogs (n=15) (Mean ±SE)	Day0 (n=82) (Mean± S.E.)	Day 5 (n=82) (Mean ± S.E.)
1.	Rectal temperature (^{0}F)	101.4 ± 0.2^a	102.92 ± 0.19^b	101.6 ± 0.2^a
2.	Respirationrate (breath/min.)	30.1 ± 1.07^a	39.1 ± 2.1^b	32.6 ± 2.8^{ab}
3.	Heart rate (beats/min.)	104.9 ± 3.25^a	112.34 ± 2.61^a	107.56 ± 1.54^a

The above findings are similar to those of Mylonakis *et al*. (2016) who observed that Leukopenia due to neutropenia and/or lymphopenia is the prominent haematological abnormality in Canine Parvoviral Enteritis due to the destruction of bone marrow precursors, the depletion of lymphoid tissues and the increased demands of the massively inflamed intestinal tract.

The mean pre-treatment values of RBC, Hb and HCT values were 7.0 ±0.27 X 10^{12}/L,12.48 ± 0.53 g/dL, 38.35 ± 1.56 % on Day 0 and 6.97 ± 0.52 X 10^{12}/L, 13.86 ± 0.42 g/dL, 39.36 ± 1.45 % on Day 5.The mean values of MCV, MCH, MCHC and RDW varied non significantly between Day 0 and Day 5.

Plasma Biochemical parameters

The mean pre and post treatment biochemical parameters in Canine Parvoviral Enteritis dogs are mentioned in Table 14.

The mean pre treatment values of ALT, ALP and AST were 32.99 ± 5.62 U/L, 128.44 ± 32.61U/L and 59.86 ± 9.38 U/L on Day 0 and 33.89 ± 5.37 U/L, 161.32 ± 25.58 U/L and 46.73 ± 7.51 U/L on Day 5, which varied non significantly. Non-significant increase in Bilirubin

Table 13: Pre and Post treatment Haematological Parameters of Parvoviral Enteritis dogs

Parameters	Healthy dogs (n=15) (Mean ± SE)	Day 0 (n=82) (Mean ± SE)	Day 5 (n=82) (Mean ± SE)
WBC (x 10^9/L)	11.33 ± 0.43^{ab}	10.13 ± 0.81^a	14.09± 1.57^b
Lymphocyte (%)	14.92 ± 1.37^{ab}	18.55 ± 1.46^b	10.99 ± 1.72^a
Monocyte (%)	4.39 ± 0.43^{ab}	3.25 ± 0.21^a	4.61 ± 0.35^b
Granulocyte %	80.68 ± 1.41^{ab}	74.61 ± 1.55^a	80.76 ± 2.17^b
RBC (x 10^{12}/L)	6.56 ± 0.25^a	7.00 ± 0.27^a	6.97 ± 0.52^a
Hb (g/dL)	13.96 ± 0.62^a	12.48 ± 0.53^a	13.86 ± 0.42^a
HCT (%)	39.87 ± 1.65^a	38.35 ± 1.56^a	39.36 ± 1.45^a
MCV (fL)	60.86 ± 1.12^a	57.56 ± 0.51^a	53.72 ± 4.17^a
MCH (pg)	21.21 ± 0.51^a	21.08 ± 0.59^a	19.40 ± 1.53^a
MCHC (g/dL)	35 ± 0.7^a	35.71 ± 0.19^a	32.38 ± 2.51^a
RDW (%)	13.5 ± 0.43^a	13.72 ± 0.29^a	12.63 ± 1.02^a
PLT (x 10^9/L)	301.13 ± 24.7^a	215.66 ± 23.26^a	267.50 ± 30.90^a
EOS (%)	1.85 ± 0.26^a	3.59 ± 0.67^a	3.64 ± 0.75^a

Values with different superscripts in a row differ significantly in each stage (P <0.05)

Table 14: Pre and post treatment plasma biochemical parameters of Canine ParvoviralEnteritis dogs

Parameters	Healthy dogs (n=15) Mean ± SE	Day 0 (n=82) (Mean ± SE)	Day 5 (n=82) (Mean ± SE)
ALT (U/L)	28.6 ± 1.55[a]	32.99 ± 5.62[a]	33.89 ± 5.37[a]
ALP (U/L)	66.8 ± 8.68[a]	128.44 ± 32.61[a]	161.32 ± 25.58[a]
AST (U/L)	38.13 ± 1.88[a]	59.86 ± 9.38[a]	46.73 ± 7.51[a]
Bilirubin (mg%)	0.37 ± 0.03 [a]	0.42 ± 0.09 [a]	0.34 ± 0.05 [a]
Protein (g%)	6.37 ± 0.21[b]	4.56 ± 0.37 [a]	5.60 ± 0.32[ab]
BUN (mg%)	18.98 ± 1.45 [a]	13.43 ± 1.95 [a]	18.07 ± 1.94 [a]
Creatinine (mg%)	0.8 ± 0.04[b]	0.56 ± 0.05[a]	0.48 ± 0.04[a]
Glucose (mg%)	77.86 ± 2.36[a]	92.01 ± 5.19[a]	116.90 ± 2.55[b]

Values with different superscripts in a row differ significantly in each stage (P <0.05)

of pretreatment values and than subsequent decrease on Day 5 was observed.

The mean pre treatment value of Total Protein decreased significantly from the healthy dogs and a non significant increase in Day 5 values was observed. Loss of protein and electrolytes into the gastrointestinal tract as well as changes due to dehydration, and tissue hypoxia results in hypoproteinemia (Judge, 2015).

Significant decrease in Creatinine value in pretreatment and post treatment group was present 0.56 ± 0.05mg% on Day 0 and 0.48 ± 0.04mg % Day 5. The mean pre treatment value of Glucose increased significantly from 92.01 ± 5.19 mg% on Day 0 to 116.90 ± 2.55mg% on Day 5 after institution of treatment which were in accordance with Mylonakis *et al*. (2016).

The above finding was similar to those of Joshi *et al*. (2012) who conducted a study on 11 puppies naturally infected with Canine Parvo viral Enteritis and found hypoglycemia along with Hypoproteinemia, Hyponatremia, Hypokalemia and Hypochloremia. Blood urea nitrogen (BUN) levels were also significantly decreased in Canine Parvoviral Enteritis positive puppies.

Plasma Electrolyte parameters

The mean pre and post plasma Electrolyte parameters in Canine Parvoviral Enteritis dogs are mentioned in Table 15.

Electrolyte levels in 82 positive Canine Parvoviral Enteritis dogs revealed hyponatraemia, hypokalaemia and hypochloraemia in 65.85%(54/82), 36.58% (30/82) and 24.39%(20/82) respectively.

The mean pre treatment values of Sodium and Potassium were significantly decreases compared to healthy dogs . The mean pre treatment values of Sodium and Potassium were 141.84± 0.95 mmol/L and 3.38± 0.08mmol/L on Day 0 which increased non significantly after the treatment to 144.65± 0.88mmol/L and 3.49± 0.07mmol/L respectively on Day 5. The above findings were similar to Bartges (2012) who stated that Hypokalemia may occur because of anorexia, excessive renal losses, transcellular shift due to chronic metabolic acidosis and activation of the renin-angiotensin-aldosterone system due to dietary Sodium restriction

Significant decrease in Chloride was present in pretreatment group i.e. 103.74 ± 0.82mmol/L as compared to healthy dogs which increased non significantly to 105.44± 0.74 mmol/L after the treatment. It in accordance with Joshi *et al*. (2012**)** who conducted a study on 11 puppies naturally infected with Canine Parvo viral Enteritis and found significant Hyponatremia , Hypokalemia and Hypochloremia.

Table 15: Pre and Post treatment electrolyte parameters of Parvoviral Enteritis dogs

Parameters	Healthy dogs (n=15) (Mean ± SE)	Day 0 (n=82) (Mean ± SE)	Day 5(n=82) (Mean ± SE)
Sodium (mmol/L)	154.3± 1.11[b]	141.84± 0.95[a]	144.65± 0.88[a]
Potassium(mmol/L)	4.23± 0.12[b]	3.38± 0.08[a]	3.49± 0.07[a]
Chloride (mmol/L)	107.3± 1.05[b]	103.74± 0.82[a]	105.44± 0.74[ab]

Values with different superscripts in a row differ significantly in each stage (P <0.05)

After the institution of treatment, all the dogs recovered uneventfully by Day 5.

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Received : 19.12.2022
Accepted : 25.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 42-44

Microbial profile and antibiogram trend of otitis externa in cats

M.R. Chandrika[1], R. Ramprabhu[2], S. Subapriya[3], M. Ranjitkumar[4]*

[1]Research Scholar, [2]Professor, [3]Assistant Professor, Centralized Clinical Laboratory, Madras Veterinary College, TANUVAS, Chennai, India [4]Assistant Professor, Department of Veterinary Clinical Medicine, Madras Veterinary College, TANUVAS, Chennai, India

Abstract

A total of 44 ear swab samples from 40 cats were cultured to know the prevalence of microorganisms causing otitis externa and to evaluate the sensitivity pattern of antimicrobial drugs for the management of otitis externa in cats. The study revealed that the incidence of *Staphylococcus* (68%) was highest followed by mixed infection comprising of *Escherichia coli* and *Staphylococcus* (14%), *Escherichia coli* (11%) and *Pseudomonas* (7%) species. Highest rate of sensitivity was observed with amikacin (68.2%) followed by cefotaxime (56.8%), enrofloxacin (54.5%), azithromycin (31.8%), tetracycline (22.7%) and amoxicillin (9.1%). The maximum resistance of the bacterial isolates was observed with amoxicillin.

Keywords: Antibiogram, Antibiotic resistance, Bacterial culture, Cats, Otitis externa.

Feline otitis is etiologically a complex disease, which can be clinically challenging (Shokri *et al*., 2010; Kennis, 2013). Otitis externa is the inflammation of the external ear canal namely outside of the tympanic membrane and sometimes involving the pinna (Kennis, 2013; Bollez *et al*., 2018). Multifactorial etiologies are involved in causing otitis externa in cats which may persist as acute or chronic condition (Moriello, 2013). Primary Secondary Predisposing Perpetuating (PSPP) classification system is the important classification system used to describe various etiological factors responsible for otitis externa (Jacobson, 2002). It can be either primary or secondary which involves various predisposing and perpetuating factors (Moriello, 2013).

Bacteria represent an important element in the PSPP classification system of otitis externa. Bacterial otitis externa in cats have been associated with *Staphylococcus, Pseudomonas, Escherichia, Proteus, Enterococcus, and Corynebacterium* species of bacteria (Kittl *et al*., 2018). Due to the development of resistance to the majority of conventional antibiotics, antimicrobial-resistant strains of *Staphylococcus* and *Pseudomonas* have arisen as frustrating and challenging causes of otitis (Hariharan *et al*., 2006; Qekwana *et al*., 2017).

The present study was carried out to identify and record the prevalence of various microorganisms associated with otitis externa in cats and to study the current trend in the sensitivity pattern of otitis externa affected cats to commonly available antibiotics.

*Corresponding author: drramprabhu69@rediffmail.com

Material and Methods

Study area and Study population

The present study was conducted in cats presented to Small Animal Dermatology Unit of Madras Veterinary College teaching hospital with signs of otitis externa. A total of 44 ear swab samples from 40 cats affected with otitis externa collected and presented to the laboratory were included for the study.

Bacterial culture

Collected ear swab samples inoculated with sterile inoculating loop into Brain heart infusion agar and incubated overnight observed for the presence and absence of bacterial colonies. Colonies were further cultured in MacConkey agar, Mannitol salt agar, Edward's medium and Eosin Methylene Blue (EMB) agar for identification of the organisms. Bacterial identification was made by studying the morphology of organisms in various media and by Gram's staining of bacterial colonies (Quinn *et al.,* 2002).

Antibiotic sensitivity test

Antibiotic susceptibility test was carried out to determine the antibiotic that will be most successful in treating a bacterial infection in vivo. In vitro antibiotic sensitivity patterns of the microorganisms isolated were carried out by standard agar disc diffusion method (Bauer *et al.,* 1966). Few isolated colonies were picked from the primary agar media and were streaked on Mueller Hinton agar plate. The commonly available antibiotics like amoxicillin, azithromycin, cefotaxime, enrofloxacin,

amikacin and tetracycline discs were chosen for the study. The chosen antibiotic discs were then carefully placed on to the agar plates and pressed on to the surface to ensure complete contact with the agar surface. The plates were examined for the development of inhibition zones around the discs. Based on the diameter of inhibition zone developed, the antibiotics were coded as Sensitive (S), Intermediate (I) and Resistant (R).

Results and Discussion

Otitis externa affected cats on gross examination showed changes like black, dry, ceruminous and pus discharge from affected ears (Figure 1-3). Bacterial culture of ear swab samples from otitis externa affected cats revealed *Staphylococcus* (68%), followed by mixed infection comprising of *Escherichia coli* and *Staphylococcus* (14%), *Escherichia coli* (11%) and *Pseudomonas* (7%) spp. (Figure 4). Our results correlated with the findings of Hiblu *et al*. (2020) who reported *Staphylococcus spp*. as the most frequent bacterial etiology (75%) followed by *Proteus spp*. (16.6%) and *Pseudomonas spp.* (8.4%) in cats affected with otitis externa.

In vitro antibiogram

The highest rate of sensitivity of the identified bacterial isolates was observed with amikacin (68.2%) followed by cefotaxime (56.8%), enrofloxacin (54.5%), azithromycin (31.8%), tetracycline (22.7%) and amoxicillin (9.1%) (Figure 5). Earlier Hariharan *et al*. (2006) reported that 70-90% of bacterial isolates were more susceptible to gentamicin and enrofloxacin in his study on canine and feline otitis externa. Hiblu *et al*. (2020) in his study on feline otitis externa in Trpoli, Libya reported that the bacterial isolates were most susceptible to norfloxacin (83.3%) followed by gentamicin (70.8%), Oxytetracycline (62.5%), Amoxicillin (33.3%) and Penicillin (100%).

Antibiogram against single genus isolates

Staphylococcus spp. were sensitive to amikacin (76.6%), enrofloxacin (60%), cefotaxime (53.3%), azithromycin (36.6%), tetracycline (23.3%) and amoxicillin (10%). Sensitivity of *E. coli* was cefotaxime (60%), amikacin (60%), azithromycin (40%), tetracycline (40%), amoxicillin (20%) and enrofloxacin (20%). Sensitivity of *Pseudomonas spp*. was amikacin (100%), cefotaxime (66.6%), azithromycin (33.3%). None of the *Pseudomonas* isolates showed sensitivity to amoxicillin, enrofloxacin and tetracycline. Mixed *E.coli* and *Staphylococcus spp.* showed most sensitivity to enrofloxacin (83.3%) followed by cefotaxime (66.6%) (Fig.6).

These observations are in accordance with Hariharan *et al*. (2006) that staphylococcal isolates of feline otitis externa were susceptible to gentamicin, enrofloxacin, and clavulanated amoxicillin, but more frequently resistant to penicillin and ampicillin. Similarly Jacobson (2002) reported that *Pseudomonas* isolates were susceptible to gentamicin and polymyxin B, but more resistant to penicillin in canine otitis externa cases.

The present study revealed *Staphylococcus* (68%) as the primary pathogen causing otitis externa in cats followed by mixed infection comprising of *Escherichia coli* and *Staphylococcus* (14%), *Escherichia coli* (11%) and *Pseudomonas* (7%) species. The sensitivity trend suggested amikacin (68.2%), cefotaxime (56.8%) and enrofloxacin (54.5%) as the most effective antibiotics for the treatment of otitis externa in the present scenario and revealed the development of resistance to amoxicillin in most of the otitis externa in cats.

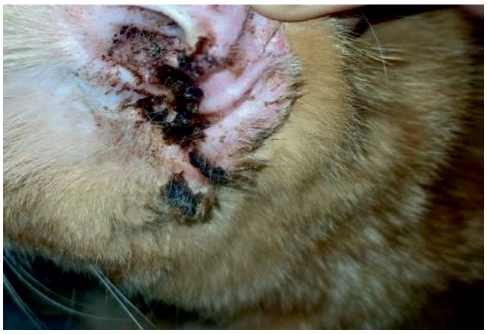

Fig. 1. Black, ceruminous, dry discharge from left ear in a one year old male Persian cat.

Fig. 2. Pus discharge in a five months old female Bengal cat.

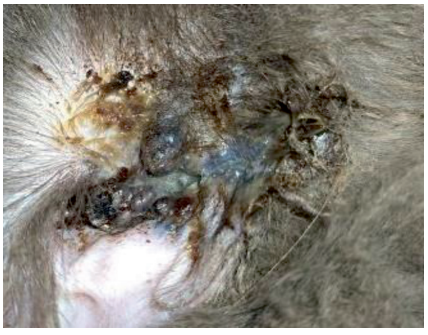

Fig. 3. Black nodular mass along with pus discharge in a five years old male Persian cat.

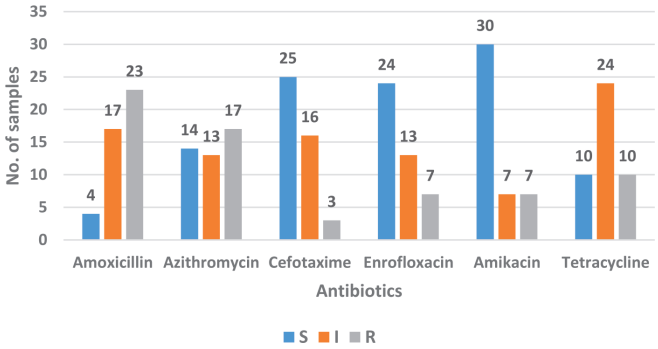

Fig. 5. Antimicrobial sensitivity pattern of otitis externa in cats.

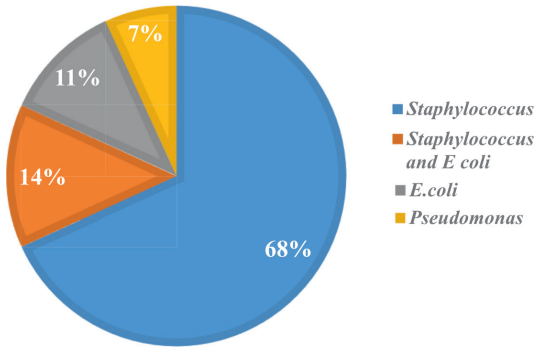

Fig. 4. Microbial profile of otitis externa in cats.

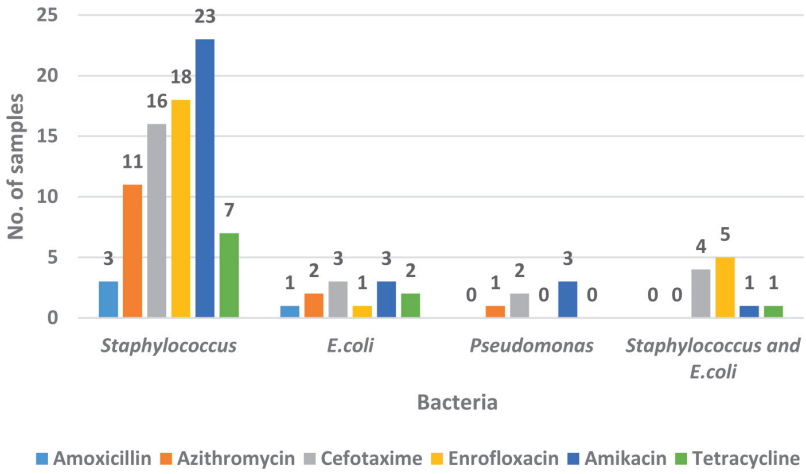

Fig. 6. In vitro sensitivity of bacterial isolates to antibiotics.

Acknowledgments

The authors would like to extend their gratitude to The Director of Clinics, TANUVAS, Chennai for the support provided throughout the study period.

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Received : 20.12.2022
Accepted : 27.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 45-55

A retrospective study of goat cases presented at the university Multi-specialty Teaching Veterinary Clinical Complex cum Hospital, Ludhiana, India

Gourav Kumar, D.K Gupta and Raj Sukhbir Singh*

Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana 141004 Punjab, (India)

Abstract

A retrospective study of goat cases presented to the Large Animal Medicine OPD of University over a period of 9 years (January 2013 to December 2021) was conducted to determine the prevalence of (medical) cases associated. Within the period of study, a total of 608 cases of goats were handled. The most prevalent infections reported were from digestive system cases (38.4%), followed by nervous system cases (17.1%) and respiratory system cases (15.9%). Prevalence of diseases in female goats (61.3%) was significantly higher than in male goats (38.6%). Age-wise distribution of total cases revealed that maximum number of cases were reported in goats of <1-year-old age group (267, 44%), followed by the age groups of 1-3 years (225, 37%), 3-6 years (91, 15%) and >6 years (25, 4%). The percentage of diseases in goats was higher in monsoon season (190, July–September), whereas the least number of cases were seen in pre-summer season (101, March–April). Enteritis (50), Pneumonia (48), tetanus (12) and acute mastitis (11) were the most common digestive, nervous, respiratory and udder system cases to be reported, respectively. Forty-nine goats were having single parasitic eggs infection while 27 were having mixed parasitic eggs infection. Maximum cases of single and mixed parasitic eggs were of strongyles and strongyles +coccidia, respectively.

Keywords: Goats; Retrospective; Hospital; Prevalence; System

The Indian livestock sector plays a significant role in the welfare of India and enriches the Indian economy. The livestock sector contributed 25.6% of the agricultural GDP and 4.11% of the national GDP (Vanita *et al*., 2022). About 27.8% of the total livestock production is contributed by goats. With 148.88 million goats, India ranks second in the world (Singh, 2020). The goat population in Punjab which is a small state in India is approximately 0.275 million.

Goats make a significant contribution to the livelihoods of low-and medium-input farmers. This business employs 40% of the rural population living below the poverty line and landless farmers (Boyazoglu *et al*., 2005). Goat milk has lower allergenicity, greater digestibility, alkalinity, buffering capacity, anti-inflammatory, anti-microbial, anti-cancerous, and some therapeutic qualities in human nutrition and medicine as compared to cow or human milk (Lima *et al*., 2018). The goat is also known as the poor man's cow since it helps poor villages with their financial needs (Iqbal *et al*., 2008). This demand is increasing because of the growing human population. There are lots of problems in the goat industry, including a lack of grazing area, lack of technical experts, an insufficient supply of vaccination, lack of epidemiologic research and many diseases affecting the goat's health. Among various problems, diseases in goats are the most important hindrance to their production in India. These diseases significantly impact the production of goats, the ability to export them, and the quality of the products they produce.

The veterinary hospital is an ideal place to learn about animal diseases as well as their solutions. Every day, people from the surrounding districts bring their sick animals to the Veterinary hospital, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana for treatment. Annually, 60 to 70 goats visit the clinics for checkups. However, precise information on the number of cases and the nature of the cases is still not available. The analysis of the case record provides a full perspective of the disease problems in the local region to determine the clinical prevalence of goat diseases, including the distribution of diseases based on species, age, sex, system affected, case type, causal agents, and seasonal variation. Also, this study is aimed at supplementing and updating existing literature on diseases of domestic ruminants prevalent in Punjab, India.

Materials and Methods

Clinical records of goat cases presented in the

*Corresponding author: drdhirajvet@yahoo.co.in

Large Animal Medicine OPD were screened from the period of January 2013 to December 2021 and all the information was collected to interpret the data. The study was performed at the Multispecialty Veterinary Hospital of Department of Teaching Veterinary Clinical Complex (TVCC), College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab. The data of the total presented cases were compiled and analyzed based on year, age, sex, season and system involved. Each system was further evaluated based on age, sex, month, affections, and clinical manifestations. Diseases and clinical signs associated with udder system were recorded and analyzed.

Statistical Analysis

The statistical analysis was performed using computer-based statistical software (Minitab Inc., Version 14.2, State College, PA, USA).

Results and Discussion

Distribution of total number of cases

As the goat industry has rapidly gained importance throughout India in recent years, diseases that are harmful to the body are also increasing. Consequently, the number of animals presented to clinics has substantially increased in recent years. Year-wise analysis of total cases revealed that maximum number of cases (110; 18.09 %) were reported in the year 2021, followed by 2018 (92; 15 %) and 2020 (83; 13.65 %) as shown in Table 1.

Minimum number of cases were observed during 2014 (36; 5.9%), followed by 2013 (40; 6.5%) and 2015 (44; 7.2%). According to Table 1, the number of cases presented in clinics has been increasing year by year. However, due to the COVID pandemic, the number of cases declined during 2019 and 2020, but again, the number rose significantly in the subsequent years. It is clearly evident from the graph that the number of goat cases in the clinics is increasing day by day, which indicates an improvement in the field of caprine practice.

Season-wise distribution of total number of cases

Out of 608 screened cases of goat diseases, the maximum number of cases were seen in the monsoon season (190, July–September), whereas the least number of cases were seen in pre-summer season (101, March–April). Maximum cases in monsoon season might be attributed to high pathogen load and environmental stress. Pre-summer had the fewest cases, which could be attributed to the moderate environmental temperature and favorable season for nutrition. Sarker *et al*. (2015) in their retrospective study also found that maximum cases were presented in rainy season (36.81%, June-October) followed by summer (35.54%, March-May) and lowest in winter season (27.64%, November-February), while Islam *et al*. (2015) and Islam et al. (2021) recorded maximum cases in rainy season (July-October) followed by winter (November-February) and summer (March-June).

Age-wise distribution of total cases

Age-wise distribution of total cases revealed that maximum number of cases were reported in goats of <1-year-old age group (267; 44%), followed by the age groups of 1-3 years (225; 37%), 3-6 years (91; 15%) and >6 years (25; 4%). Due to insufficient immunity, improper deworming, and vaccination status, < 1-year-old age group has the highest number of cases. Islam *et al*. (2021) recorded 640 cases in < 1-year age group and

Table 1: Year-wise distribution of total number of cases and major systems

Year	Total no. of cases	Major systems		
		Digestive system	Nervous system	Respiratory system
2013	40	12	9	9
2014	36	16	4	2
2015	44	12	8	15
2016	57	26	8	7
2017	72	28	7	14
2018	92	43	16	11
2019	74	26	14	12
2020	83	30	18	11
2021	110	41	20	16

590 cases in >1-year age group of goats. Sarker et al. (2015) recorded maximum cases (751; 52%) in 1-3-year age group, followed by 451; 32% in <1-year age group and 248; 17% in 3-8-year age groups of goats.

Sex-wise distribution of total number of cases

The diseases were found more in females (373; 61.3 %) than in males (235; 38.6 %). Female animals have a greater prevalence than male animals due to both a higher sensitivity to infection due to several pressures (pregnancy, lactation, environmental) and a higher population of females in the herd, resulting in a higher incidence of cases.

Also, females are kept in the herd for longer periods of time than males for breeding or milk production (Waziri *et al*., 2006). Similar findings have been observed by Sarker *et al*. (2015), who reported more cases in female goats (924) than in male goats (526). Also, Kabir *et al*. (2010), Ali *et al*. (2011) and Islam *et al*. (2021) reported similar observations with regard to gender variation in goat diseases.

System-wise distribution of total cases

Different cases in goats were categorized system-wise to observe the involvement of system during the period of study. The data revealed that maximum number of cases presented during the last 9 years were from the digestive system (234), followed by nervous (104) and respiratory (97). The least number of cases were of urinary (9), followed by musculoskeletal and integumentary (19 each) as shown in table 2.

Table 2: System-wise distribution of total number of cases

System involved	No. of cases	Percentage (%)
Digestive	234	38.4%
Nervous	104	17.1%
Respiratory	97	15.9%
Mammary	45	7.4%
Others	45	7.4%
Multisystem	36	5.9%
Integumentary	19	3.1%
Musculoskeletal	19	3.1%
Urinary	9	1.5%
Total	608	100%

The multisystem included PPR cases, which involved both the digestive and respiratory systems. Neoplasia of unknown origin, septicemia, pyrexia of unknown origin, and naval ill were categorized as others. According to Pawaiya *et al*. (2017), among all organ systems studied, diseases of the alimentary system caused the highest mortality (40.43%) in goats. Parvez *et al*. (2014) observed maximum cases of 16.85% of digestive system diseases, followed by 15.22% of parasitic diseases, 11.95% of infectious diseases, 7.91% of general systemic, 9.57% of respiratory system diseases, 3.31% of urinary system diseases. Sarker *et al*. (2015) recorded maximum occurrence of cases in digestive system (334), followed by multisystem (261), reproductive and integumentary (203 each), and respiratory system (145). Islam *et al*. (2015) recorded maximum cases of digestive disorders (372; 372), followed by respiratory system (327; 12.3%) and musculoskeletal system (69; 2.6%). Ali *et al*. (2011) reported the highest number of cases from the digestive system (58%), followed by integumentary (18%) and respiratory (17%) systems in their retrospective study of 1397 goat cases. Our study, as well as other studies from different parts of the world, observed maximum number of cases belonging to GIT system. However, we observed more number of nervous system cases, next to GIT system cases. But other studies do not support it. The reason for more number of nervous system cases might be better facilities and expertise at the university clinics.

Digestive system cases

Season-wise distribution of digestive system cases

Season-wise case distribution of digestive cases revealed that maximum cases were reported in the monsoon season (70), followed by summer (51), post-monsoon (39), winter and pre-summer (37 each) (Table 3). Ali *et al.* (2011) investigated 809 cases of digestive diseases and found that maximum number of digestive cases were presented in (358) rainy season (June-October), followed by (258) winter (November-February) and (193) summer season (March-May). Sarker et al. (2015) reported maximum digestive system cases (124) in the rainy season, followed by the summer season (117) and winter season (93). Ours and several other studies reported maximum number of cases during monsoon/rainy season, which might be attributed to high pathogen load and stress factors, while the winter season experiences a considerably lower number of cases; the reason may be due to low pathogen load and a high plane of nutrition with less stress during this season.

Age-wise distribution of digestive system cases

Digestive system cases were observed to be highest in <1Y (105), followed by 1-3Y (87) and 3-6Y

Table 3: Season-wise distribution of major systems

System involved	Season					Total
	Monsoon	Post-monsoon	Winter	Pre-summer	Summer	
Gastrointestinal	70	39	37	37	51	234
Nervous	29	20	27	16	12	104
Respiratory	31	23	18	10	15	97

Table 4: Age and sex-wise distribution of major systems

System involved	Age (Year)				Sex		Total
	<1 Y	1-3 Y	3-6 Y	>6 Y	M	F	
Gastrointestinal	105	87	35	7	100	134	234
Nervous	53	32	17	2	41	63	104
Respiratory	36	35	19	7	41	56	97

(35) age groups of goats (Table 4). Low status and poor management might be the reasons behind the high number of patients falling under <1 year age group. Sarker et al. (2015) reported the maximum number of digestive cases in 1-3Y (47%) age group, followed by <1Y (36%) and 3-8 Y (17%) age groups of goats.

Sex-wise distribution of digestive system cases

Digestive diseases were found more in females (134) as compared to males (100) as shown in table 4. Sarker et al. (2015) also found a greater number of GIT cases in females (217) as compared to males (117). Ali et al. (2011) also noticed greater GIT cases in females (516) as compared to males (293) in their retrospective study during the period of January 2006 to December 2010.

Distribution of clinical signs associated with digestive system diseases

Inappetence (121) and diarrhea (112) were the chief complaints found in digestive cases, followed by anorexia (75), bloat (40), fever (33), pain (20) and constipation (9) (Table 5). Kabir *et al*. (2010) reported fever (33; 28%), diarrhea (10; 8.7%) and anorexia (7; 6%) out of 115 goat cases. Karim *et al*. (2014) reported a clinical prevalence of 209 goats with diarrhea, fever, anorexia and bloat in 37, 14, 12 and 5 cases, respectively.

Disease-wise distribution of digestive system cases

A total of 62 out of the 234 digestive cases presented could not be definitively diagnosed. Maximum cases were of enteritis, followed by strongylosis (29) and lactic acidosis (23). The least number of cases were of foreign body syndrome (FBS) as shown in table 5.

Ali *et al*. (2011) reported 809 digestive system cases in goats during the period from 2006 to 2010. They detected 678 cases of worm overload, followed by 34 cases of indigestion and 27 cases of enteritis. Rahman et al. (2012) recorded 83 digestive system cases in goats and observed that 22 had enteritis, followed by bloat (9), indigestion (3), and stomatitis in 3 goats. Mellado et al. (1991) reported enteritis as the second most important cause of death.

Distribution of various GIT parasitic eggs

Out of total 608 reported cases, 76 OPD cards were having fecal examination reports. Out of these, 49 reports were having single parasitic egg infection while 27 reports showed mixed parasitic egg infection (Table 6). Single parasitic eggs infection involved strongyle (29), coccidia (16), moniezia (2), trichuris and capillaria (1 each). Singh et al. (2017) also observed highest single infection of strongyle (19.04%; 32/168), followed by coccidia (16.66%; 28/168) and strongyle + coccidia as the most prevalent mixed parasitic infection.

Anumol *et al*. (2011) reported that strongylosis was the most common type of gastrointestinal helminth infection, which was found to be 50 percent. Hassan et al. (2011) also reported Moniezia sp. and Capillaria sp. as the least common GIT parasites. Internal parasites are a major cause of production losses in the livestock industry. They can cause diarrhea, anemia decreased production and reproduction, and weight loss in small ruminants. Incomplete or irregular deworming increases the parasitic load in the gut (Starkey and Pugh, 2020).

Table 5: Number of cases presented according to major systems and its affections and clinical signs

Systems and their affections	Number of cases	Percentage	Systems and their clinical signs	No. of cases	Percentage
Digestive system cases	234	38.48	Digestive system cases	234	38.48
Enteritis	50	8.2	Inappetence	121	19.9
Strongylosis	29	4.76	Diarrhea	112	18.4
Lactic acidosis	23	3.78	Anorexia	75	12.3
Indigestion	21	3.45	Bloat	40	6.57
Coccidiosis	14	2.3	Pain	20	3.29
Peritonitis	13	2.13	Constipation	9	1.48
Frothy bloat	13	2.13			
Toxicity	4	0.65			
Stomatitis	3	0.49			
FBS	2	0.32			
Undiagnosed	62	10.19			
Nervous system cases	104	17.1	Nervous system cases	104	17.1
Tetanus	12	1.97	Recumbent	60	9.87
PEM	8	1.31	Stiffness of limbs	18	2.96
Toxicity	7	1.15	Circling	16	2.63
Peripheral nerve damage	6	0.98	Posterior paresis	16	2.63
Spinal trauma	4	0.65	Seizures	11	1.8
Encephalopathy	4	0.65	Head turn	9	1.48
Undiagnosed	63	10.36	Ataxia	6	0.98
			Head pressing	4	0.66
			Head tilt	4	0.66
Respiratory system cases	97	15.95	Respiratory system cases	97	15.95
Pneumonia	48	7.89	Nasal discharge	60	9.86
Bronchitis	14	2.3	Coughing	54	8.88
Pharyngitis	7	1.15	Fever	30	4.93
Pleural effusion/Pleuritis			Dyspnea	14	2.3
Rhinitis	6	0.98	Weight loss	8	1.31
Undiagnosed	1	0.16	Frictional rubs	8	1.31
	21	3.4	Sneezing	3	0.49
Udder system cases	45	7.4	Udder system cases	45	7.4
Acute mastitis	11	1.8	Inflammation	13	2.13
Chronic mastitis	9	1.48	Flakes	8	1.31
Fibrosis	8	1.31	Fibrosed	8	1.31
Haemolactia	6	0.98	Half quarter affected	4	0.66
Gangrenous mastitis	3	0.49	Pus discharge	4	0.66
Per acute mastitis	3	0.49	Blood	4	0.66
Udder edema	2	0.32	Cold to touch	3	0.49
Thelitis	2	0.32	Agalactia	3	0.49
Mammary hypoplasia	1	0.16			

Season-wise distribution of parasitic eggs

Season-wise distribution of parasitic eggs depicts maximum cases in the monsoon season (33), followed by post-monsoon (22) and pre-summer (17). The least number of cases were presented in winter (13), followed by summer (14). Rahman *et al*. (2012) reported 74 cases of parasitic diseases in goats. They reported most cases (28) during the rainy season (July-October), followed by 25 during the winter season (November-February) and 23 during the summer season (March-June). Singh *et al*. (2015) reported that the highest seasonal incidence of GIT parasites was in the monsoon season (98.06%) and the lowest in the winter season (91.7%). Amin (2015) reported higher cases of parasitic infection in rainy season

Table 6: Incidence of GIT parasitic infection in goats

Single parasitic eggs	Number	Mixed parasitic eggs	Number
Strongyle	29	Strongyle +Coccidia	18
Cocccidia	16	Moniezia +Strongyle	02
Moniezia	02	Strongyle +Trichuris	02
Trichuris	01	Coccidia +Trichuris	02
Capillaria	01	Strongyle +Fasciola	02

(51.28%), followed by autumn (41.61%), winter (27.98%) and summer (40.37%). Singh *et al*. (2017) findings are partially similar to the present study. They reported maximum cases of parasitic infection in the monsoon (89.04%) followed by summer (71.6%). Singh *et al*. (2015), Jithendran (1998), Pathak and Pal (2008), Singh and Swarnkar (2010) also reported higher incidences of gastro-intestinal parasites during monsoon season. The reason for higher parasitic eggs during the monsoon season is well explained by Singh *et al.* (2017) and Singh *et al*. (2015). They described that monsoon season has favorable climatic conditions such as humidity and temperature to promote parasite growth and development, resulting in a rise in the availability of infective larvae during this season. GIT parasitism in grazing animals is well known to be directly correlated to the presence of larvae on pasture and seasonal pasture contamination. Climatic conditions also uplift larval dispersal on herbage, increasing the likelihood of interaction between host and larvae. A higher prevalence of infection during the monsoon season may also be attributed to adequate salt molarities in the soil, which is a crucial factor for ecdysis. According to Hutchinson *et al*. (1972), cold arrested the development of larvae. During the winter, animals are also partly stall-fed, which decreases the risk of infection. The frequency of grazing is also curtailed during the winter, and pre-parasitic stages also undergo hypobiosis, which leads to low infection during this season.

Sex-wise distribution of parasitic eggs

Sex-wise distribution of parasitic eggs revealed that females (47) acquired more parasitic eggs than males (29). Singh *et al*. (2017) also reported more cases of females as compared to males harbouring parasitic eggs. Sarker *et al*. (2015) and Ali *et al*. (2011) both reported more females than males harbouring parasitic eggs in the ratio 516/293 and 33/22, respectively. According to Mir *et al*. (2013) and Singh *et al*. (2017), the influence of sex on animal susceptibility to infections might be linked to genetic predisposition as well as differential vulnerability due to hormonal regulation. Female animals' physiological differences, which frequently comprise stress factors, lowering their immunity to diseases, and being lactating mothers. Females happen to be weak and malnourished, as a result of which they are more vulnerable to infections, among other reasons.

Hematological profile of goats with GIT parasites

Hematological profile of goats with GIT parasite was available with 42 records. Mean values of hemoglobin and PCV were calculated in affected goats and compared with those of healthy goats. Hemoglobin in affected goats ranged from 2.8 to 13.2 g/dL with a mean of 6.6 ± 0.38 g/dL while the mean of PCV was 22.61 percent (Table 7). In comparison with healthy goats, the values of Hb and PCV were less in affected goats. Ahmad *et al*. (2015) performed hematological parameters of goats affected with GIT parasites and compared them with healthy goats. The mean value of Hb, PCV and TLC were 8.56 ± 1.27, 36.2 ± 1.17 and 9.12 ± 1.31. In the present study, the increase in TLC count is due to an increase in the local immune response by the blood cells and also may be due to the presence of secondary bacterial infection. WBC may also rise due to increased sensitivity to the protein of the parasite, which is foreign to the animal's body (Muhammad, 2009). The rise in neutrophils is produced by the cell's phagocytic activity, which digests parasite particle matter and debris as part of the cell-mediated immune response.

Nervous system cases

Season-wise distribution of nervous system cases

Season-wise distribution of nervous system cases exhibited maximum cases in the monsoon season (29) and minimum cases in pre-summer season (16) as shown in table 3. Sarker *et al*. (2015) recorded maximum cases in rainy season (37%), followed by summer (35%) and winter (27%).

Age-wise distribution of nervous system cases

Nervous system cases were observed to be highest in <1Y (53; 51), followed by 1-3Y (32; 31) and 3–6Y (17; 16%) old group goats (Table 4). Sarker et al. (2015) recorded maximum cases between the age group of <1Y (57%), followed by 1-3 Y (32%) and 3-8 Y (11%) age group of goats.

Sex-wise distribution of nervous system cases

Sex-wise distribution of nervous system cases revealed that out of 104 cases, 63 were females and 41 were males (Table 4). Sarker *et al*. (2015) reported more nervous cases in females (62%) as compared to males (38%).

Distribution of clinical signs associated with nervous diseases

Different clinical signs displayed by goats in different neurological diseases are depicted in table 5. The majority of nervous cases (60) were presented in a recumbent state followed by clinical signs such as stiffness of limbs (18), star grazing posture and circling (16 each), posterior paresis (15), seizures (11), head turn (9), ataxia (6), and head pressing (4). According to Pugh and Baird (2012), nervous diseases are generally presented with opisthotonos, head pressing, aimless wandering, head turn convulsions, coma, etc. usually have a lesion in the cerebrum part of the brain, multiple cranial nerve deficits and loss of mentation in brainstem and if the goat is ataxic, showing hypermetria and wide-base stance, the lesion is preferably present in the cerebellum part of the brain. Nema *et al*. (2014) reported polioencephalomalacia in 22 goats, clinically presented with head pressing, excitability, circling movements, and muscular tremors.

Disease-wise distribution of nervous system cases

A total of 63 cases out of 104 nervous system cases could not be diagnosed. Tentatively, tetanus was diagnosed in 12 cases, followed by PEM (8), toxicity (7), peripheral nerve damage (6), spinal trauma (4), and encephalopathy (4) (Table 5). Mohanambal *et al*. (2017) detected 120 cases of polioencephalomalacia out of 215 goats presented with neurological symptoms. Rehman *et al*. (2012) reported 0.8% of the total 363 cases. Karim *et al*. (2014) reported tetanus in 0.5% of the total 189 cases.

Respiratory system cases

Respiratory disorders are one of the leading causes of huge economic losses in ruminants. Lung affections in these animals impair animal productivity and result in significant losses in animal husbandry.

Season-wise distribution of respiratory cases

Season-wise distribution of respiratory cases revealed that maximum cases were in the monsoon season (31) and minimum cases in pre-summer season (10) as shown in Table 3. Greater number of cases in the monsoon season demonstrates that rainfall and relative humidity have an impact on the prevalence of these disorders.

Rahman *et al*. (2012) investigated 61 cases of respiratory disorder and noted maximum cases (26) in summer (March-June), followed by (21) in rainy (July-October) and (14) in winter season (November-February).

Age-wise distribution of respiratory system cases

Age-wise distribution of respiratory system cases revealed that the majority of the respiratory infections were recorded in goats aged <1 year (36; 37%) followed by 1-3Y (35; 36%) and 3-6Y (19, 20%) old age groups

Table 7: Comparison of Hb and PCV in goats affected with GIT parasites and healthy goats

Parameters (n=68)	Values Mean ± S.E	Normal (n=5) Mean ± S.E
Hb* (g/dL)	6.7 ± 0.32 (2.8-13.2)	9.38 ± 0.7 (7.6-11.4)
PCV* (%)	22.9 ± 0.9 (12-34)	30.6 ±2.0 (25-37)
TLC (Cells/µL)	15821 ± 993.7 (1600-35680)	9091.8 ± 646.5 (8457-11454)
Absolute neutrophils* (Cells/µL)	11469 ± 902 (808.4-31398.4)	4018.7 ± 211.8 (3249.3-4397.6)
Absolute lymphocytes (Cells/µL)	4342 ± 372 (249.7-12540)	5073 ± 540.6 (4059.4-4740.8)

*Significant (P< 0.05)

(Table 4). Sarker *et al.* (2015) reported maximum cases of respiratory diseases in the age group of 1-3 Y (47%), followed by <1Y (36%) and 3-8Y (17%) age groups.

Sex-wise distribution of respiratory system cases

Sex-wise distribution of respiratory system cases depicts that from a total of 97 respiratory cases, 56 cases were of males and 41 cases were of females (Table 4). However, other workers have reported respiratory cases more in females than males. Sarker *et al*. (2015) reported more females (65%) than males (35%) affected with respiratory system diseases. Ali *et al*. (2011) also found more females (156) as compared to males (83) suffering from respiratory diseases.

Disease-wise occurrence of respiratory cases

The total number of cases from the respiratory system was 97. From these 97 cases, the maximum cases reported to the clinics were of pneumonia (48), followed by bronchitis (14), pharyngitis (7), pleuritis (4), pleural effusions (2), and least by rhinitis (1). However, 21 of the respiratory cases could not be properly diagnosed (Table 5).

Emikpe *et al*. (2013) reported that pneumonia is an important cause of mortality in small ruminants in their retrospective study of eleven years. Bell (2008) described that stress (Transportation, concurrent disease, and overcrowding predisposes small ruminants to pneumonia. Respiratory infections in sheep and goats, particularly pneumonia, are caused by the coexistence of several infectious agents under the influence of physical stressors (Rahman and Iyer, 1979; Martin, 1983). Kabir et al. (2010), Rehman *et al*. (2012) and Karim *et al*. (2014) reported pneumonia in 6.96% (8/115), 16.8% (61/363) and 9.5% (18/189) of the total cases, respectively. Mellado et al. (1991) also determined pneumonia being the leading cause of death in their study. Ali *et al*. (2011) recorded 18 cases of pneumonia out of 122 respiratory system cases. Mekibib *et al*. (2019) examined the lungs of 374 goats and found pneumonic changes in lungs of 69 (18.45%) goats.

Clinical signs associated with pneumonia

The clinical signs shown by the animals associated with pneumonia were maximally nasal discharge (32), followed by coughing (27), dyspnea (9), weight loss (6), and sneezing (3) (Table 5).

Abdullah *et al*. (2015) documented a case of pneumonic pasteurellosis in goats showing clinical signs of tachycardia, dyspnea and wt. loss. Samadipoor et al. (2022) recorded 2 goats showing clinical signs of weight loss, coughing, nasal discharge, open mouth breathing, fever and crackling lung sounds on auscultation affected with pneumonic pasteurellosis. In their prevalence study on 60 sheep and 40 goats, Mahmoud *et al*. (2005) also recorded similar clinical signs such as increase in body temperature (104˚F), depression, nasal discharge, loss of appetite and increase in respiration rate.

Lung pattern associated with pneumonia cases

The radiological examination was conducted in 44, out of 48 cases of pneumonia. The interstitial pattern (25) was the most common lung pattern associated with pneumonia cases, followed by nodular (7), bronchial (7), and alveolar pattern (5). Mekibib *et al*. (2019) observed interstitial pneumonia in 19 goats. Radiographic findings of two female goats with respiratory signs depicted an interstitial to alveolar pattern affected with pneumonic pasteurellosis (Samadipoor *et al*., 2022).

Mammary system cases

Diseases associated with udder system

Clinical examination of the mammary gland involves palpation udder for the presence of swelling, pain, inflammation, and finally examination of secretions. Forty-five cases of the mammary system were presented to the clinics, which involved 11 cases of acute mastitis, followed by chronic mastitis (9) and fibrosis (8). Minimum cases were of mammary hypoplasia (1) and thelitis (2) (Table 5). Ameh et al. (1994) reported a case of gangrenous mastitis in a 4-year doe clinically presented with watery milk and cold-to-touch udder. Karim et al. (2014) and Islam *et al*. (2021) recorded mastitis in 2.6% (5/189) and 4.6% (57/1230) cases, respectively.

Clinical signs associated with mastitis

The clinical signs depicted by the mammary gland diseases are shown in table 5. Inflammation (13), flakes (8) and fibrosis (8) were the major manifestations, followed by blood in milk (4) and pus discharge (4), cold to touch (3) and absence of milk in teat (3).

Ameh et al. (1999) investigated 51 goats that had mastitis. Of these 51 cases, 35 (68%) had only half quarter affected. According to Marogna *et al*. (2012), clinical symptoms associated with altered milk could be hemorrhage, pus discharge, clots, or secretion from a single teat.

Infectious diseases

Different infectious diseases in goats

The most common infectious disease of goats reported in clinics was PPR (36), followed by Mastitis (28), Tetanus (12), and contagious ecthyma (5). Islam *et al*. (2021) reported the highest prevalence of PPR cases in their study. Peter *et al*. (2015), in their study during the years 2009-2013, reported maximum cases of Mastitis (8), followed by PPR (8), and Tetanus (7). Karlewad *et al*. (2007) reported that the prevalence rate of PPR in Osmanabadi goats was 58.78%. Singh et al. (2008) analyzed that PPR (34.5%) caused the highest percentage of average losses during the period of 15 years (1991-2005). Noman *et al*. (2011) discovered that PPR was the most common infectious etiology in all goat groups. Karim *et al*. (2014), Rehman *et al*. (2012), Kabir *et al*. (2010) and Islam *et al*. (2021) reported PPR in 5.3% (10/189), 5.2%, 28% and 18.5% (228/1230) of the total cases, respectively. Sarker *et al*. (2015) also reported maximum number of PPR (15%) cases during the period of January 2012 to December 2014. Islam *et al*. (2021) reported the prevalence of contagious ecthyma and tetanus in 1.14% and 1.4% of the total cases in goats, respectively.

Age-wise distribution of PPR cases

Age-wise distribution of PPR cases revealed that maximum number of cases were presented in <1Y age followed by 1–3Y age group of goats. Muheet *et al*. (2020) inspected 81 PPR cases in goats and found 38 cases in <1-year age group, followed by 17 cases in 1–3-year age group and 26 cases in >3-year age group of goats. Noman et al. (2011) detected 123 cases of PPR in <1-year age group and 47 cases in >1-year age group. Kabir *et al*. (2010) reported 33 PPR cases in goats and determined 18 cases in >1-year and 15 cases in <1-year age group of goats. The young animals might be more susceptible to PPR cases because of lack of immunity, undernourishment and poor husbandry practices.

Conclusion

Maximum number of cases were of digestive system, followed by nervous and respiratory. The maximum number of reported cases was from <1 Year, followed by 1-3Y and 3-6Y age groups. Maximum cases to be presented were of females than males. Maximum number of cases were reported in monsoon (July-September) and least in pre-summer (March-April). PPR was the most common infectious disease in goats.

Acknowledgment

The authors are privileged and thankful to the Director of Clinics, GADVASU, Ludhiana, Punjab, India for proving the necessary facilities for conducting this study.

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Received : 18.02.2022
Accepted : 26.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 56-59

Retrospective study on Medical cases in bovines

A. M. Syed[*1], *P. M. Mane*[1], *T.A. Shafi*[2], *M. F. M. F. Siddiqui*[2] *and M. P. Sakhare*[2]

[1]Veterinary Clinical Complex, [2]Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani-431402 (MS)

Abstract

Retrospective study was conducted on bovine medicinal cases presented to the Veterinary Clinical Complex, COVAS, Parbhani, Maharashtra (India) from April 2015 to March 2022 (Seven years period). Out of the total 5457 bovines medicinal cases presented during this period prevalence was highest for anorexia of unknown etiology (20.39%) followed by respiratory system affection (pneumonia) (19.24%), enteritis (17.15%), miscellaneous (fever of unknown etiology, weakness) cases (10.02%), simple indigestion (9.82%), skin diseases (5.07%), tympany (4.34%), mastitis (3.99%), acidic indigestion (3.17%), endoparasite infection (2.47%), alkaline indigestion (2.18%), metabolic diseases (1.19%), snake bite cases (0.42%) and post parturient hemoglobinuria (0.38%) while the least prevalent condition was colic (0.12%). The high prevalence of these conditions may be due to poor management practices, improper health care, stress on pregnant animals, neglect of prophylactic measures for disease prevention and more cases presented to hospital may be due to increased awareness of the hospital location and good services provided by the hospital. Therefore, there is need for awareness and education of livestock farmers/owners on effective prevention and control measures through livestock extension services and proper management system.

Key words: Retrospective Study, Bovine, Medicinal cases.

Livestock is an integrated part of our farming system and plays an important role in the traditional economy. Among the various constraints to cattle, buffaloes and goats production, diseases are the most important which degrade the productivity of these animals (Sarker *et al*., 1999). Disease is an abnormal condition or derangement that affects the normal body functions of an animal. The etiology may be infectious such as virus, bacteria, mycoplasma, parasite, rickettsia, protozoa, and some metabolic disorders caused by inappropriate feeding and poor standard of management. This affects productivity, income and profit of the animal's owner and sometimes death. Ruminant production is seriously hampered by tropical diseases. It increases cost of production by prolonging production time; stunted / reduced growth, reduces the quality and quantity of animal products and generally causes great loss to the farmer (Rabiu *et al*. 2013). It has also been observed that the high prevalence rate of livestock diseases in most developing countries is a major constraint to livestock production. Until the existence of diseases in a particular area is understood, it is difficult to plan systemic health program or formulate effective control strategies.

Retrospective evaluation of clinical case records helps to understand the predominant clinical problems and also their demographic and seasonal distribution in a particular area. Retrospective study of animal diseases is a rapid and cheap means to identify the strategy for effective disease control when analysed properly. Therefore, the objectives of this study were to determine the most prevalent diseases of bovines and to analyse the data of bovine cases presented to the Veterinary Clinical Complex, College of Veterinary and Animal Sciences, MAFSU, Parbhani for effective disease management, prevention and control of the prevalent diseases.

Materials and Methods

The seven years retrospective study on medicinal cases in bovines was conducted at Veterinary Clinical Complex, College of Veterinary and Animal Sciences, Parbhani, Maharashtra (India) from April 2015 to March 2022. The data collected from the clinical case record of VCC, COVAS, Parbhani contains information related to the patients and their owners, and also information such as clinical signs observed, clinical parameter recorded, laboratory investigation conducted, disease diagnosed and treatment instituted. Diagnoses were often made based on history, clinical signs and laboratory analysis. Data gathered were analyzed based on species and disease conditions using simple descriptive statistic.

*Corresponding author: mujeebvet@rediffmail.com

Results and Discussion

The present retrospective study revealed that total 5457 bovine medicinal cases were presented to the Veterinary Clinical Complex, COVAS, Parbhani, Maharashtra (India) from April 2015 to March 2022 (Seven years period). Out of the total 5457 bovines medicinal cases presented during this period prevalence was highest for anorexia of unknown etiology (20.39%) followed by respiratory system affection (pneumonia) (19.24%), enteritis (17.15%), miscellaneous (fever of unknown etiology, weakness) cases (10.02%), simple indigestion (9.82%), skin diseases (5.07%), tympany (4.34%), mastitis (3.99%), acidic indigestion (3.17%), endoparasite infection (2.47%), alkaline indigestion (2.18%), metabolic diseases (1.19%), snake bite cases (0.42%) and post parturient hemoglobinuria (0.38%) while the least prevalent condition was colic (0.12%) (Table 1).

In this study, it is evident that the most predominant general and systemic disorders of bovine were anorexia, fever, weakness, respiratory diseases, gastrointestinal diseases, skin diseases, mastitis, endo-ectoparasitic infestations, metabolic disorders and snake bite that devastate health of bovine ruminants. Therefore, there is need to educate animal owners regarding proper feeding and rearing management practices to be followed that will help in alleviating problems such as anorexia, pneumonia, gastrointestinal (GIT) disorders, mastitis, metabolic disorders and skin problems. Animal owners are unaware about nutrition and feeding of animals which results in GIT problems like tympany, indigestions, colic and enteritis. Respiratory diseases, skin problems and endo-ectoparasitic infestations are result of poor managemental practices, unawareness about parasitic and vector control. Low prevalence of certain disease conditions might be due to their low severity that does not require animals to be presented to the clinics for diagnosis and treatment purpose or due to high transportation charges, instead animal owners use ethno-veterinary medicine to treat their animals at their place.

Parasitism in ruminants in developing countries has been reported as one of the major problems especially where nutrition and sanitation are poor (Odoi *et al*., 2007), although it has been reported as a major health problem in domestic ruminants throughout the world (Swarnakar *et al*., 2015). Helminthoses has been implicated as one among the health problems constraining the well-being and productivity of cattle in terms of decreased growth rate, weight loss, diarrhea, anorexia, gastroenteritis, abdominal distention, emaciation and sometimes anaemia

Table 1: Disease wise Medicinal Cases in Bovine Presented to VCC, COVAS, MAFSU, Parbhani, Maharashtra (India) from 2015-2022

Sr. No.	Disease/ Condition	Total	Percent
1.	Anorexia of unknown origin	1113	20.39
2.	Pneumonia	1050	19.24
3.	Enteritis	936	17.15
4.	Simple Indigestion	536	9.82
5.	Skin Diseases	277	5.07
6.	Tympany	237	4.34
7.	Mastitis	218	3.99
8.	Acidic Indigestion	173	3.17
9.	Endoparasite infection	135	2.47
10.	Alkaline Indigestion	119	2.18
11.	Metabolic Diseases	65	1.19
12.	Snake Bite	23	0.42
13.	PPH	21	0.38
14.	Colic	7	0.12
15.	Miscellaneous	547	10.02
Total		5457	100

(Nahed-Toral *et al*., 2003; Swai *et al*., 2006; Keyyu *et al*., 2005; Hesterberg *et al*., 2007; Ogudo *et al*., 2015). High prevalence of endoparasitism in ruminants has been reported by various researchers around the world (Osakwe and Anyigor, 2007; Ahid *et al*., 2008; Nath *et al*., 2011; Tesfaheywet, 2012; Elele *et al*., 2013; Vanessa *et al*., 2014). Ectoparasitism has also been reported in ruminant animals that has been attributed to environmental conditions, irregular animal movement control, availability of vectors, poor managemental practices, irregular ectoparasite control and possible development of resistance to ectoparasiticides as well as high temperature and sunlight favoring ectoparasitic infestations ((Cunha,2000; Van-den-Broek *et al*., 2003). Haemoparasitism a main cause of red blood cells destruction results in anaemia, jaundice, anorexia, weight loss and infertility, although its effect on cattle production is difficult to quantify (Samdi et al., 2010), has been main attributing factor for losses in traction power, milk and meat production and costs of control programs (ILIR, 1997). Haemoparasites and their vectors (ticks and blood-sucking flies) have worldwide distribution (Okorafor and Nzeako, 2014).

The least prevalent conditions in this study were gastrointestinal conditions (indigestions, colic), snake bite, metabolic diseases and minerals deficiency an finding also reported of Abiola *et al*., (2016) and low prevalence of such conditions might be due to their low severity that does not require animals to be presented to the clinics for diagnosis and treatment purpose or due to high transportation charges, or use of ethno-veterinary medicine to treat their animals at their place (Sandabe *et al*., 2006). Moreover, extension services aimed at disease awareness and better managemental practices for feeding, rearing and housing to the farmers will help in the reduction of occurrence of the diseases in animals.

Conclusions

This retrospective study on bovine medicinal cases highlighted the prevalence of various disease conditions that may be due to poor management practices, improper health care, stress on pregnant animals and neglect of prophylactic measures for disease prevention therefore, there is need for awareness, education of livestock farmers/owners regarding proper feeding, vaccination, deworming, spraying ectoparasiticide, first aid in emergency, record keeping, effective prevention and control measures to be followed that will help in alleviating such problems. The information generated in this study will be valuable for the clinicians, researchers, and academicians for planning and taking necessary action to strengthened veterinary services, accessible, affordable for low-income livestock farmers and to create facility for doorstep services in less accessible areas to reduce losses to farmers and increasing profitability.

Acknowledgement

Authors are grateful to Associate Dean, College of Veterinary and Animal Sciences, Parbhani for granting permission and providing the necessary facilities to carry out retrospective study and publications of data.

Conflict: There is no conflict of interest.

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Received : 23.12.2022
Accepted : 24.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 60-66

Therapeutic efficacy of topical polyherbal preparation of turmeric, aloe vera, sesame oil and calcium hydroxide in subclinical mastitis in crossbred dairy cattle

Mohneet Kaur, Sikh Tejinder Singh, Dhiraj Kumar Gupta, Deepti Narang#*

Department of Veterinary Medicine, # Department of Veterinary Microbiology, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Abstract

Udder health maintenance is an important factor in dairy farming economics and subclinical mastitis is the most prevalent disease. The present study aims at controlling subclinical mastitis in dairy cattle by ethnoveterinary medicine. The study was carried out in 30 HF × Sahiwal crossbred cattle at University dairy form. The animals having SCC more than 2 lakh cells/ ml were selected and randomly divided into two Treatment (n = 20) and Control (n = 10) groups. The Treatment group was treated with topical polyherbal preparation of turmeric powder (50 gms), aloe vera gel (250 gms), sesame oil (10 ml) and calcium hydroxide (5 gms) twice a day for five days. It was applied to the whole udder post milking. The milk culture, SCC and MCMT of quarter milk and SCC, MCMT, phagocytic activity, phagocytic index, milk pH and electrical conductivity, biochemical composition of milk was evaluated at day 0, 7, 14 and 21. The culture of the milk revealed presence of E. coli, *Staphylococcus aureus, Staphylococcus hemolyticus, Staphylococcus chromogens, Streptococcus agalactiae and Streptococcus uberis.* The composite milk SCC and MCMT declined significantly ($p<0.05$) whereas phagocytic activity and phagocytic index increased significantly ($p>0.05$) during different days of treatment in the Treatment group. No such effect was seen in the control group. The quarter milk SCC and MCMT score also decreased in Group I i.e., Infected, treatment. There was no effect of the therapy on the composite milk pH, electrical conductivity and milk composition such as fat, SNF, protein and lactose concentration. Hence, the findings of the present study indicate the therapeutic potential of the polyherbal preparation.

Keywords: cattle, subclinical, mastitis, polyherbal, ethnoveterinary, medicine.

Dairy industry is one of the major contributors to the gross domestic products (GDP) of India that contributes to about 5 percent of the economy. India ranks first in the world in total milk production, and the dairy sector provides direct employment to about 8 crore farmers. Udder health maintenance is an important factor in dairy farming economics. Disorders of the udder results in lower profitability, unplanned culling, poor quality of milk and poor milk hygiene. Mastitis is an endemic disease affecting dairy herds all over the world (Halasa *et al*., 2007). The most common type is the subclinical mastitis that has no visible symptoms and causes insufficient milk production, changes in milk consistency (density), a reduced potential of appropriate milk processing, low protein and a significant risk of milk hygiene because it may include pathogenic organisms. Milk somatic cell count (SCC) values are frequently used to determine quality standards and detect subclinical mastitis. It has been demonstrated that somatic cell count (SCC) in milk is a good indicator of subclinical mastitis (Paape *et al*., 2002). The composite SCC above a threshold value of 200,000 cells/mL has been considered as occurrence of udder infection (Bradley and Green, 2005). The mainstay treatment for mastitis is antibiotic therapy. The cost of antibiotic treatment, antibiotic residues in milk and antimicrobial resistance are important concerns. One strategy to lessen the burden of mastitis is to improve the cow's natural capacity to endure infections. Alternative therapy options for treatment of mastitis includes use of medicinal herbs that function as antibacterial, anti-inflammatory or immune-modulatory substances (Mushtaq *et al*., 2018). Herbal plants are important component of ethno-veterinary medicine (Van der Merwe *et al*., 2001). The EVM is concerned with people's knowledge, skills, techniques, practices, and ideas about managing and keeping their animals healthy, which are learned during practical experience and passed down from generation to generation (McCorkle, 1986). Aloe vera (*Aloe barbadensis miller*) is known to possess anti-inflammatory, astringent, emollient, anti-fungal and anti-viral properties (Bashir *et al*., 2011). It has been reported that aloe vera has antibacterial activity against *Mycobacterium tuberculosis*, *Pseudomonas aeruginosa*,

*Corresponding author: sikhtejindersingh@yahoo.co.in

E. coli, Staphylococcus aureus and *Salmonella typhi* (Djeraba and Quere, 2000). It is known to have healing, soothing and moisturising properties also. Turmeric (*Curcuma longa*) is rich in bioactive chemicals that have anti-inflammatory and antioxidant activities. Curcumin is an anti-inflammatory chemical found in turmeric (Nelson *et al*. 2017). The sesame (*Sesamum indicum*) is a flowering plant belonging to the Sesamum genus and family Pedaliaceae. Sesame oil has been found to help in variety of conditions, including oxidative stress. Sesame oil is used as a solvent in pharmaceutical industry due to its resistance to oxidation (Chang *et al*., 2002). It is a popular ingredient of massage in the ayurvedic medicine. It has antioxidant, anti-inflammatory, and antibacterial properties (Chen *et al*., 2005) (Heidari-Soureshjani *et al*., 2016). Calcium hydroxide is added to the polyherbal preparation to improve their penetration through the skin. It has two significant properties: it inhibits bacterial enzymes, which has an antibacterial impact, and it activates tissue enzymes, such as alkaline phosphatase. When some plants are used together, there is synergistic action of certain pharmacological actions of the active constituents which are not seen when they are used individually (Parasuraman *et al*., 2014). Ethno-veterinary medicine may provide an effective, affordable and farmer and animal friendly prevention and control solution for mastitis.

Materials and Methods

The study was conducted on the crossbred dairy cattle (Holstein Frisian × Sahiwal) maintained at the dairy farm of the Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The animals were kept in a loose barn with head-to-head housing system. They were provided free access to ad-libitum drinking water, seasonal green and concentrate mixture as per the standard recommendations. The animals were milked by using automatic machine milking in the morning and evening. Post milking teat dip with a mixture of povidone iodine and glycerine (4:1) was practiced. Thirty crossbred cattle suffering from subclinical mastitis i.e., having milk somatic cell count more than 2 lakh cells/ ml) were selected for the study. The selected cattle were randomly divided into two groups i.e., Treatment (n=20) and Control (n=10) groups. Treatment group was treated with a topical polyherbal preparation and other group was taken as control. The control group was not given any treatment. The polyherbal preparation comprised of turmeric powder (50 gms), aloe vera gel (250 gms), sesame oil (10 ml) and calcium hydroxide (5 gms). All the ingredients were weighed and mixed uniformly to make a paste. The polyherbal preparation was applied to whole udder post milking twice a day for five days in the Treatment group. It was prepared fresh every time before application.

Composite and quarter milk samples were collected for each animal before treatment (day 0) and on day 7, 14 and 21. Proper cleanliness and dryness of the udder was ensured during sample collection. Composite milk samples (50 ml) were collected in plastic disposable vials and analysed for somatic cell count, MCMT score point, phagocytic activity, phagocytic index, milk pH, milk electrical conductivity and biochemical composition of milk (fat, SNF, protein and lactose concentration). Quarter milk samples (10 ml) were collected in sterilized test tubes and assessed for milk culture, MCMT score point and somatic cell count.

The quarter milk samples were streaked on blood agar plates and incubated aerobically at 37ºC for 18 to 24 hours and examined for presence of any bacterial growth. The individual bacterial colonies were streaked on BHI agar and the organisms were identified using MALDI-TOF MS. Modified California Mastitis Test (MCMT) was conducted and interpreted as per standard method described by Pandit and Mehta (1969). The results were interpreted as no mastitis (0), doubtful (1), positive (2) and strong positive (3) depending upon the degree of gel formation. The analysis of milk samples for SCC was done by using SomaScope Smart, an automatic milk somatic cell counter from DELTA Instruments, BV Kelvinlaan 3, 9207 JB Drachten and results were expressed in $\times 10^3$ cells/ ml of milk. The pH of milk was recorded with the help of digital pH meter Mettler Toledo, Five Easy Plus. The electrical conductivity of milk samples was recorded with the help of Digital Conductivity Meter, CON 700, Eutech instruments and the results were expressed in milli Siemens per cm (mS/cm). The biochemical composition of the milk i.e., fat, SNF, protein and lactose were analyzed by using Milk analyzer Lactoscan LA from Milkotronic Ltd., Bulgaria and the results were expressed in % (w/v). Phagocytic activity of milk neutrophils was done according to the method described by Shafi *et al*. (2013). Mean concentrations of various parameters were calculated and compared between different days in treatment and control groups by using one way analysis of variance (ANOVA).

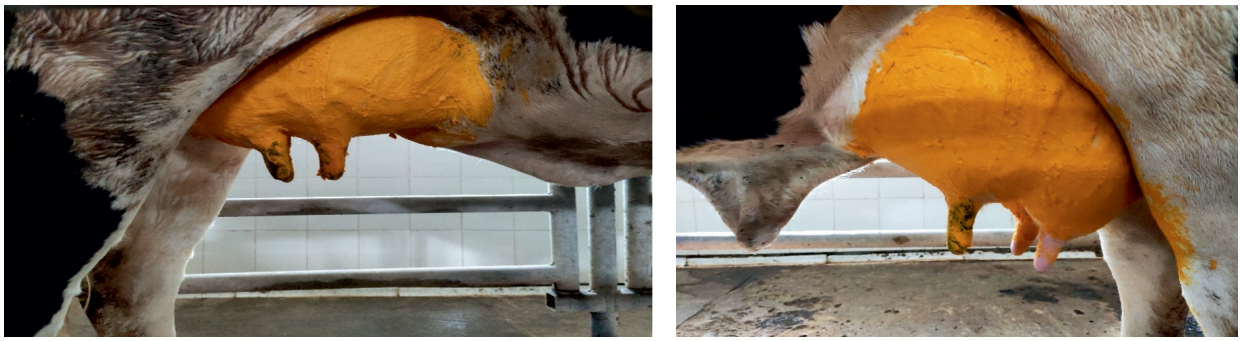

Fig. 1. Application of topical polyherbal preparation on the udder of cattle.

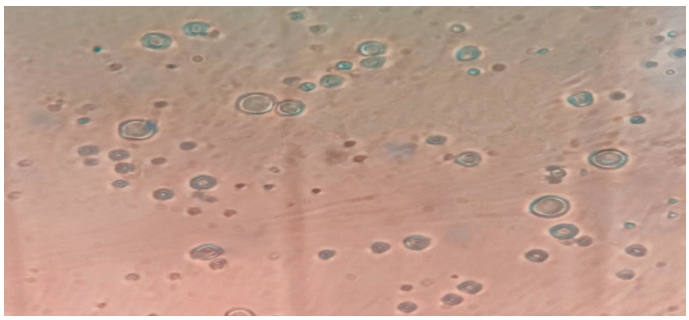

Fig 2. Phagocytic activity of milk leucocytes against C. albicans (40X)

Results and Discussion

Culture and Somatic cell count

The organisms isolated on day 0 in dairy cattle were E. coli, *Staphylococcus aureus, Staphylococcus hemolyticus, Staphylococcus chromogens, Strepreptococcus agalactiae and Streptococcus uberis.* The effects of topical polyherbal preparation application on composite milk somatic cell count in Treatment and Control groups during different days is presented in Table 1. There was significant effect of the treatment on the composite milk somatic cell count ($p<0.05$). No such effect was seen in the control group ($p>0.05$). In Treatment group, the mean somatic cell count of composite milk on day 0 was 576.10±62.30 $\times 10^3$ cells/ml that ranged from 250.00 to 1274.00 $\times 10^3$ cells/ml. It reduced significantly to 268.70±31.02 $\times 10^3$ cells/ml on day 7, 215.10±35.56 $\times 10^3$ cells/ml on day 14, and 251.50±33.88 $\times 10^3$ cells/ml on day 21.

The effects of the topical polyherbal preparation application on the quarter milk somatic cell count are presented in Table 2. Treatment group was further sub-divided into two groups viz. Group 1 (Infected, treatment) and Group II (Non-infected, treatment) on the basis of milk culture. Control group was further sub-divided into two groups viz. Group III (Infected, control) and Group IV (Non-infected, control) on the basis of milk culture. There was significant effect of the therapy in Group I i.e., infected, treatment group ($p<0.05$). The mean quarter milk somatic cell count on day 0 was 587.34±42.65 $\times 10^3$ cells/ml. It decreased to 314.78±54.68 $\times 10^3$ cells/ml on day 7, 302.95±51.64 $\times 10^3$ cells/ml on day 14 and 257.73±46.13 $\times 10^3$ cells/ml on day 21. No significant effect of the therapy ($p>0.05$) was seen in Group II, Group III and Group IV. Similarly, Maramulla *et al*. (2019) observed decrease in milk SCC in 16 affected quarter from 10 animals treated with topical application of paste prepared from *Moringa oleifera* leaves, turmeric powder and common salt. Panigrahi *et al*. (2022) found significant reduction in the SCC in 6 quarters suffering from subclinical mastitis and fed with the polyherbal formulation of *Moringa oleifera, Ocinum sanctum* and *Azadirachta indica* leaves and *Curcuma longa* rhizome @10 mg/kg.

Modified California mastitis test point score

The effects of topical polyherbal preparation application on composite milk modified California mastitis test point score in the Treatment and Control groups is presented in Table 1 There was significant effect of therapy on the composite milk modified MCMT in the Treatment group $p<0.05$); whereas, in the Control

Table 1. Effects of topical polyherbal preparation on composite milk parameters in dairy cattle suffering from subclinical mastitis (Mean±SE).

Parameters	Group	Day				F value
		0	7	14	21	
SCC (×10^3/ ml)	Treatment	576.10±62.30^{a}	268.70±31.02^{b}	268.70±31.02^{b}	251.50±33.88^{bd}	F = 15.371, df = 3 (p<0.05)
	Control	866.70±222.46^{a}	894.00±146.10^{a}	901.80±304.35^{a}	1030.30±250.66^{a}	F = 0.094, df = 3 (p>0.05)
MCMT score point	Treatment	1.60±0.15^{a}	0.70±0.10^{b}	0.70±0.12^{bc}	0.55±0.11^{bd}	F = 14.516, df = 3 (p<0.05)
	Control	1.70±0.26^{a}	1.80±0.20^{a}	1.90±0.27^{a}	1.70±0.21^{a}	F = 0.159, df = 3 (p>0.05)
Phagocytic Activity (%)	Treatment	14.67±0.59^{a}	27.33±1.22^{b}	24.50±0.50^{bc}	22.83±0.79^{cd}	F = 41.976, df = 3 (p<0.05)
	Control	15.67±0.88^{a}	15.00±0.63^{a}	15.17±0.83^{a}	12.33±1.05^{a}	F=3.014, df = 3 (p>0.05)
Phagocytic Index	Treatment	1.10±0.01^{a}	1.30±0.01^{b}	1.27±0.01^{bc}	1.24±0.01^{d}	F = 65.470, df = 3 (p<0.05)
	Control	1.13±0.01^{a}	1.13±0.01^{a}	1.12±0.01^{a}	1.09±0.01^{a}	F=1.542, df = 3 (p>0.05)
Milk pH	Treatment	6.53±0.02^{a}	6.55±0.02^{a}	6.54±0.02^{a}	6.56±0.02^{a}	F = 0.267, df = 3 (p>0.05)
	Control	6.57±0.06^{a}	6.64±0.03^{a}	6.60±0.03^{a}	6.63±0.04^{a}	F = 0.512, df = 3 (p>0.05)
Milk electrical conductivity (mS/cm)	Treatment	4.53±0.06^{a}	4.43±0.06^{a}	4.44±0.05^{a}	4.47±0.05^{a}	F = 0.507, df = 3 (p>0.05)
	Control	4.78±0.16^{a}	4.86±0.16^{a}	4.86±0.20^{a}	4.53±0.17^{a}	F = 0.771, df = 3 (p>0.05)
Milk fat (%)	Treatment	2.13±0.14^{a}	2.18±0.18^{a}	2.20±0.13^{a}	2.29±0.14^{a}	F = 0.201, df = 3 (p>0.05)
	Control	2.43±0.30^{a}	2.36±0.25^{a}	3.04±0.97^{a}	2.82±0.31^{a}	F = 1.183, df = 3 (p>0.05)
Milk SNF (%)	Treatment	9.94±0.08^{a}	9.79±0.08^{a}	9.87±0.06^{a}	9.74±0.11^{a}	F = 1.005, df = 3 (p>0.05)
	Control	9.95±0.15^{a}	9.91±0.17^{a}	9.90±0.21^{a}	9.96±0.21^{a}	F = 0.023, df = 3 (p>0.05)
Milk protein (%)	Treatment	3.63±0.03^{a}	3.58±0.03^{a}	3.61±0.02^{a}	3.56±0.03^{a}	F = 0.813, df = 3 (p>0.05)
	Control	3.62±0.05^{a}	3.64±0.07^{a}	3.61±0.07^{a}	3.63±0.07^{a}	F = 0.035, df = 3 (p>0.05)
Milk lactose (%)	Treatment	5.45±0.04^{a}	5.36±0.04^{a}	5.42±0.04^{a}	5.34±0.06^{a}	F = 1.174, df = 3 (p>0.05)
	Control	5.41±0.08^{a}	5.39±0.08^{a}	5.37±0.12^{a}	5.40±0.12^{a}	F = 0.025, df = 3 (p>0.05)

Values with common superscript (a, b, c) in a row do not differ significantly (p<0.0

Table 2. Effects of topical polyherbal preparation on quarter milk somatic cell count 10^3 cells/ml) in dairy cattle suffering from subclinical mastitis (Mean±SE).

Day	Quarter wise groups			
	Group I (Infected, treatment) (n=41)	Group II (Non-infected, treatment) (n=39)	Group III (Infected, control) (n=24)	Group IV (Non-infected, control) (n=16)
0	587.34±142.65[a]	177.79±52.50[a]	629.50±158.50[a]	565.12±273.25[a]
7	314.78±54.68[b]	84.17±17.65[a]	1042.40±250.43[a]	519.38±128.60[a]
14	302.95±51.64[b]	85.15±20.19[a]	1260.90±401.00[a]	1114.80±482.47[a]
21	257.73±46.13[bd]	117.72±25.44[a]	839.00±203.30[a]	373.06±67.83[a]
F value	F = 3.190, df = 3 (p<0.05)	F = 1.871, df = 3 (p>0.05)	F = 1.012, df = 3 (p>0.05)	F = 1.286, df=3 (p>0.05)

Values with common superscript (a, b, c) in a column do not differ significantly (p<0.05)

group, no significant effect was observed (p>0.05). The mean MCMT score in the Treatment group on day 0 was 1.60±0.15, with the range of 1 to 3 and decreased significantly on day 7 to mean of 0.70±0.10, with the range of 0 to 1. The mean MCMT on day 14 and 21 was 0.70±0.12 and 0.55±0.1, respectively. The effects of the topical polyherbal preparation application on quarter milk modified California mastitis test point score is presented in Table 7. There was significant effect of the treatment in Group I (p<0.05). No significant effect (p>0.05) was observed in any of the other groups viz. Group II, Group III and Group IV. The mean CMT on day 0 was 1.24±0.15 in Group I and reduced to 0.73±0.12 on day 7, 0.68±0.10 on day 14 and 0.65±0.10 on day 21. Similarly, Shafi et al. (2016) showed a significant decline in the CMT score from 1.65±0.17 on day 0 to 0.80±0.28 on day 14, and 0.40±0.23 on day 28 after oral supplementation of O.sanctum leaf powder in twenty crossbred cattle. Tawheed et al. (2018) found significant decline in CMT after treatment with non-antibiotic preparation Masticure. The present findings are also in agreement with Gupta (2010) who reported a significant reduction in CMT and SCC after treatment with oral administration of the herbal powder mix containing O. sanctum and W. somnifera.

Phagocytic activity and Phagocytic index

The effects of topical polyherbal preparation application in Treatment and Control groups on composite milk phagocytic activity and phagocytic index is presented in Table 1. The mean phagocytic activity differed significantly in the Teatment group (p<0.05). However, no such effect was observed in the Control group (p>0.05). The mean phagocytic activity on day 0 was 14.67±0.59% and ranged between 10 to 17%. The highest phagocytic activity with the mean of 27.33±1.22% and range of 22 to 34% was seen on day 7 after therapy in the Treatment group. The phagocytic activity remained elevated with the mean of 24.50±0.50% on day 14 and 22.83±0.79% on

Table 3. Effects of topical polyherbal preparation on quarter milk modified california mastitis test point score (CMT) in dairy cattle suffering from subclinical mastitis (Mean±SE).

Day	Quarter wise groups			
	Group I (Infected, treatment) (n=41)	Group II (Non-infected, treatment) (n=39)	Group III (Infected, control) (n=24)	Group IV (Non-imfected, control) (n=16)
0	1.24±0.15[a]	0.43±0.12[a]	1.29±0.20[a]	1.25±0.19[a]
7	0.73±0.12[b]	0.17±0.07[a]	1.70±0.20[a]	1.18±0.20[a]
14	0.68±0.10[b]	0.20±0.07[a]	1.66±0.19[a]	1.50±0.25[a]
21	0.65±0.10[bd]	0.62±0.10[a]	1.62±0.17[a]	1.25±0.21[a]
F value	F = 4.892, df = 3 (p<0.05)	F = 1.702, df = 3 (p>0.05)	F = 0.945, df = 3 (p>0.05)	F = 0.397, df = 3 (p>0.05)

Values with common superscript (a, b, c) in a column do not differ significantly (p<0.05).

day 21 in Treatment group. There was significant effect of the treatment on composite milk phagocytic index in the Treatment group ($p<0.05$). No such effect was seen in the Control group ($p>0.05$). The mean phagocytic index of composite milk on day 0 was 1.10±0.01 and increased to 1.30±0.01 on day 7. It decreased to 1.27±0.01 on day 14, and 1.24±0.01 on day 21, but still it was a significant change as compared to day 0. Similarly, Shafi *et al*. (2016) found a significant increase in the phagocytic activity at day 7 of oral treatment with O.sanctum leaf powder in twenty crossbred cattle. It increased from 17.10 ± 0.64% on day 0 to 29.10 ± 1.62% on day 7. Phagocytic index was also significantly increased in the animals. Similar to this, Gupta *et al*. 2016 found that oral treatment with Tinospora cordifolia dried stem powder for subclinical mastitis (100 mg/ kg BW) demonstrated a significant increase in the mean phagocytic index and total serum immunoglobulin levels.

pH and electrical conductivity

The effects of topical polyherbal preparation application on composite milk pH and electrical conductivity in Treatment and Control groups is presented in Table 1. There was no significant effect of the treatment on the composite milk pH and electrical conductivity ($p>0.05$) in Treatment and Control groups. No literature was found in this support. On the contrary, Tawheed et al. (2018) reported decrease in milk pH and electrical conductivity in the animals treated with combination therapy of Masticure granules and spray. Gupta (2010) also reported decrease in the pH and electrical conductivity in animals after treatment with oral herbal powder mix of O. sanctum and W. somnifera. Waghmare *et al*. (2013) studied that after application of herbal teat dip post-milking the pH and SCC of milk was significantly ($P < 0.01$) improved in the treated groups and was normalized on 30th day post application. Kolte *et al*. (2008) used a paste of W. somnifera, O. sanctum, *Curcuma amada* and *Asparagus reacemosus* topically in subclinical mastitis in cows and recorded a significant decrease in pH, sodium ions and potassium ions after 10 days of therapy.

Milk composition

The effects of topical polyherbal preparation application on the composite milk composition i.e., milk fat, SNF, lactose and protein concentration in Treatment and Control is presented in Table 1. There was no significant difference in both the groups during different days of treatment on the milk composition. Similarly, Hase *et al*. (2013) found no change in the milk fat concentration after topical treatment with mastilep gel. Panigrahi *et al*. (2022) also reported non-significant changes in milk lactose and milk protein concentration during different observation days of study in the animals fed with polyherbal formulation of *Azadirachta indica*, *Moringa oleifera, Ocimum sanctum* and *Curcuma longa*. On the contrary Tawheed *et al*. (2018) reported significant improvement in milk fat, SNF, protein and lactose concentration in animals treated with combination therapy (Masticure granules and spray) with or without antibiotic.

Conclusions

The findings of the present study indicate the therapeutic potential of topical polyherbal preparation of turmeric, aloe vera, sesame oil and calcium hydroxide in subclinical mastitis in dairy cattle. The effects of the therapy are attributed to the antimicrobial, anti-inflammatory, antioxidant and immunomodulatory properties of the polyherbal ingredients. It is substantiated by decrease in the milk SCC and MCMT score; and increase in the phagocytic activity and phagocytic index of the milk. The alternative ethnoveterinary medicines are cheaper, farmer friendly and easily available. The concerns for antibiotic resistance can also be addressed.

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Received : 15.03.2023
Accepted : 18.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 67-69

Short Communication

Epidemiological observation of Cryptosporidiosis in adult beetal goats: First comprehensive study in Sub-Himalayan region

Burhan Nabi[1], S.R.Upadhyay[1], ShoorVir Singh[2], Shikha Sharma[3], Omer Mohi U Din Sofi[3], Sanober Rasool[4], Sheikh SajadIqbal[1], Raashid Lateef Dar[5], PeerzadaRouf Ahmed[6]*

[1]Division of Veterinary Medicine, [2]Department of Biotechnology, Institute of Applied Sciences & Humanities, GLA University, Mathura, U.P. [3]Division of Veterinary Parasitology, [4]Division of Veterinary and Animal Husbandry Extension, [5]Division of Veterinary Gynaecology and Obstetrics [6]Division of Veterinary Public Health & Epidemiology, F.V.Sc&A.H., SKUAST-J, Jammu, J&K.

Cryptosporidiosis is a highly infectious zoonotic waterborne disease caused by the species Cryptosporidium that poses a public health risk. Sheep and goats are intermediate hosts for Cryptosporidium.Cryptosporidiosis has such a severe impact on the farm economy, owing to high morbidity and, at times, high death of farm animals (Casemore *et al*., 1985).Cryptosporidium sp. is a pathogen that causes gastrointestinal problems in domestic animals (cattle, buffalo, sheep, goat, pig, dog, cat, and horses), birds, fish, amphibians, reptiles, and humans, which is transmitted by faeco-oral route (Fayer *et al*., 2000; Ahamed *et al*., 2015). Infected animals shed a huge number of oocysts (108–109/g), which serve as a contamination reservoir for other animals and humans (Romero-Salas *et al*., 2001).

In India, though cryptosporidiosis has been documented in does and goat kids, but no comprehensive epidemiological investigations incorporating tribal flocks have been described, with the exception of Jammu and Kashmir (J&K). Keeping in view the paucity of information available in India about Cryptosporidium oocyst rise in goats, this study was conducted to know the bio-load of cryptosporidiosis amongst milch breed (Beetal) reared in Jammu region (Sub-Himalayan Region). To our knowledge this is the first large scale comprehensive study conducted in the Jammu Region targeting female beetaldoes; a milch breed reared by socio-economically weaker sections.

Sampling

This epidemiological study was conducted in and around Jammu division of J&K UT in the period of October, 2021 to December, 2021 (winter period) from the goat flock unit; sponsored by Sheep Husbandry Department, J&K (Beetal breed; Fig. 1) of socio-economically weaker sections. A total of 384 faecal samples were collected directly from the rectum with random-effects model from age group 1-2 years, 2.-3 years and > 3 years old does reared in organised and unorganised management pattern which had history of poor and hunted growth over a long period despite being taken for browsing timely and timely dewormed mostly against nematodes and trematodes.

Ethical clearance

The sampling procedures were approved by Faculty of Veterinary and Animal Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India (Institutional Animal Ethics Committee; approval. No: 07/IAEC-20/2021).

Screening of samples for Cryptosporidium spp. Oocysts

Faecal samples of animals were collected directly from the rectum and thick faecal smears were prepared and air-dried. The faecal smears were stained by Acid-Fast staining (Henricksen and Pohlenz, 1981). After air drying the stained smears were observed under 100X magnification using oil immersion.

Identification of Cryptosporidium oocysts

The Cryptosporidium sp. oocysts were identified as bright red spherical bodies against a blue background in the faecal smears, and infection was evaluated as positive or negative depending on the presence or absence of the oocysts(+1 as per OIE, 2008). A sample was considered positive if an oocyst with the right morphology was found.

Using Zeihl-Neelsen technique additional findings of cryptosporidium oocysts (Fig. 2) were identified with overall percentage of 42.9 per cent (165 out of 384) in organized and unorganized goat farms. Out of 165 animals positive for cryptosporidiosis only 10 animals were having diarrhoeic faeces and poor growth of age 1 year, rest of the animals were asymptomatic and all

*Corresponding author: m.ibnnabi@gmail.com

positive animals were reared in unorganised management system.

In organized farms overall percentage of cryptosporidium oocysts in faecal samples was found 35.1 per cent (19 out of 54) and in unorganized farms overall percentage of cryptosporidium oocysts in faecal samples was found 44.2 percent (146 out of 330). Overall age wise percentage of shedders were 28.1 per cent, 14.06 per cent and 0.78 per cent in age group 1-2 years, 2-3 years, >3 years respectively (Fig. 4.21). Age wise percentage of cryptosporidium oocyst shedders in two management systems includes 29.3 per cent and 14.8 per cent unorganized flocks of age group 1-2 years, 2-3 years while as in organized management system percentage shedders include 20.3 per cent, 9.2 per cent and 6 per cent of age group 1-2 years, 2-3 years, >3years respectively.

Cryptosporidiosis is a widespread intestinal protozoan disease in many agro-ecological zones across the world, posing a substantial threat to the global livestock sector. It is the most significant limitation to global livestock production (Akinkuotu and Fagbemi, 2014; Paul *et al*., 2014). Our investigation is in agreement with the findings of Khan *et al*., (2021) who also reported increased over all prevalence of cryptosporidiosis in age group 1-2-year-old group as compared to 2-3 years' group or above. Though in organised group showed increased incidence in >2-year-old group which can be attributed to the differences in hygienic conditions, environmental factors such as heavy rain fall, high relative humidity, high temperature, immune status of animal, feeding and watering management conditions. In our findings the overall prevalence was 42.9 per cent which is in close agreement with Khan *et al*. (2021) who also reported 47.5 per cent prevalence in does.However, the overall prevalence of cryptosporidiosis in India is lower as compared to our findings and but Ahmad (2012) also reported 40.41% prevalence in goats of Jammu region using acid-fast staining technique. The geographical distribution with in one agro-climatic plane can vary as mentioned by Majewska *et al*. (2000) Veracruz has higher prevalence of cryptosporidiosis as compared to found in goats in Spain.In contrary to our findings Utaaker *et al*. (2017) reported very low prevalence of cryptosporidiosis in adult goats in northern region of India. As the Jammu region falls under the intermediate climatic region the difference in the values can be attributed to the difference in the agro-climatic conditions in the region as compared to the study by Utaaker *et al*. (2017), the parasite often survives cold environment conditions as mentioned Fayer *et al*. (2000) and Jenkins *et al*. (2003) who observed that Cryptosporidium oocysts can remain viable and infective for 4–5 months at 5–20^{0}C.However, comparing the prevalence of Cryptosporidium infection in animals between locations should be done with caution because matching for animal traits and raising conditions is difficult.

Cattle, sheep, buffaloes and goats are frequently raised together in Jammu region, and this interaction along with poor hygienic sanitary conditions in the agroecosystems where they are raised might account for transmission of Cryptosporidium infection among animal species. Therefore, apprehensions are needed for

Fig. 1. Picture of Beetal Goat does reared by economic weaker sections in Jammu

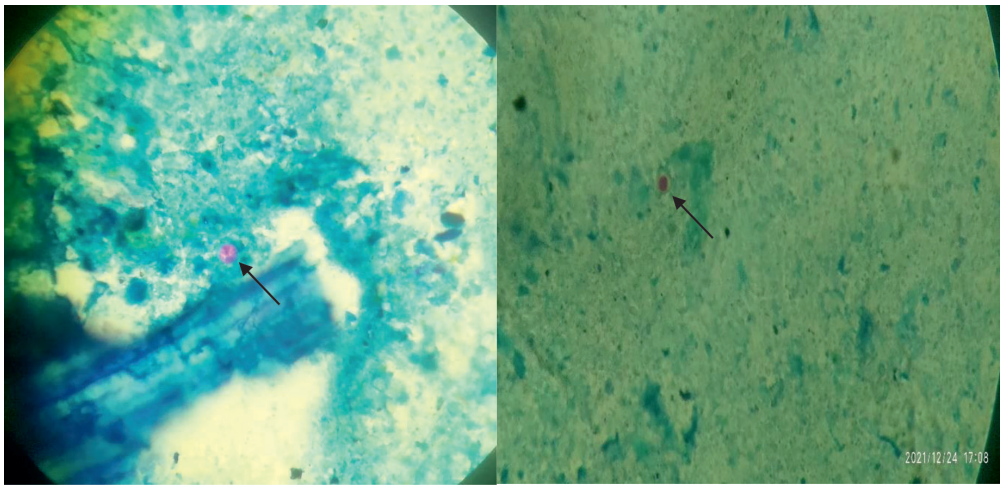

Fig. 2. Picture of Cryptosporidium parasite oocyst in faecal smear of Beetal breed reared in Jammu region

the risk factors of transmission which lead to economic losses as well as reduced welfare of the flock.

The study is the first comprehensive report on Cryptosporidium sp. infection in goats reared by socio-economically weaker sections of Jammu region. Presence of Cryptosporidium sp. infection in goat population not only adversely affects per animal productivity but is also potential threat to other livestock, wild-life and human population. Further work is needed to determine the molecular epidemiology of MAP, risk factors and its impact on livestock of the region and devise preventive measures accordingly.

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Received : 11.01.2023
Accepted : 13.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 70-74

Impact of age on Blood pressure and Electrocardiographic changes in Healthy German shepherd Dogs

K. Kavitha [1,2], D. Umesh [1], K. Mahendran [1], Vivek Joshi[1], C. Alok Kumar[1,3], N.S. Thakur[1], P. Megha [4], A.C. Saxena[5], D.B. Mondal[1], K.R. Harini[6], M. Veena[7], Y.S. Roopa devi[8]*

[1]Division of Medicine, ICAR-Indian Veterinary Research Institute, Izatnagar, UP, [2]Department of Veterinary Clinical Complex, Veterinary College, Hebbal, Bengaluru-560024, KVAFSU, Department of Veterinary Medicine, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura, UP, [4]ICAR-Central Institute for Research on Cattle, Meerut, [5]Division of Veterinary Surgery, Indian Veterinary Research Institute, Izatnagar, 243122, [6] Livestock production and management section, ICAR-Indian Veterinary Research Institute, Izatnagar, UP, [7]Department of Veterinary Parasitology, Veterinary College, Hassan, [8]Department of Veterinary Pathology, Veterinary College, Hebbal, Bengaluru-560024, KVAFSU, India

Ageing is related to a reduction in cardiovascular reserve and adaptability. It is well documented that the frequency of cardiovascular disorders increases with ageing in dogs (Bonagura, 1981; Hamlin, 2005). Age, gender and breed-dependent mortalities are seen in cardiovascular disorders of dogs. In mid of life, cardiac output gradually decreases and can still drop by up to thirty percent in geriatric dogs (Bright *et al*., 1997). Fat deposition and fibrous tissue accumulation may occur in some of the structures of pacemaker system and degenerative changes occur in heart muscle and its conduction system as age advances (O connar *et al*., 2008). Chronic valve disorders are more frequently encountered in aged dogs, which can lead to inadequate pumping and myocardial hypoxia (Detweiler, 1965; Carpenter, 2005). Arrhythmias, conduction abnormalities and the function of the myocardium can all be evaluated with electrocardiography. Due to kidney disorders, hyperthyroidism, hypothyroidism, hyperadrenocorticism, hyperparathyroidism and diabetes mellitus, systemic hypertension is commonly seen as secondary to these disorders in dogs (Mosier, 1989).So screening for these disorders in aged dogs is very important to rule out secondary systemic hypertension, as primary systemic hypertension is less commonly noticed in dogs. Only limited scientific data is available on changes in blood pressure and ECG pattern with ageing. Purpose of the present study is to compare the variation in blood pressure and electrocardiogram (ECG) parameters in healthy German shepherd dogs among various age groups, so that it helps the clinician to know age related changes in Electrocardiography.

*Corresponding author: geturkavitha@gmail.com

Apparently healthy dogs presented for vaccination, deworming and general health check up etc. during year (2019-20) at the Referral Veterinary Polyclinic, ICAR- Indian Veterinary Research Institute, Izatnagar were considered. A thorough clinical examination was carried out in dogs viz, rectal temperature, heart rate, pulse rate, respiratory rate, blood pressure, haematobiochemical estimation, urine analysis, radiography and electrocardiographic examination. The animals were divided into 4 groups (groups 1 to 4), each group having 6 animals (n=6). Groups were based on age in years. Group I consisted of birth to one year, II consisted of 1 to 8 years, III consisted of 8-10 years and IV consisted of >10 years age (Geriatric). All 24 German shepherd dogs included in the study were apparently healthy.

Blood pressure measurement

Blood pressure was measured using BPL multi-parameter monitor ULTIMA PRIME D machine on left forearm region by indirect oscillometric method.

Electrocardiographic examination

In all the dogs ECG was done by using single channel cardiart ® 6108 T BPL ECG machine at paper speed 50 mm/s and sensitivity of 10 mm/mV. For recording of ECG dogs were positioned in right lateral recumbency. Dogs were placed on an insulated table with forelimbs straight and parallel to each other, and hind limbs flexed normally and to avoid direct contact finger is placed in between the two limbs. The ECG machine was placed at body level. Dogs were given sufficient time to acclimatize before recording the ECG. Positive (+ve) and –ve ECG electrodes were placed on the skin at palmer aspect of left and right forelimbs or

just distal to olecranon and at the cranial aspect of right and left hind limb over patellar ligament. Before applying alligator clips areas were properly cleaned and shaved and ECG gel was applied to increase the body contact. During ECG recording precautions were taken to avoid contact of two clips. The amplitude and duration of various complexes were calculated. Leads I, II, and III and augmented unipolar limb leads, Lead aVR, aVL and aVF were recorded. All the measurements of P, Q, R, S, T complexes were studied in lead II electrocardiogram.

Statistical analysis

To study the effect of groups for various parameters, One way ANOVA (analysis of variance) was used. The multiple comparisons between the groups for various parameters were done by using Tukey's test at 5% level of significance. The analysis was done by JMP 9.0 software. Results of the various parameters are expressed as Mean ± SE.

Mean ± S.E. of body weight, heart rate, respiratory rate, systolic blood pressure, diastolic blood pressure (DBP) and mean arterial pressure in various age groups of German shepherd dogs are depicted in Table 1. Heart rate, respiratory rate and blood pressure in various age groups of dog were well within the standard reference range (Detweiler and Erickson, 2004; Reece, 2004). Significant ($P<0.05$) decrease in heart rate was observed in group IV dogs compared to group I dogs, significant ($P<0.05$) decrease in respiratory rate was noticed in groups II, III and IV dogs compared to group I dogs. No significant difference was noticed in systolic blood pressure and mean arterial pressure with ageing in German shepherd dogs. Significant ($P<0.05$) decrease in diastolic blood pressure was noticed in groups III and IV compared to group I. With ageing, stiffening and loss of elasticity will occurs in blood vessels; thereby reducing the effect of vascular recoil in maintaining diastolic blood pressure, therefore causes fall in diastolic blood pressure in geriatric dogs (Meurs *et al*., 2000).

Mean ± SE of P wave amplitude, Q wave amplitude, R wave amplitude, S wave amplitude and T wave amplitude in various age groups of German shepherd dogs were depicted in Table 1. Significant ($P < 0.05$) decrease was noticed in R wave amplitude in groups III and IV as compared to group I dogs of various age groups. Significant ($P < 0.05$) increase was observed in T wave amplitude in group IV compared to groups I, II and III dogs of various age groups of German shepherd

Table 1: Electrocardiographic parameters in different age groups of German shepherd dogs. (Mean ± SE)

Parameters	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group IV (n=6)
Body weight	29.50±3.04^{a}	33.20±0.57^{a}	33.00±0.63^{a}	36.00±1.46^{a}
HR	120.33±3.03^{a}	109.00±4.81^{ab}	100.50±1.46^{bc}	94.00±2.67^{c}
RR	54.33±2.01^{a}	42.67±2.11^{b}	41.67±1.69^{b}	40.67±1.26^{b}
SBP(mmHg)	138.67±2.76^{a}	140.33±2.16^{a}	142.50±2.31^{a}	140.00±2.02^{a}
DBP(mmHg)	84.33±2.08^{a}	82.33±1.76^{ab}	76.67±1.20^{bc}	71.17±1.68^{c}
MAP(mmHg)	104.67±3.02^{a}	103.00±3.61^{a}	97.33±2.91^{a}	94.67±2.58^{a}
P ampl (mV)	0.22±0.017^{a}	0.22±0.017^{a}	0.22±0.031^{a}	0.30±0.026^{a}
Q ampl (mV)	0.38±0.044^{a}	0.35±0.067^{a}	0.45±0.041^{a}	0.37±0.022^{a}
R ampl (mV)	2.02±0.119^{a}	1.92±0.070^{ab}	1.61±0.108^{b}	1.20±0.073^{c}
S ampl (mV)	0.13±0.021^{a}	0.15±0.022^{a}	0.16±0.013^{a}	0.18±0.010^{a}
T ampl (mV)	0.26±0.013^{b}	0.25±0.014^{b}	0.29±0.012^{b}	0.36±0.010^{a}
P dur (s)	0.04±0.000^{a}	0.04±0.003^{a}	0.04±0.003^{a}	0.04±0.000^{a}
QRS dur(s)	0.06±0.003^{a}	0.06±0.001^{a}	0.05±0.003^{ab}	0.04±0.004^{b}
T dur (s)	0.04±0.000^{a}	0.04±0.002^{a}	0.04±0.002^{a}	0.04±0.000^{a}
PR Int (s)	0.09±0.007^{b}	0.12±0.014^{ab}	0.14±0.010^{a}	0.16±0.007^{a}
QT Int (s)	0.16±0.014^{a}	0.19±0.007^{a}	0.18±0.012^{a}	0.22±0.024^{a}
ST Int (s)	0.06±0.016^{a}	0.06±0.010^{a}	0.07±0.008^{a}	0.08±0.007^{a}

'Values within a row, having different superscripts, differ significantly ($P<0.05$) with each other'

dogs. No significant difference was observed in P, Q wave amplitude and S wave amplitude between various age groups.

Mean ± SE of P wave duration, QRS duration, T wave duration, PR interval, QT interval and ST segment in various age groups of German shepherd dogs were depicted in Table 1. Significant ($P < 0.05$) decrease in QRS duration was noticed in in group IV in contrast to group I & II in German shepherd dogs. Significant ($P < 0.05$) increase in PR interval was noticed in group III and IV as compared to group I. No significant difference was observed in P wave duration, T wave duration, QT interval and ST segment between various age groups.

In the present study, in more than 10 year age group, abnormal rhythm noticed are Atrial premature complexes (Fig. 1) and arrhythmia (Fig.3) and abnormal ECG morphology noticed is low QRS voltage complexes. In 8-10 year age group abnormal rhythm noticed is arrhythmia and abnormal ECG morphology noticed are noticed are Q dipping (Fig.2). In 1-8 year age group abnormal ECG morphology noticed are, ST coving and biphasic P wave and in less than one year age group Q dipping was the predominant change in ECG morphology. Changes in cardiac rhythm and morphology are predominant in more than 10 year age and 8-10 year aged animals.

ECG parameters in different age groups of dog were within the normal reference range as reported by authors (Tilley, 1992; Gugjoo *et al*., 2014). However significant changes in R and T wave amplitude, QRS duration, PR interval were noticed with ageing. In the present study significant ($P < 0.05$) decrease was noticed in R wave amplitude and QRS duration in group IV dogs with ageing, one dog in group IV exhibited low QRS voltage complexes. Similar observations were noticed by Spasojevic *et al*. (2017). Ventricular depolarization parameters like QRS duration and amplitude of R wave differed significantly with ageing. Aged dog may exhibit low voltage QRS complexes; this may cause significant decrease in amplitude of R wave with ageing.

In the present study significant ($P < 0.05$) increase in T wave amplitude and PR interval was noticed with ageing. Kumar *et al*. (2003) also made similar observations with ageing P and T wave amplitudes increased, R wave amplitude decreased, where as duration of PQ interval, ST segment and QT interval increased with age. These observations were similar to current findings. Rezakhani *et al*. (1990) reported prolonged PR and QT interval in German shepherd dogs may attributed to slower heart rate in these breeds. Variance to this, non significant changes in P wave amplitude and PR interval was reported in old dog but comparatively higher values in old dogs was observed than young (Spasojevic *et al*., 2017). First degree AV block in geriatric dog may cause prolongation of PR interval. Ageing leads to changes in cardiac electrical characteristics, impulse conduction disturbance increases as age advances.

Atrial premature complexes and arrhythmia were

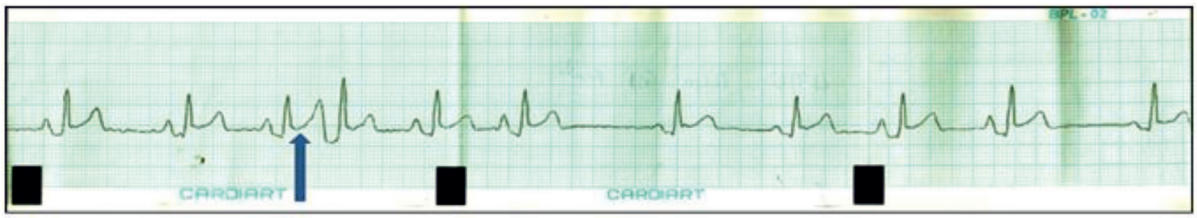

Fig. 1. Electrocardiogram (Lead II) of a 10 year old German shepherd dog showing Atrial premature complexes (Paperspeed : 50 mm /sec, Sensitivity : 1 mV = 1 cm)

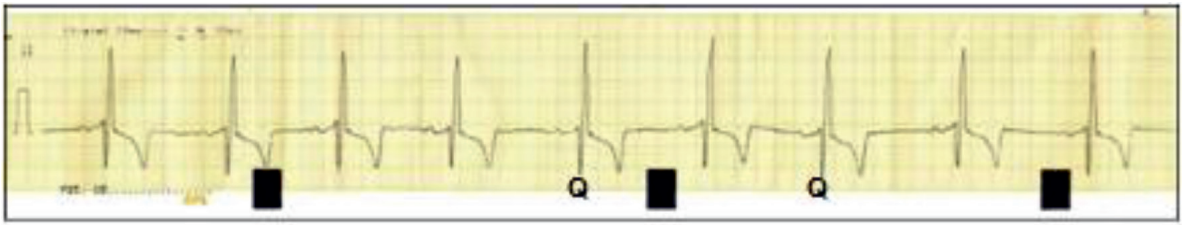

Fig. 2. Electrocardiogram (Lead II) of a 9 year old German shepherd dog showing Q wave dipping. (Paperspeed : 50 mm /sec, Sensitivity : 1 mV = 1 cm)

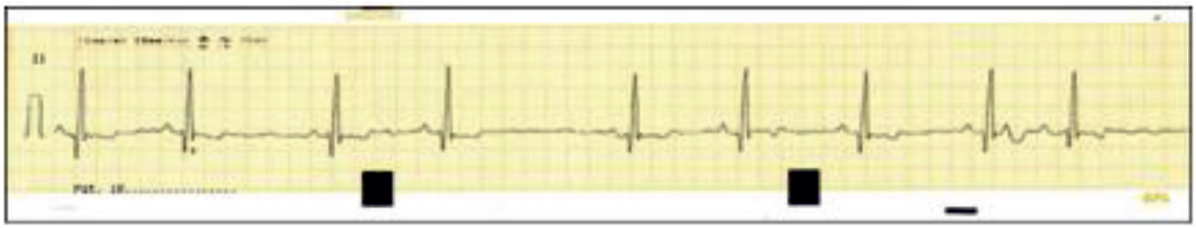

Fig. 3. Electrocardiogram (Lead II) of a 11 year old German shepherd dog showing arrhythmic pattern (Paperspeed : 50 mm / sec, Sensitivity : 1 mV = 1 cm)

predominantly recorded in groups III and IV along with high incidence of low QRS voltage complexes noticed in the same. ST coving and biphasic P wave are noticed group II dogs, one dog exhibited Q dipping in Group I. Spasojevic *et al*. (2017) reported similar findings Sinus arrhythmia, Wandering pacemaker, Sinus bradycardia, Sinus block, Sinus pause, Sinus arrest and AV block 1° in both young and aged healthy German Shepherd dogs. Low R wave amplitudes are also associated with obesity (Deepti *et al*., 2015). Nonspecific electrolyte changes also cause ST segment depression (Cote, 2010).

In veterinary patients, cardiac arrhythmias are often detected. These animals may have cardiac disease, non-cardiac disease, or may be apparently healthy (Boswood, 2001).Sinus tachycardia may be physiological or pathological. Sinus tachycardia occurs at an elevated rate caused by sympathetic predominance over parasympathetic inputs (Cote, 2010). As observed in one study a dog with congestive heart failure may have normal ECG (12 dogs with CHF had normal ECG) and a completely normal animal may have nonspecific ECG abnormalities (Deepti *et al*., 2015). Aged animals have many physiological and pathological disorders as compared to young animals (Paddleford, 1999). In dogs, impulse conduction disturbances increases as they become older this may be the reason for abnormal rhythm and abnormal ECG morphology even in healthy dogs. The structural and functional variations in cardiac pacemaker and its conduction system are related to ageing. With ageing increase in collagen between the tissue cells of AV node and common bundle of His, slow down the intensity of impulse formation and conduction (Schmidlin *et al*., 1992).

From the present study diastolic blood pressure, ECG parameters (amplitudes and duration) are affected by age. Abnormal rhythm and abnormal ECG morphology were also predominant in aged animals. All these findings highlight that age should be taken into account in the assessment of cardiac status by ECG morphology. The observation of the present study can be used for monitoring the cardiac health status among German shepherd breed of dogs.

Acknowledgement

The authors are thankful to Director, Indian Veterinary Research Institute, Izatnagar for providing fund and necessary facilities for the present study.

Conflict of interest

Authors declare there is no conflict of interest

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Received : 13.01.2023
Accepted : 16.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 75-77

Evaluation of the status of trace minerals and immunoglobulin G in calves of Indian zebu cattle suffering from acute undifferentiated diarrhoea

H. Agrawal, A. K. Tripathi, M. Jaiswal, P. N. Panigrahi, A. Sharma and S Dhuriya*
Department of Veterinary Medicine, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura (UP) -281001

Calf diarrhoea due to complex interaction of the environment, infectious agents and the calf itself are the major constraints for raising replacement stock. It has been estimated that 75% of early calf mortality in dairy herds is caused by acute diarrhoea in the pre-weaning period and also, a commonly reported disease in young animal and still a major cause of productivity and economic loss to cattle producers and also a cause of high morbidity and mortality in the cattle industry worldwide (Uhde *et al.,* 2008; Bartels *et al.,* 2010). New-born calves are born aggamaglobulinemic, without any measurable circulating IgG or IgM. The new-born calf acquired passive immunity by absorbing immunoglobulins from colostrum provided within the first hour of life. In the calf, passively acquired immunity is of importance to the calf health for the extended period of time until they are capable of making their own antibodies (Morrill and Tyler, 2012). Trace minerals such as copper and zinc deficiencies, impaired colostral transfer of immunoglobulin is the major reason of this decreased resistance of calves, mainly resulting in perinatal mortality and diarrhea (Enjalbert *et al.,* 2006). Keeping in view the above facts, present investigation was undertaken to evaluate the blood trace mineral and immunoglobulin G status of calf diarrhoea in Indian zebu cattle breeds.

In present investigation, 12 cow calves having acute diarrhoea and 6 healthy calves (healthy control) aged within 0-1months of Indian zebu cattle breeds' *viz.* Sahiwal and Haryana was selected at LFC of DUVASU. Blood samples were collected and serum was harvested from diarrhoeic and healthy calves of both breeds processed and stored at -20°C for estimation. Serum samples were digested by Microwave digestion method as per the standard procedure described (Felipo and Rennan, 2017). Digested serum samples were transferred to a plastic auto sampler tube and diluted with water to 10 ml mixed and centrifuged at 4000 rpm for 5 minute and dilute further fivefold for ICP analysis. The trace minerals namely copper (Cu), zinc (Zn) were analyzed by the inductively coupled plasma optical emission spectroscopy (5800 ICP- OES Agilent, CA, USA) facility at Animal nutrition department, DUVASU Mathura. The wavelength (nm) used were 324.7 for Copper, 213.8 for Zinc. The instrument conditions were 12 l/min plasma gas flow, 0.7 L/min nebulizer gas flow, 1l/min Aux flow and viewing mode was axis at 8 mm height for analysis of the minerals. All the samples were run in triplicate. Standard was 0,0.1,0.2,0.5,1,5 and 10 ppm were prepared with ICP multi element standard solution IV (Merck chemicals, Dermstadt, Germany). From these standards calibrations curve was prepared for various mineral by plotting the absorbance against the concentration. After plotting the calibration curve the concentration of mineral (mg/l) in the sample was calculated automatically by system using ICP expert software. Assessment of serum immunoglobulin IgG in diarrhoeic and healthy calves of Haryana and Sahiwal breed were estimated by using bovine specific quantitative ELISA Kits (Sincere Biotech, Beijing, China). Standard procedure of estimation was followed as provided in kits literature. Curve expert basic version 1.4 software was used to draw standard curve for ELISA. Statistical analysis of all the data to test significance of means was done as per the method described by Snedecor and Cochran (1994).

Calf diarrhoea generally results from complex interaction of the environment, infectious agent and the calf itself. These are the major constraints for raising replacement stock, adversely affecting the current status, longevity in the herd, the productive and reproductive performance of animals (Muktar *et al.,* 2015). Present study was designed to evaluate the blood trace minerals viz zinc, copper and serum immunoglobulin was done to know their status in acute undifferentiated calf diarrhoea

The Mean ±SE value of serum copper concentration was found to be significantly higher in diarrhoeic calves of Haryana and Sahiwal breeds in comparison to healthy calves of respective breeds. There was no any variation observed in serum Copper concentration in healthy and diarrhoeic calves of Sahiwal

*Corresponding author: arvindvet04@rediffmail.com

Table 1: Serum Copper, Zinc (mg/L) and Serum Immunoglobulin G (mg/ml) levels in acute undifferentiated diarrhoeic calves

Group	Serum copper (Cu) concentration (mg/L)	Serum Zinc (Zn) concentration (mg/L)	Serum immunoglobulin G (IgG) level, (mg/mL)
Sahiwal healthy	0.52^{a} ±0.006	4.48^{a} ±0.04	21.52^{a} ± 0.76
Haryana healthy	0.53^{a} ± 0.008	4.35^{a}± 0.07	20.47^{a} ± 0.60
Sahiwal diarrhoeic	0.83^{b} ± 0.004	3.65^{b} ± 0.07	16.11^{b} ± 0.45
Haryana diarrhoeic	0.83^{b}± 0.070	3.48^{b}± 0.08	15.50^{b}± 0.55

Values (Mean ±SE) with different superscript between healthy and diarrhoeic calf differ significantly ($p< 0.05$)

and Haryana breeds (Table 1). The Mean ±SE value of serum zinc concentration were found to be significantly lower in diarrhoeic calves of Haryana and Sahiwal breed in comparison to healthy calves of respective breeds. There was no any variation observed in serum Zinc concentration in healthy and diarrhoeic calves of Sahiwal and Haryana breeds. The Mean ±SE value of serum immunoglobulin (IgG) concentration were found to be significantly lower in diarrhoeic calves of Haryana and Sahiwal breeds in comparison to healthy calves of respective breeds. There was no any variation observed in serum Immunoglobulin (IgG) concentration in healthy and diarrhoeic calves of Sahiwal and Haryana breeds.

Serum Cu concentration in acute undifferentiated diarrhoeic calves was found to be significantly higher while serum Zn concentration was significantly lower in diarrhoeic calves than healthy calves of Haryana and Sahiwal breed. Significantly lower level of copper and zinc in calves with diarrhoea was earlier reported (Gherariu and Kadar, 1979), possibly due to adrenal insufficiency, however findings of present investigation are contrary to the findings earlier reported. The lower serum Zn level in diarrhoeic calves could be due to excessive loss of Zn from gastrointestinal tract during diarrhoea and poor absorption from the gut. These findings of present investigation are in accordance of the findings reported by Ranjan *et al.*(2006). The role of zinc in pathogenesis of gastrointestinal disorder has been thoroughly investigated in human. Copper is an integral part of acute phase protein ceruloplasmin which contains about 95% of circulatory copper and its level rises in acute phase infection. In present investigation the higher level of serum Cu concentration in diarrheic calves might have occurred due to acute phase reactions in the gut mucosa, which might be the reason of increased serum level of copper in diarrhoeic calves in comparison to healthy calves. These findings are in agreement with findings earlier reported (Ranjan *et al.,* 2006). Hypozincaemia and Hypercupremia have been recorded in several infection and inflammatory condition (Conner *et al.,* 1986, Naresh *et al.,* 2001).

The value of serum immunoglobulin (IgG) in acute undifferentiated diarrhoeic calves significantly lower than healthy calves of Haryana and Sahiwal breeds. In present investigation partial failure of passive transfer of immunoglobulins might be the reason that calves may suffered with acute episode of diarrhoea. Low gamma-globulin in diarrhoeic and dehydrated calves had been reported (Thronton *et al.,* 1972). The risk of development of infectious diseases is greater in calves in which there has been failure of passive transfer of maternal immunoglobulins (Gay, 1983). The mechanism by which colostral immunoglobulin protects against these diseases probably depends on the agent and system involved. Successful passive transfer resulting in protective calf serum immunoglobulin concentrations requires formation of high immunoglobulin-concentration colostrum by the dam, and ingestion of adequate colostrum by the calf, and (3) the absorption of immunoglobulin from the gut to the blood by the calf. Failure of passive transfer may occur because of failure at any of these levels (Besser and Gay, 1985). Infectious disease remains the leading cause of morbidity and mortality in neonatal calves. Numerous publications in the past three decades correlated neonatal morbidity and mortality rates with low levels of serum immunoglobulins popularly termed failure of passive transfer of immunoglobulin (PTI) in calves (Wittum and Perino, 1995).

Trace mineral elements such as Cu and Zn have important roles in the health and immunity of peripartal dairy cows and their offsprings as colostrum is the main source of minerals and immunoglobulins which are

essential for the peripartum health of the calf and the levels of trace minerals and collostrum immunoglobulins may enhanced by mineral supplementation to the dam during the transition period (Enjalbert *et al.,* 2006).

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Received : 18.12.2022
Accepted : 15.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 78-82

A prospective study on haemato-biochemical aspects of subclinical ketosis in dairy cows of early lactation on Thrissur district

Anjaly Francis[1], V. R. Ambily[1], Usha Narayana Pillai[1], Deepa Chirayath[2], N. Madhavan Unny[1], and M. Shynu[3]*

[1]Department of Veterinary Clinical Medicine, Ethics and Jurisprudence, [3] Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala Veterinary and Animal Sciences University, Kerala, [2]Veterinary Surgeon, Edappal, Malappuram, Kerala

Frequent monitoring of metabolic disorders during early lactation is very essential for the evaluation of successful management strategies during transition period. Major metabolic disorders associated with improper management practices during transition period includes ketosis, post-partum hypocalcaemia, retention of placenta, metritis, displacement of abomasum, and lameness (Oetzel, 2014). A successful adaptation to the existing negative energy balance is essential for the future production performance of the animal.

Subclinical ketosis (SCK) is described as an increase in beta-hydroxy butyrate (BHB) levels in the blood, plasma, or serum over the normal reference range (1.2 mmol/L), or ketonuria in a cow with no clinical indications (Andersson, 1988), is an important metabolic disorder occur due to the failure of adaptation to the existing negative energy balance. Subclinical ketosis causes severe economic impacts on production and profit in farms as reduction in milk production, prolonged calving interval, huge treatment cost, death or culling of animals. Published data regarding scientific researches on haematological and biochemical implications of SCK among cattle population in Kerala are meagre.

With these considerations present study was conducted with the objective of evaluation of haematological and biochemical parameters of subclinical ketosis affected cattle in Thrissur district of Kerala state.

Multiparous heathy cows in early lactation formed the subject of the research work. The selection of animals was based on the risk period for the occurrence of subclinical ketosis (SCK). Post-partum cows with blood BHB value of ≥ 1.2 mmol/L were considered as positive for SCK (Oetzel, 2004). Cows with blood BHB < 1.2 mmol/L were considered as normal animals. Occurrence of SCK was evaluated on 14th and 28th day. Haematology and serum biochemical analysis were conducted for SCK positive (Group I) and normal multiparous animals (Group II) comprising of 8 cows in each group on both test days.

About 2mL of blood in K-EDTA tube was collected via jugular venipuncture and estimated the following parameters viz. total leucocyte count ($\times10^3$/µL), lymphocytes ($\times10^3$/µL), monocytes ($\times10^3$/µL), granulocytes ($\times10^5$/mm^3), total erythrocyte count ($\times10^6$/µL), haemoglobin (g/dL), volume of packed red cells (VPRC) (per cent), and platelets ($\times10^3$/µL) using an automated haematology analyzer (Orphee, Mythic TM 18 Vet) within half an hour of collection of blood samples.

Blood was drawn into 4 mL capacity m-tube vacutainers coated with clot activator from eight SCK positive and eight normal animals on 14th and 28th day post-partum. Serum was separated from the clotted blood. Sera thus separated were stored at -20^{0}C until further analysis. Biochemical analysis was performed with HOSPITEX DIAGNOSTICS, MASTER T machine. Serum parameters were estimated using commercial kits supplied by SPINREACT company, Spain (Table 1).

Statistical analysis was done using SPSS version 24.0. Haematology and biochemical parameters between diseased and normal animals were compared using independent-t-test for day 14 and 28 post-partum separately. Paired t-test was used to compare parameters between 14th and 28th day for diseased and normal animals.

The mean haematological values of SCK positive (Group I) and normal animals (Group II) on day 14 and 28 post-partum are summarized in the Table 2. Statistical analysis did not reveal any significant difference in TLC between groups and within groups in day 14 and 28. A non-significant increase in TLC was noticed in group I on 14th and 28th day. The mean value of lymphocytes, monocytes and granulocytes in animals of group I were 10.6 ± 3.62, 1.04 ± 0.26 and 4.34 ± 0.91 x 10^3/µL, respectively on 14th day and 9.85 ± 3.37, 0.6 ± 0.10 and 4.14 ± 0.62 x 10^3/µL, respectively on 28th day post-partum. Statistical analysis did not reveal any significant difference between two groups during valuation period

*Corresponding author: ambily.vr@kvasu.ac.in

Table 1 List of biochemical parameters and analytical procedures

Sl.NO	Parameter	Kit	Analytical method	Reference
1	Total protein	SPINREACT	Biuret method	Gomall et al. (1949)
2	Albumin	SPINREACT	Bromocresol green method	Doumas et al. (1971)
3	Aspartate amino transferase	SPINREACT	IFCC method without pyridoxal phosphate	Bergmeyer et al. (1986)
4	Total bilirubin	SPINREACT	Diazo method	Jendrassik and Groff (1938)
5	Creatinine	SPINREACT	Jaffe's method	Fabiny and Ertingshausen (1971)

except for the significant ($p \leq 0.05$) monocytosis in group I on 28th day.

There was no significant difference in mean values of TLC, lymphocytes, monocytes, and granulocytes of diseased animals on test days when compared with normal animals in the present study. Similar results were recorded by Marutsova *et al*. (2015) and Paramesh *et al*. (2020). A non-significant leucocytosis in diseased animals might be due to other periparturient infections like mastitis and metritis in the screened population. A significant increase in mean monocyte count was noted in diseased group on 28th day. Ketotic group had a larger predominance of monocytes than normal animals in the research trial by Mezzetti *et al*. (2019) who reported activation of immune system function in all animals before they became sub clinically ketotic. The value was within the normal physiological limit range (Constable *et al*., 2017).

Total erythrocyte count of SCK animals was within their normal physiological limit (Constable *et al*., 2017). No significant difference was detected in total erythrocyte count of diseased and normal animals on 14th and 28th day post-partum. This is in accordance with the results of previous researches (Paramesh *et al*., 2020; Ali and Hassan, 2021). Statistical analysis revealed a significant reduction of haemoglobin in group I on 14th day (($p \leq 0.05$) and 28th ($p \leq 0.01$) day when compared with group II. Significant reduction ($p \leq 0.05$) was observed in mean haemoglobin value of group I animals on 14th day when compared to 28th day. Ali and Hassan (2021) reported a significant reduction in haemoglobin in cows with subclinical ketosis. Yadav *et al*. (2018) observed a significant reduction in haemoglobin concentration of SCK positive goats. The decrease in haemoglobin concentration might be attributed to oxidative stress associated with negative energy balance in peripartum as suggested by Sahoo *et al*. (2009). No significant difference was noticed in the mean value of VPRC in diseased animals when compared with normal animals on 14th day post-partum. Statistical analysis revealed a significant decrease ($p<0.05$) in mean VPRC value in diseased animals 28th day post-partum.

Mean platelet count of animals of group II were 348.63 ± 47.24 and $366.13 \pm 48.37 \times 10^3/\mu L$ on 14th and 28th day post-partum. Corresponding values of group I were 315.38 ± 69.44 and $374.75 \pm 92.41 \times 10^3/\mu L$. Statistical analysis did not reveal any significant difference in platelet count of SCK positive animals and normal animals in the present study. Similar results were recorded by Paramesh *et al*. (2020) and Marutsova *et al*. (2015).

Mean values of serum biochemical parameters of SCK positive animals (group I) and normal animals (group II) on 14th and 28th day post-partum are presented in Table 3. No significant difference in mean total protein and albumin was observed between groups and within groups on both test days. Contrary to this study, Paramesh *et al*. (2020) observed a significant decrease in total protein levels in affected animals. Protein catabolism might lead to decreased protein levels in SCK positive animals due to an increased rate of gluconeogenesis, which acts as an essential source of energy for the synthesis of milk lactose and milk protein while the animals suffer from a state of negative energy balance.

Mean values of AST in animals of group I were 74.2 ± 4.95 and 76.6 ± 4.46 IU/L, respectively on 14th and 28th day. The corresponding values in animals of group II were 89.34 ± 6.01 and 89.29 ± 7.49 IU/L, respectively. No significant difference was observed between AST values of diseased and normal animals on both 14th and 28th day post-partum in present study. Contrary to this, Paramesh *et al*. (2020) and Mohsin *et al*. (2022) recorded higher AST values in cows with SCK than in normal animals. Excess fat metabolism and subsequent deposition of fat globules in the hepatocyte, as well as leakage of enzyme in the blood circulation and fat buildup in the liver, might contributed to excessive

hepatocyte membrane permeability in post-parturient animals and therefore increase in AST values could be used as a tool for diagnosis of metabolic liver diseases. In the SCK group, AST levels spiked in the first week after calving and then remained reasonably steady over the next three weeks. Then it rose to its highest point in the fifth week post-partum, dropped drastically in the sixth week, and then rose rapidly again in the seventh week (Mohsin *et al*., 2022). The variation observed in the present study might be due to the variation in sampling time, as sampling was done only in the 2nd and 4th weeks post-partum. The mean total bilirubin of group I (0.31 ± 0.05) was significantly lower ($p \leq 0.05$) than group II (0.47 ± 0.05 mg/dL) on 14th day post-partum, but both the values were within the normal range. No significant difference noted in mean total bilirubin value of animals in group I (0.37 ± 0.04) and group II (0.32 ± 0.08 mg/dL) on day 28 post-partum. The mean value of total bilirubin of diseased animals was significantly lower ($p \leq 0.05$) than normal animals on 14th day post-partum, but within the

Table 2. Mean values of haematological parameters of animals of group I and group II on day 14 and 28 post-partum

Parameter	Test day	Group I	Group II	t-value	p-value
Total leucocyte count (10^3/µL)	14	16.01 ± 4.71	7.36 ± 0.45	1.829	0.109
	28	15.23 ± 4.26	7.63 ± 0.32	1.78	0.118
	t-value (p-value)	1.003 (0.349)	0.788 (0.457)		
LYM (10^3/µL)	14	10.6 ± 3.62	4.33 ± 0.69	1.701	0.130
	28	9.85 ± 3.37	4.34 ± 0.65	1.606	0.149
	t-value (p-value)	1.431 (0.195)	0.054 (0.959)		
MON (10^3/µL)	14	1.04 ± 0.26	0.54 ± 0.06	1.895	0.096
	28	0.60 ± 0.10	0.33 ± 0.04	2.543*	0.023
	t-value (p-value)	2.088 (0.075)	2.862 (0.024)		
GRA (10^3/µL)	14	4.34 ± 0.91	2.94 ± 0.32	1.451	0.182
	28	4.14 ± 0.62	2.94 ± 0.24	1.802	0.105
	t-value (p-value)	0.382 (0.714)	0^{ns} (1.0)		
RBC (10^6/**µL**)	14	5.91 ± 0.32	5.9 ± 0.35	0.029	0.977
	28	6.18 ± 0.33	6.36 ± 0.33	0.380	0.710
	t-value (p-value)	1.119 (0.300)	3.158 (0.016)		
Hb (g/dL)	14	7.09 ± 0.20	8.18 ± 0.36	2.657*	0.019
	28	7.59 ± 0.13	8.53 ± 0.27	3.075**	0.008
	t-value (p-value)	3.282* (0.013)	2.297 (0.055)		
VPRC (%)	14	27.49 ± 1.04	29.95 ± 1.19	1.558	0.141
	28	28.91 ± 0.73	31.9 ± 0.71	2.927*	0.011
	p-value	1.479 (0.183)	2.867* (0.024)		
PLT (10^3/µL)	14	315.38 ± 69.44	348.63 ± 47.24	0.396	0.698
	28	374.75 ± 92.41	366.13 ± 48.37	0.083	0.935
	t-value (p-value)	1.554 (0.164)	0.606 (0.563)		

Group I – SCK positive, Group II – Normal animals

** significant at 0.01 level, * Significant at 0.05 level

Table 3. Mean serum biochemical parameters of animals of group I and group II on day 14 and 28 post-partum

Parameter	Test day	Group I	Group II	t-value	p-value
Total protein (g/dL)	14	7.88 ± 0.14	7.76 ± 0.19	0.532	0.603
	28	7.88 ± 0.24	7.47 ± 0.14	1.475	0.162
	t-value (p-value)	0.037 (0.972)	1.431 (0.196)		
Albumin (g/dL)	14	3.59 ± 0.09	3.67 ± 0.1	0.597	0.560
	28	3.64 ± 0.07	3.52 ± 0.05	1.396	0.185
	t-value (p-value)	0.697 (0.508)	2.171 (0.067)		
AST (IU/L)	14	74.2 ± 4.95	89.34 ± 6.01	1.945	0.072
	28	76.6 ± 4.46	89.29 ± 7.49	1.456^{ns}	0.167
	p-value	0.420 (0.687)	0.005 (0.996)		
Bilirubin (mg/dL)	14	0.31 ± 0.05	0.47 ± 0.05	2.288*	0.038
	28	0.37 ± 0.04	0.32 ± 0.08	0.655	0.555
	p-value	1.432 (0.195)	1.516 (0.173)		
Creatinine (mg/dL)	14	1.16 ± 0.07	0.98 ± 0.03	2.232*	0.042
	28	1.01 ± 0.07	0.99 ± 0.04	0.537	0.599
	p-value	1.990 (0.087)	0.051 (0.961)		

Group I – SCK positive, Group II – Normal animals

* Significant at 0.05 level

normal physiological range. During the first seven weeks post-partum period, no significant variations were noted in total bilirubin between the SCK and normal healthy groups (Mohsin *et al*., 2022).

Mean creatinine value of diseased animals on 14th day was significantly higher ($p<0.05$) than normal animals, but values were in normal physiological range. No significant difference noticed on 28th day. This is in agreement with findings of Mezzetti *et al*. (2019) and Antanaitis *et al*. (2019). Mann *et al*. (2018) reported a significant decrease in creatinine value of animals positive for SCK after different treatment protocols. The increase in serum creatinine in diseased animals might be due to moderate dehydration status in ketotic animals as opined by Issi *et al*. (2016). Contrary to this finding, a marked reduction was observed in previous studies. The obvious post-partum decline in creatinine in ketotic cows confirmed that these cows were mobilising higher quantities of tissue protein than normal animals, implying that these cows were in negative protein balance post-partum (Rodriguez-Jimenez *et al*., 2017).

Haematological parameters of diseased animals were normal except for a significant reduction in haemoglobin value on both test days. No significant variations were recorded in biochemical parameters of diseased and normal animals except for a significant reduction in total bilirubin value and a significant increase in serum creatinine value in diseased animals. But these values were in normal physiological range.

Acknowledgments

The authors are thankful to Kerala Veterinary and animal sciences university for all the facilities provided.

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Received : 13.01.2023
Accepted : 17.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 83-85

Symmetric Dimethyl Arginine: A Prognostic Marker in Early Diagnosis of Canine Chronic Kidney Disease

Chaitanya Yalavarthi, N.Lakshmi Rani, V.Vaikunta Rao, P.Ravi Kumar, Makkena Sreenu*
Department of Veterinary Clinical Complex, NTR College of Veterinary Science, Gannavaram, Sri Venkateswara Veterinary University (SVVU), Tirupati-517502 (AP), India.

Kidney diseases are most common clinical problems, occurring in dogs (Katoch *et al*., 2018) and considered as the third leading cause of death. Indiscriminate use of certain antimicrobial, non-steroidal, anti-inflammatory or analgesics and anti-neoplastic drugs have been reported to cause renal damage in dogs (Legatti *et al.*, 2018). The emergence of several infectious (*Ehrlichia canis, Babesia gibsoni, Leptospira*,etc.) and metabolic diseases (diabetes) have further aggravated the incidence rate of renal disorders among dogs in India. Early diagnosis of kidney diseases is essential to stabilise renal function and prevent the rapid progression of the disease. In general, the markers of renal disease recognized from haematological and serum biochemical evaluations, urinalysis, or imaging or pathology studies (Polzin, 2011) have low sensitivity and specificity in the early stages which limit their use in screening of renal diseases. Biomarkers that are capable of early detection, risk stratification and prognostication such as SDMA would represent a tremendous focus (Hall *et al*., 2016). Symmetric dimethyl arginine (SDMA) is primarily removed from the body by the kidneys, and unlike creatinine it is not influenced by muscle mass, age and breed (Yerramilli *et al.,* 2016). The key to successful management of patients with renal disease lies in the early detection of varied etiology and initiate aggressive therapy. Timely intervention and systematic approach will slow down the progress of disease process in kidneys. Therefore, the present study was conducted for early detection of chronic kidney disease in dogs with SDMA biomarker and to see its association with other serum biochemical parameters.

In the present study, a total of 9,347 dogs of different breeds, age groups of either sex were screened for kidney diseases. A total of 103 dogs were selected based on history, clinical signs and diagnosis of CKD was confirmation by estimation of SDMA. The study also included apparently healthy dogs (n=10) as control. Apart from imaging studies, quantitative estimation of canine symmetric dimethyl arginine (SDMA) was done using sandwich ELISA method as described by manufacturer using the kits supplied by M/s. Bioassay Technology Laboratory, Shanghai and expressed in µg/dL. The other serum biochemical parameters estimated using assay kits and standard procedures were BUN, creatinine, total protein, albumin, globulin, ALT and ALP. The dogs with CKD were categorized into 4 stages based on SDMA, viz., stage I, II, III and IV according to IRIS guidelines. The data was subjected to statistical analysis by using SPSS (SPSS 20.0, Chicago, IL, USA). Tukey's multiple comparison post hoc test was also used to find the differences between groups. All the data was presented as Mean±SE and $P < 0.05$ was considered significant (Snedecor and Cochran, 1994).

In the present study, the means ± SEs of SDMA in dogs with stage I, II, III and IV CKD were 16.59±0.53 µg/dL, 25.07±1.30 µg/dL, 46.89±1.09 µg/dL and 87.51±3.11 µg/dL, respectively and these were compared with other biochemical parameters in healthy dogs and dogs with CKD (Table 1).

Majority of the dogs (44.67 %) in the current study were found to be in stage IV and their values range from 54-146 mg/dL with Mean± SE as 87.51±3.11mg/dL. These findings were in agreement with those of Sharma *et al*. (2015), who graded affected dogs into different stages and recorded that majority of the dogs were in stage III and IV. It is evident from this study that the mean serum creatinine level in stage I of CKD dogs was 0.84 ± 0.07 mg/dl, in stage II 1.83±0.09, in stage III 2.85±0.15 and in stage IV 8.93 ± 0.51mg/dL. Though serum SDMA was above 14 µg/ dL, serum creatinine was below 1.4 mg/dL in 13 dogs of CKD stage I and 3 dogs of stage II (Table 1), which was in agreement with Yerramilli *et al.* (2016) who reported creatinine as insensitive for the detection of early renal disorders and also opined that SDMA was more sensitive biomarker for early detection of renal dysfunction even in non-azotemic dogs that are not influenced by muscle mass, age and breed (Hall *et al.*, 2016). SDMA, a new biomarker for the early detection of

*Corresponding author: chaitanya.yalavarthi@gmail.com.

Table 1: Serum biochemical parameter in healthy and dogs with different stages of CKD (Mean± SE)

Sr. No	Parameter	Healthy (n=10)	CKD-I (n=17)	CKD-II (n=15)	CKD-III (n=25)	CKD-IV (n=46)
1.	SDMA (µg/dL)	9.12± 0.89^{a}	16.59±0.53^{b}	25.07±1.30^{c}	46.89±1.09^{d}	87.51±3.11^{e}
2.	Creatinine (mg/dL)	0.69±0.10^{a}	0.84±0.07^{a}	1.83±0.09^{b}	2.85±0.15^{c}	8.93±0.51^{e}
2.	Blood Urea Nitrogen (mg/dL)	16.36±1.07^{a}	14.9±0.39^{a}	37.76±3.75^{ab}	55.87±6.01^{b}	127.25±16.4^{d}
3.	Total Protein(g/dL)	7.83±0.66^{d}	6.49±0.29^{d}	6.93±0.33^{cd}	5.60±0.28^{a}	5.54±0.23^{a}
4.	Albumin (g/dL)	3.25±0.07^{c}	2.86±0.04^{b}	2.85±0.30^{b}	2.54±0.24^{a}	3.11±0.12^{c}
5.	Globulin(g/dl)	3.71±0.68^{d}	3.73±0.31^{d}	4.08±0.28^{d}	3.06±0.19^{b}	2.43±0.21^{a}
6.	A/G ratio	0.87±0.23^{a}	1.32±0.07^{a}	0.79±0.13^{a}	0.97±0.12^{a}	1.27±0.87^{b}
7.	Alanine amino-transferase (U/L)	17.81±3.92^{a}	19.24±0.28^{a}	22.63±3.69^{a}	30.18±3.35^{b}	27.98±1.49^{b}
8.	Alkaline phosphatise (U/L)	48.37±5.77^{a}	51.88±0.77^{a}	61.28±8.38^{ab}	87.22±7.91^{b}	145.52±20.3^{c}

Means bearing different superscripts within a row differed significantly (P<0.05)

kidney dysfunction, is an endogenous methylated form of the arginine that is released into circulation during normal protein catabolism. Dahlem *et al.* (2017) stated that SDMA is excreted by the kidneys into urine in an unchanged form and hence, this metabolite accumulates in the course of renal dysfunction, which increases earlier than serum creatinine in animals with progressing kidney dysfunction. Pelander *et al.* (2015) also stated that SDMA estimation in addition to creatinine might improve the diagnostic value and avoid false positives as with estimation of serum creatinine alone which was in agreement with present study.

Significant elevation of BUN and creatinine values in dogs with CKD were recorded in this study similar to earlier observations (Sonu *et al*., 2019). Elevated levels of creatinine and blood urea nitrogen could be due to diminished renal excretion and enhanced tubular absorption of urea which would be elevated only when there was loss of up to 75 % of functional renal mass, whereas SDMA would be elevated even with loss of 10 % functional nephrons (Dahlem *et al.*, 2017).

Significantly lower (P<0.05) mean values of serum total protein (g/dL) were recorded in dogs with chronic kidney disease stage III (5.60±0.28) and stage IV (5.54±0.23) as compared to Stage II, I and healthy control group. Similar was the trend for globulin and inverse trend for A/G ration in dogs with CKD (Table 1). These findings were in accordance with the reports of Kandula and Karlapudi (2015), who opined that hypoproteinemia might be due to gastrointestinal bleeding and proteinuria.

Significant elevation of alanine amino transferase and alkaline phosphatase in CKD stage III and IV was recorded in the present study. Elevated alkaline phosphatase in CKD might be due to secondary renal hyperparathyroidism and was associated with increased mortality (Beddhu *et al.*, 2009).

Although novel markers like SDMA provide exciting clues into the pathophysiology of diseases and enable us to improve diagnostic capabilities, the high cost involved is still prohibitive for widespread clinical application.

Our study demonstrated that SDMA is a sensitive biomarker in early detection of kidney diseases, which further helps in slowing down the progression of disease.

Acknowledgement

Authors thank Dr. Metta Sudhakar for the statistical analysis and Sri Venkateswara Veterinary University, Andhra Pradesh, India for the support.

Conflict of Interest: None.

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Received : 15.12.2022
Accepted : 24.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 86-88

Clinical Articles

Successful therapeutic management of acute organophosphate poisoning in horse: A case report

Shubhasini Dhuriya, Arpan Chauhan, Shveta Singh, Manu Jaiswal, A.K. Tripathi*

Department of Veterinary Medicine, CVSc & AH, Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalayevam Go Anusandhan Sansthan (DUVASU), Mathura- 281001 (UP)

Abstract

A four years old male horse was presented to the TVCC, DUVASU Mathura, suffering from acute insecticide (organophosphate) poisoning from one-day. According to the owner, the horse was accidentally exposed and grazed on field where organophosphate insecticide was used on that day and consumes a lot of fodder. Acute clinical signs develop after 4-5 hours of grass ingestion. Clinical manifestations observed as fever, salivation, nasal discharge with respiratory distress and restlessness. Based on history and clinical signs, the case was diagnosed as organophosphate poisoning and immediately treated with inj. Atropine @0.04mg/ kg b.w. IV, inj. Flunixin Meglumine @1.1mg /kg b.w. IV for three days, Charcoal@300ml orally, inj. Ampiciilin&Cloxacillin @10mg/ kg b. w. IM, inj. Tribivet @15 ml IM, inj. Furosemide (RIDEMA)@10 ml IM, and aggressive fluid therapy including RL and DNS @40ml/kg BW for three days. The animal was continuously monitored on the 3rd, 7th, and 15th days after treatment with successful recovery. The horse was in healthy appearance after one month of follow up schedule with regular intake of food and water.

Key word: Horse, Insecticide, Poisoning, Atropine

Organophosphate (OP) compounds are widely used in agriculture to control pests, weeds, or plant diseases and many of these products are highly hazardous and lack species selectivity (Sumathi *et al.,* 2014). In equines poisoning occur through ingestion of toxic forage, baits, pesticides, improperly stored grain and hay, drugs, and medications given in an overdose or by an improper route, barn, and stable cleaning compounds, paint, and other toxic substances. Symptoms are lack of coordination, hyper excitability, tremors, seizures, respiratory depression, and collapse. Death may occur in a very short period if the symptoms are not recognized and prompt first aid treatment initiated. Consumption of contaminated feed (mistaken addition of insecticide to feeds or recently treated crop) or access to incorrectly stored insecticides is the most common causes of poisoning in horses (Nagy et al., 2019).

Case History and Observations

A four year old male horse was presented to the TVCC, DUVASU Mathura, suffering from acute insecticide (organophosphate) poisoning since one-day. According to the owner, the horse was accidentally exposed and grazed on field where insecticide was used on the day and consumes a lot of fodder. Clinical signs develop after 4-5 hours of grass ingestion. On clinical examination fever (103^0F), frothy nasal discharge (slightly yellowish in colour) respiratory distress with abnormal sound, salivation, lacrimation and restlessness was found with mild degree colic signs.

Based on history and clinical examination findings, the case was diagnosed as organophosphate poisoning and immediately treated with antidote with some supportive medications. Therapy started with inj. Atropine @ 0.04mg/kg b.w. IV, inj. Flunixin meglumine @1.1mg /kg b.w. IV for three days, Charcoal (kaolin) @300ml orally, inj. Ampiciilin &Cloxacillin @10mg/ kg b. w. IM, inj. Tribivet @15 ml IM, inj. Furosemide (RIDEMA)@10 ml IM, and aggressive fluid therapy including RL and DNS @40ml/kg BW for three days. The animal was continuously monitored on the 3rd, 7th, and 15th day post treatment. Animal was clinically recovered from all symptoms of poisoning related to respiratory, gastrointestinal and mainly. Normal intake of feed, defecation and urination was also recorded. After fifteen days of follow-up schedule, animal was surviving healthy life.

The following images show the clinical symptoms of poisoning at 0^{th} day (pretreatment and 3^{rd} day (post treatment) of therapy.

*Corresponding author: dhuriyashubhasini10@gmail.com

Pre - treatment (on 0th day)

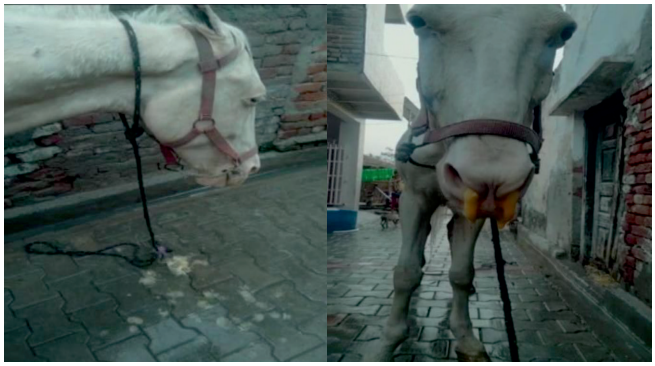

Fig. 1. Frothy nasal discharge with excessive salivation and increase respiration rate due to acute poisoning

Post - treatment (on 3th day)

Fig. 2. Normal respiration pattern without any discharge after three days of therapy

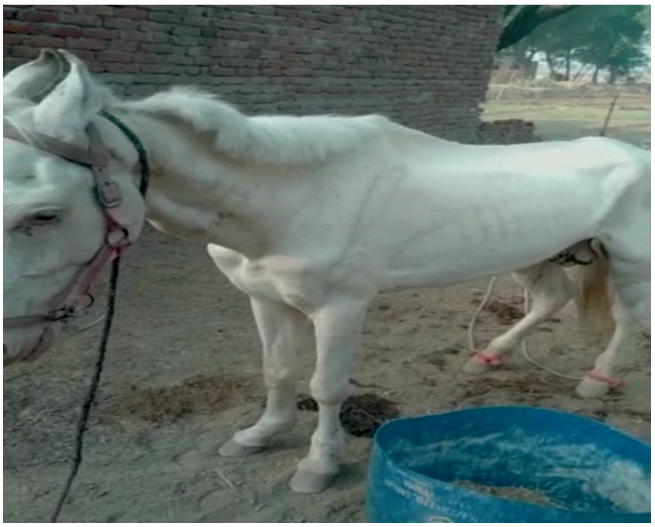

Fig. 3. Horse clinically recovered from all symptoms of poisoning and having normal respiration rate, feed intake, urination and defecation after seven days of therapy.

Discussion

On the basis of present case history, horse severally expresses the sign and symptom of organophosphate toxicity and completely recovered 3 days of post therapy. All physiological parameters comes to normal in healthy state. Atropine given as antidote of organophosphate toxicity. A compound that extensively used in agriculture and industry for controlling pests of crops. Organophosphate compounds bind irreversibly to acetyl cholinesterase in the plasma, Red cell, and cholinergic synapses in CNS and PNS and symptoms produced due to activation of excessive muscarinic receptor. Reduced cell or plasma cholinesterase activity indicates OP exposure. AChE activity, less than 50% indicates exposure to one of these insecticides, and less than 25% of normal indicates toxicities from one of these insecticides (Fukuto,1990). Organophosphate compounds inhibit AChE via covalent binding to the serine hydroxyl group in the enzyme active site. This blockage results in the accumulation of the NTs acetylcholine in the synaptic cleft, which in turn leads to saturation of cholinergic receptors and an inability to control the muscles involved in breathing, leading to asphyxiation, paralysis, and eventually death (Katz *et al*., 2018). Atropine is a drug of choice because it acts on central and peripheral cholinergic receptors. Acute clinical signs produce due to muscarinic, nicotinic, and central receptor effects. Muscarinic cholinergic stimulation result as the "SLUD" signs (increased salivation, lacrimation, urination, and defecation) and bronchorrhea.

Nicotinic and acute central symptoms include muscle weakness contributing to respiratory distress, confusion, and convulsions, further compromising the airway, and increasing aspiration risk causing hypoxia. Symptoms occur early in OP poisoning, which can be rapidly reversed by atropine therapy because it slows down intestinal transit time and prolongs OP toxicity. Persistence of the Organophosphate in the Gut lumen observes after 10day poisoning (Martinez Chuecos *et al.,* 1992). Each compound also has unique characteristics and outcomes (Eddleston *et al.,* 2005). Pralidoxime chloride (2-PAM) is the true antidote that regenerates AChE. It controls the nicotinic signs and works best when combined with atropine treatment. So Clinical presentation and severity of poisoning depends not only on the toxicological and toxicokinetic properties of the poison, but also on the quantum of poison, the route of exposure, co-ingestions, and patient characteristics.

An accurate diagnosis of poisoning requires a systematic approach, beginning with a comprehensive history, followed by clinical examination of affected horses, clinical pathologic testing, postmortem examinations, and analytical toxicology testing (Wickstrom and Blakley, 2002).

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Received : 13.12.2022
Accepted : 16.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 89-90

Management of Ant Chalk Poisoning in a Puppy

Kavin Ravikumar[1], Gowtham Raja Murugan[2], Pradeep Sidder[3], Kavin Thangaraj[4]*

[1]Veterinary Dispensary, Devakottai, Sivagangai, [2]Veterinary Dispensary, Kanniappampillaipatti, Theni, [3]Veterinary Dispensary, Kilasevalpatti, Sivagangai, [4]Veterinary Dispensary, Karunganni

Abstract

Pesticide toxicity is common in pets. This case study reports that sixty days old, Pomeranian puppy presented with a history of ingestion of ant chalk which was kept in the open place. Mild shivering and hypersalivation were noticed. Based on the history and clinical signs, the case was diagnosed as cypermethrin poisoning and treated accordingly. The animal recovered uneventfully.

Keywords: Cypermethrin, pesticide toxicity, Pomeranian

Pesticide use is expanding day by day in response to agricultural and household demand. Pesticides applied in and around the home may be toxic to animals. When these drugs are used to control insects and ectoparasites, pesticide poisoning is very common in pets (Parmar *et al*., 2018).The synthetic type II pyrethroids - cypermethrin, deltamethrin, and fenvalerate are commonly employed in agriculture (Biswas *et al*., 2019). Among these, due to its low cost and high efficacy, cypermethrin is widely used (Klainbart *et al*., 2014). This fat-soluble chemical is rapidly metabolised in the liver and eliminated within 12-24 hours following oral or cutaneous absorption (Valentine, 1990 and Gupta, 2012).Numerous reports on pyrethroid toxicity in cats have been documented in the veterinary literature, however, pyrethrin/pyrethroid toxicity in dogs is unusual (Hansen *et al*., 1994).

Case history

A sixty days old, Pomeranian puppy was presented with a history of ingestion of ant chalk (JEETH ACTION™cockroachant killer, 1% w/w cypermethrin chalk) (Fig.1) which was kept on the house's veranda. The animal had eaten almost half of the ant chalk and vomited frothy contents twice. The animal was presented thirty minutes after the incident. The animal was active and showing signs of generalized tremor, hypersalivation and mild ataxia (Fig. 2). All the physiological parameters were normal.

Treatment and Discussion

The puppy was treated with intravenous injection of bolus normal saline @ 40ml/kg, injection Tribivet (Vitamin B1, B6 and B12) 0.5ml, I/V and injection chlorpheniramine maleate 0.5ml, I/M. About 10 grams of activated charcoal, bismuth subnitrate, calcium phosphate and light kaolin oral granule (Fig. 3) was mixed with raw egg white and made into a slurry and fed orally to the animal. The same was repeated six hours after the initial treatment. The animal recovered uneventfully on the subsequent days.

There is no specific antidote for cypermethrin, hence it must be treated symptomatically. Because the animal was active with slight incoordination and tremors in this case, no anticonvulsant was administered.The animal developed neurological symptoms characteristic of TS- syndrome linked with pyrethroid toxicosis (Klainbart *et al*., 2014).Given the occasional occurrences of pesticide toxicity in pets, owners must read and observe pesticide application instructions, and it should be stored out of reach of pets (Parmar *et al*., 2018).

Conflict of interest: The authors declare they have no conflicts of interest.

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*Corresponding author: kavinlkk@gmail.com

Fig. 1. Ant chalk (JEETH ACTION™ cockroachant killer, 1 % w/w cypermethrin chalk)

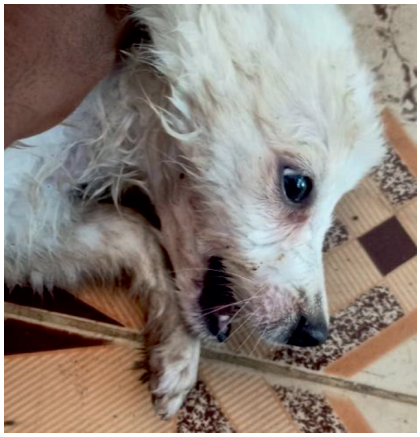

Fig. 2. Animal showing signs of hypersalivation and tremor

Fig. 3. Activated charcoal, bismuth subnitrate, calcium phosphate and light kaolin oral granule

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Received : 09.01.2023
Accepted : 27.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 91-93

Successful Therapeutic Management of Canine Lymphoma: A Case Report

Shubhasini Dhuriya, Manu Jaiswal, A.K. Tripathi*

Department of Veterinary Medicine, CVSc&AH, U.P. Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalay evam Go Anusandhan Sansthan (DUVASU), Mathura- 281001 (UP)

Abstract

A three year old non-descript intact male dog of about 15 kg weight was presented to TVCC, DUVASU Mathura, with the history of anorexia , frequent vomiting , constipation and swelling in neck region since 25 days. Clinical examination revealed multiple cutaneous nodules which was painless and spreaded in to various parts of skin, mouth,lymph nodes of body. There was excessive enlargement of lymph nodes (sub-mandibular, pre-scapular and popliteal). FNAC (fine needle aspiration cytology) finding of nodular swellings revealed,presence of large number of lymphoblast cells. On the basis of history and clinico-pathological observations the case was diagnosed as canine lymphoma. The dog was successfully treated with chemotherapeutic and immunosuppressive drug along with supportive medication.

Key words: Generalized Lymphadenopathy, Cutaneous Lymphoma, Dog, Chemotherapy

Lymphomas are one of the most common types of all malignancies in canine. Lymphoma in dog considered as systemic disease with diverse manifestations, and occurs mainly due to uncontrolled proliferation of malignant lymphocytes. Multicentric lymphoma is the most common type of lymphoma which accounts for approximately 80% of all canine lymphomas, often asymptomatic, but 20% to 40% of dogs will have anorexia, lethargy, fever, weight loss, vomiting diarrhea, and melena (Ettinger, 2003). Present case report deals with a generalized cutaneous lymphoma in dog and its therapeutic management.

A 3 year old non-descript intact male dog was presented in clinic with the history of anorexia, frequent vomiting, constipation and swelling in neck region since 25 days.The swelling was initialy started from oneside of neckwhich further progress in to other side. Multiple cutaneous nodular growths were observed in skin including several lymph nodes. The dog also had several cutaneous nodules on the head (cheek, chin, and top of the head). The nodules were,raised,painles s,erythematous, and well-defined measuring between 5 and 10 mm in diameter. There was mild pyrexia at 39.2° Calong with periodontal disease. Lesion in mouth with ulceration,stomatitis,and loosening of teeth with severe halitosis during period of illness was observed. Animal was highly emaciated and unable to intake food and chew properly. The animal was treated by local vet with Monocef, Polybion, Avil without any improvement. Complete blood count shows leukocytosis. Fine needle aspiration cytology of nodular swellings revealed presence of more number of large lymphoblastic cells with increased nuclear cytoplasmic ratio. Therefore, on the basis of history, clinical and laboratory examination case was highly suggestive of canine lymphoma and treated with chemotherapeutic and immunosuppressive drug along with supportive medication. Chemotherapeutic drugs (cyclophosphamide @ 2 mg /kg b.w. orally at alternate day for 3 weeks, Vincristine @ 0.7 mg/m^2 = 0.49 ml i/v weekly for 3 weeks and Immunosuppressive drug (Prednisolone @ 2mg/kg BW in the first week i/m and 1 mg/kg in the second week i/m and 0.5 mg/kg in the third week i/m,Tab Clindamycin @5 mg/kg, Tab Metronidazole @15 mg /kg and Syp Silybon 5ml , Syp sucral-o BID orally for two weeks.

Animal was presented in clinic after 7 days of treatment with successful recovery with history of reduced vomiting, normal intake of food with proper urination and defecation. Oral ulceration and stomatitis was completely lost with drastic reduction in the halitosis. Sub mandibular lymph node was also regaining their normal size and swelling was reduced. Multiple cutaneous nodules present over skin of head region were also reducing in size. After 7 days of follow-up schedule, the dog showed gradual improvement in the clinical condition and almost recovered back to healthy state after 3 weeks of treatment.

Canine lymphoma is a heterogeneous spectrum of neoplasms that mostly arise from lymphocytes, from lymphoid tissues such as lymph nodes, spleen, thymus, and bone marrow, but it can potentially occur at any location in body. Multicentric lymphoma is

*Corresponding author: dhuriyashubhasini10@gmail.com

Clinical manifestation on 0 day

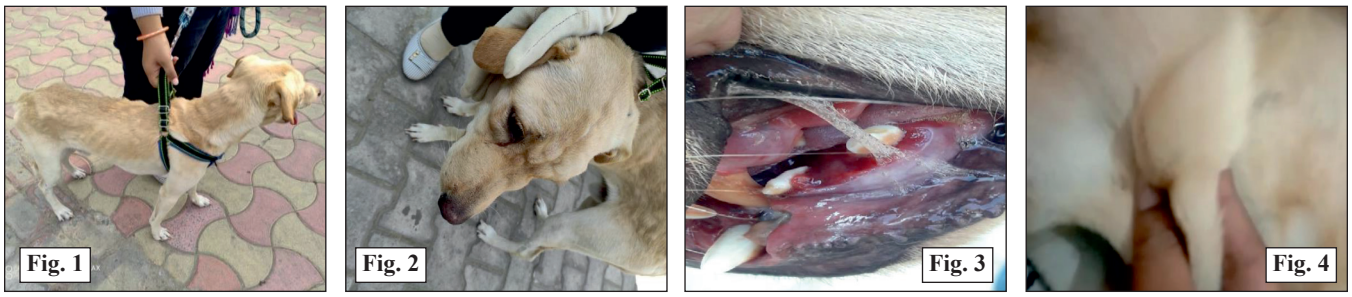

Fig.1,2: Generalized lymphadenopathy and cutaneous form of lymphoma
Fig.3: Presence oforal ulcer, erosive mucosa and excessive salivation along with loosening of teeth in mouth of dog
Fig. 4: Enlargement of sub mandibular lymph node of dog.

Clinical recovery on 7th days of treatment.

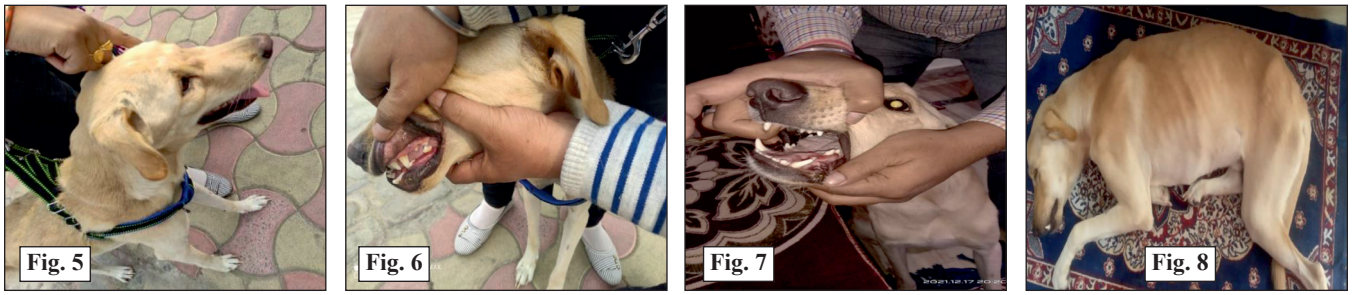

Fig 5, 6, 7, 8: Shows clinical recovery in dog in terms of absence of cutaneous nodule over body along with healthy appearance of oral cavity after 7 days of therapeutic management.

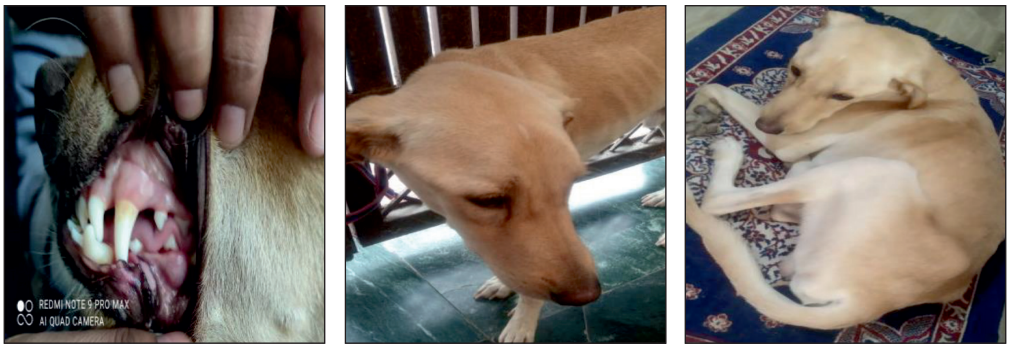

Image shows recovery in dog after 15 days of treatment.

the mostcommon presentation of canine lymphoma, accounting for 75%-80% of all lymphoma cases. (Lopes *et al*., 2021). Lymphomas in canines and humans require a specific diagnosis for selecting the most appropriate chemotherapy. Physical examination can usually detect the excessive enlargement of superficial lymph nodes, and giving an idea for diagnosis; then CBC and biochemical analysis are also recommended (Zhang *et al*., 2021). Canine diffuse large B type cell lymphoma shows a relatively good response to treatment with multi-agent cyclophosphamide, doxorubicin, vincristine, and prednisone (CHOP) chemotherapy (Mizuno *et al*., 2020). Oral cyclophosphamide chemotherapy in combination with prednisolone is a useful treatment for canine multicentric lymphoma with minimal mild associated toxicity(Todd *et al.,* 2021). In the present report frequently used chemotherapy protocols to treat canine multicentric lymphoma with a combination of drug vincristine, cyclophosphamide, and prednisolone provided better response in clinical manifestation of disease. So given therapy in this case was very effective and show a best result in clinical condition.

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Received : 23.12.2022
Accepted : 29.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 94-96

Successful management of hepatozoonosis in a tiger cub *(Panthera tigris)*

A.S. Shalini[1], V.M. Dhoot[1], S.V. Upadhye [1], M.D Pawshe[1] and S.M. Kolangath[1]*
Wildlife Research and Training Centre, Gorewada , Nagpur

Abstract

A five month old male tiger with heavy tick infestation was captured from Khutwanda Beat, Katoda round, Tadoba range, TATR core with clinical signs of dehydration and anaemia. The cub after preliminary treatment at Transit treatment centre, Chandrapur and was shifted to Gorewada Rescue centre, Nagpur where it was noticed that the cub had mild abnormal distension of abdomen and had a stunted growth. The cub was isolated and was screened for the presence of blood parasites. Physical examination was done and all the vital parameters viz. HR, RR, Temperature etc. was within normal ranges. Haematology revealed monocytosis with severe leukocytosis. Some Sero-biochemical parameters were at higher side. On the basis of hemato-biochemical changes and blood smear examination, it was confirmed to be case of hepatozoan spp. infection. The present case study represents the effect of therapy with Oxytetracycline against Hepatozoon spp. infection

Key words: Hepatozoonosis, Tiger cub, *Panthera tigris*

Hepatozoon species is an epicomplexan parasite of family Hepatozoidae affecting primarily mammalian leukocytes (Baneth, 2001). Unlike most tick-borne diseases, hepatozoonosis is not transmitted through a tick bite but through ingesting an infected tick. Transmission of disease takes place by ingestion of *Rhipicephalus sanguineus* tick belonging to family Ixodidae. However, meat eating, hunting and transplacental transmission is also reported. Mixed infections are possible with hepatozoonosis as single tick may harbor multiple pathogens (Banerjee, 2008). Hepatozoan species in felines were first described by Patton (1908) in India. Since then, hepatozoan species infection have occasionally been reported as gametocytic or schizogenic development in domestic and wild felids (Kubo *et al*., 2010). *Hepatozoon canis* primarily affects the haemolymphatic tissue and blood cell forming organs such as the bone marrow, spleen and lymph nodes. Animals with severe clinical conditions show signs like fever, loss of appetite, weight loss, hyperglobulinaemia often resulting in hepatitis, anaemia, glomerulonephritis and pneumonia. Co-infection of Hepatozoan spp. with other blood parasites such as Ehrlichia, Leishmania is a common condition (Baneth and Weigler, 1997). The diagnosis of hepatozoonosis is made by observation of gamonts in blood smears, histopathology, PCR or serology. In India, very limited work on hepatozoonosis of wild felines have been reported. Herein, we present a case of hepatozoonosis in a tiger cub and its successful management.

*Corresponding author: a.sshalini@yahoo.com

Case history and Observation

A male tiger cub about 8-9 months was brought from Khutwanda Beat, Katoda round, Tadoba range, TATR core to Wildlife research and Training Centre, Gorewada, Nagpur with the signs of mild abdominal distension, stunted growth and with the history of treatment for anaemia, dehydration, and heavy tick infestation. The cub was isolated and detailed clinical examination was done which revealed that the vital parameters viz. HR, RR, Temperature were within normal limits. The urine pH was found to be acidic. Haemato-biochemistry showed leucocytosis with monocytosis and mildly elevated ALT and AST. Blood smear examination revealed gamonts in neutrophils (Fig.1). On the basis of haemato-biochemistry and blood smear examination, it was confirmed to be a rare case of hepatozoonosis in a tiger cub.

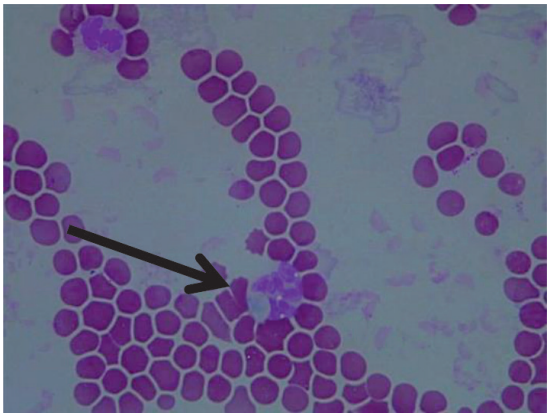

Fig. 1: Arrow showing gamonts of Hepatozoon sp. in a neutrophils from peripheral blood smear stained with Giemsa (100x).

Table 1. Haemato-biochemical changes in hepatozoonosis of tiger cub recorded during pre and post treatment

Sr. No.	Hematology			Sr. No.	Serum biochemistry		
	Parameters	**0^{th} day**	**30^{th} day**		**Parameters**	**0^{th} day**	**30^{th} day**
1	Haemoglobin(g/dl)	10.3	11.3	1	BUN (mg/dl)	25	31.7
2	RBC ((10^6/cu.mm)	6.02	6.58	2	Creatinine (mg/dl)	0.9	1.5
3	PCV (%)	37.9	41.6	3	Total protein (gm/dl)	7.8	6.8
4	Platelets (10^3 /mm^3)	364	79	4	Albumin(g/dl)	4.3	3.0
5	WBC (10^3 /cu.mm)	26.09	5.5	5	Globulin(g/dl)	3.6	3.8
6	L (%)	18.6	21.5	6	Sodium (mmol/l)	143	147
7	N (%)	70.6	76.8	7	Potassium (mmol/l)	4.2	4.0
8	M (%)	7.6	1.7	8	SGPT (IU/L)	112	20.2
9	E (%)	2.9	2.0	9	SGOT (IU/L)	86	14.7
10	B (%)	0.2	0	10	SAP(IU/L)	63	37.4
				11	Calcium (mg/dl)	11	9.1

Treatment and Discussion

The tiger cub was treated with Oxytetracyline @ 5mg/kg b.wt bid given intravenously with Normal saline along with Tab. Silybon (Silymarin) @ 20mg/kg/day given per-orally. Multivitamin combination containing Vitamin B complex and Vitamin C was also given per-orally. The peripheral blood smear was evaluated on weekly basis and treatment was continued for 30 days till recovery. Haemato-biochemical changes were recorded during and after the treatment which is shown in Table 1.

In order to ascertain that there were no relapses, the peripheral blood smear was evaluated on monthly basis for nine months after recovery and it was found to be negative for hepatozoonosis.

Most commonly hepatozoonosis occurs in subclinical form, though age related acute or chronic form has been reported in young animals due to underdeveloped immune system (Cummings *et al*., 2005). Leukocytosis with monocytosis and mild elevated levels of liver specific enzymes are may be due to chronic inflammatory response to Hepatozoan infection.

Successful treatment of hepatozoan spp in dogs with combination therapy including doxycycline and oxytetracycline has been reported by Sarma *et al*.,2012 . It has been reported that imidocarb dipropionate fails to eliminate H. canis infection when given as a sole therapy by Baneth *et al*. 2011. Imidocarb dipropionate was once considered as a drug of choice for canine hepatozoonosis, but recent reports suggest a failure of combination therapy of imidocarb dipropionate and toltazuril/emodepside plus clindamycin in treatment of Hepatozoon canis infection (Thakur *et al*., 2018). Also, combination therapy containing pyrimethamine, sulfadiazine/trimethoprim and clindamycin followed by long term therapy with decoquinqte has been recommended by Allen, 2022. However, the therapy was not suitable in this case as sulphadiazine/trimethoprim requires alkaline pH of urine for the drug excretion. In the present case, therapy with Oxytetracycline and supportive therapy with Silymarin for treatment of hepatozoonosis in tiger cub resulted in elimination of infection.

Acknowledgement

The authors are grateful to Forest Development Corporation of Maharashtra Ltd., for providing necessary facilities to carry out this case study and Principle Chief Conservator of Forest (Wildlife), Maharashtra State for granting necessary permission for publication.

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Received : 28.12.2022
Accepted : 30.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 97-98

Contagious Ecthyma: The Benefits of Allopathic and Herbal Interventions

Mohd Akil and Harshit Saxena*
Livestock Farm Complex, Apollo College of Veterinary Medicine (RAJUVAS) Jaipur,
Division of Medicine, ICAR-IVRI, Izzatnagar, Bareilly, U.P.

Abstract

Contagious ecthyma is a viral disease that poses a significant threat to the health and well-being of goats and sheep, making it a major concern for farmers who raise these animals. Unfortunately, many of these farmers are unable to afford the costly treatments required to combat this debilitating illness, leaving their herds vulnerable to its devastating effects. During one of our routine clinic visits, we encountered a herd of goats that had fallen victim to contagious ecthyma. A total of 17 goat kids and 4 adult goats were found to be suffering from this ailment. To combat this viral disease, we employed a combination of allopathic medicines, which were provided by our team, and herbal remedies such as aloevera and neem paste. Our diligent efforts proved to be successful, as all of the affected animals made a full recovery, and there were no fatalities during this period.

Keywords: Contagious ecthyma, Goats, Jaipur, Treatment.

Orf, also known as contagious pustular dermatitis or contagious ecthyma, is a viral disease caused by the parapox virus of the subfamily Chordopoxvirinae, family Poxviridaee (Pal *et al.,* 2013). It affects both wild and domesticated artiodactyls, but is more common in small ruminants like sheep and goats (Haig *et al*. 2006). Orf is highly contagious and can have a significant impact on the economy of developing countries, including India (Gelaye *et al.,* 2016). Symptoms include lesions on the oral mucosa, nostrils, tongue, ears, and teats of nursing mothers, which can lead to anorexia or starvation and abandonment of offspring. Orf is usually diagnosed based on symptoms, but must be differentiated from similar conditions. The lesions in goats and sheep go through a series of stages, starting with maculae and ending with scab formation (McKeever *et al*., 1988). The Orf virus is attracted to the skin and causes growths on the mouth and nose. These growths usually go away within 1-2 months. The first signs of the disease are red spots, followed by blisters, bumps, pus-filled bumps, and scabs. Young animals after being weaned are more likely to get the disease and have more severe symptoms (Bharathy and Akila., 2015). Orf frequently affects young ones during the post-weaning period. The disease is not normally fatal but can be debilitating and fatal under certain circumstances. The infection occurs by direct or indirect contact with infected animals or their saliva or tissue containing the virus (Mohammad *et al*., 2016). Zoonotic diseases are most commonly transmitted during specific activities such as lambing, docking, shearing, drenching, or slaughtering of infected animals. The decrease in production, decrease in value of meat, leather, and wool in both local and global markets, and expenses associated with being zoonotic are all factors that contribute to financial losses (Nandi *et al.,* 2011).

*Corresponding author: mohammadakil098@gmail.com

Case History and Observations

During our regular visits to villages near Jaipur as part of our ambulatory clinic duties, we came across a group of 32 goats in Jeetawala village near Jaipur in July 2021. Among them were 17 goat kids of age about three to four months and 4 adult goats displaying symptoms of contagious ecthyma. The majority of the animals had lesions, such as loss of appetite, dullness, fever ranging from 104^0F to 105^0F and severe cauliflower-like growths around their lips covering their nose, muzzle and ears. The owner of the goat herd informed us that most of the goats were experiencing Inappetance due to the lesions on their lips and muzzle, causing them to become weak day by day. There were also chances of secondary bacterial infection as the goats had been suffering for the last 10 days.

After reviewing the animal's medical history and examining its symptoms, we made a preliminary diagnosis and started treatment. Unfortunately, there is no treatment for Contagious Ecthyma since it is caused by a virus. However, we can alleviate the animal's suffering by administering supportive care and antibiotics. For treatment of animals we used both

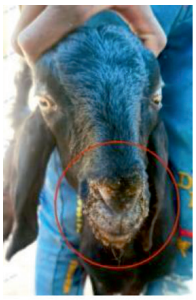
Fig. 1

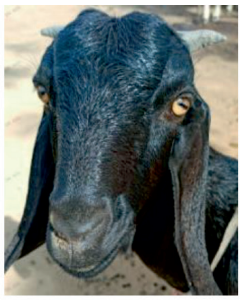
Fig. 2

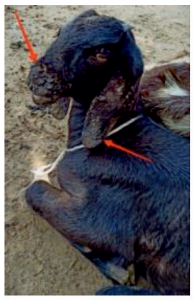
Fig. 3


Fig. 4

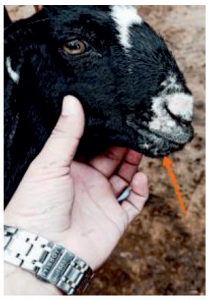
Fig. 5

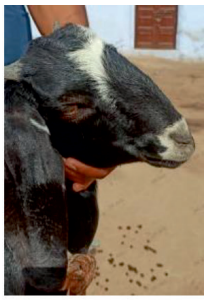
Fig. 6

Figures 1, 3, 5 are showing dry, proliferative, scabby lesions at lips, muzzle, nose and ears suggestive of Contagious Ecthyma. Conversely, Figures 2, 4, and 6 showcase goats that have successfully recovered post-treatment.

allopathic and herbal medicines, in allopathic treatment we gave Inj. Enrofloxacin @ 5 mg/kg B.wt. as antibiotic, Inj. Megludyne @1.1 mg/kg B.wt. as analgesic, Inj. Tribivet @ 0.5-1 ml as multivitamin, all injectables given intramuscular to each affected animal continuously for five days. Additionally, their lesions were cleaned with a diluted solution of potassium permanganate and then treated with a paste made from aloevera and neem. This herbal treatment was continued for 15 days, but most animals showed improvement within 7 days.

Discussion

Contagious Ecthyma is a highly contagious viral disease that affects goats and other small ruminants. These findings can guide veterinary practitioners in managing and preventing the spread of the disease in field conditions. The animals in this study recovered successfully with a combination of allopathic and herbal medicines. Goat owners are often poor farmers who rely on their animals for milk and money, so these contagious diseases can have a significant economic impact. In young kids, it is important to use bactericidal antibiotics rather than bacteriostatic to prevent mortality. This study provides valuable insights into the clinical manifestations of the disease and the efficacy of treatment in promoting recovery.

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Received : 27.12.2022
Accepted : 19.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 99-100

Clinico-therapeutic and diagnostic aspects of *Diphyllidium caninum* infection in a dog

V. K. Varun[1], P. S. Maurya[2], M.V. Jithin[1], Ajit Kumar Singh[1], Desh Deepak[3], Jeny K. John[1], Ramakant[3], T.K.Sarkar[3]*

[1]Department of Veterinary Clinical Complex, [2]Department of Veterinary Parasitology, [3]Department of Veterinary Medicine, College of Veterinary and Animal Sciences, SVPUAT, Meerut- 250110 (U.P.)

Abstract

A 2.5 month old Bhotiap up was presented to Department of Veterinary Clinical Complex, College of Veterinary and Animal Sciences, with the history of dullness, anorexia, loose faeces and melena since last 4 days. White cucumber seed shaped segments in faeces and scooting behaviour was also noticed. Faecal sample with proglottids were collected in a sterile vial and was sent to Department of Veterinary Parasitology for coproscopic examination. The proglottids were processed by standard protocol for the identification of the endoparasite. Proglottids were noticed in chain and single. The direct faecal sample examination revealed large number of typical egg capsules which were round in shape containing large number of eggs, characteristic of *Diphyllidium caninum*. Pup was treated with praziquental@ 5 mg/kg body weight orally and animal recovered completely.

Dipylidiumcaninum infection is an ubiquitous infection among the dogs and cats. It is reported mainly from dogs and cats infected with fleas or louse (Wani*et al*., 2015), but cases in humans are also reported (Taylor *et al*., 2007). The intermediate host is the larval stage of *Ctenocephalides* species of dog or cat flea. Dogs and cats accidently swallow the infected fleas and acquires infection. It is one of the commonest cestode infection in pets. Canines which are infected will shed the segments of *D. caninum* in faeces and contaminate the surrounding with these proglottids which act as a source of infection (Yasuda *et al*., 1971).It is a disease of public health importance as children usually are in close contact with pets and they can easily contract infection. Proper diagnosis, flea control and deworming is very essential to prevent the infection in humans and animals. Children will catch infection through accidental consumption of dog fleas and in most of the cases there would not be any apparent clinical manifestations. Clinical signs in affected dogs are reduced growth rate, pot-belly, diarrhoea and anal scooting due to pruritis (Taylor et al., 2007). Proglottid shedding can be noticed usually from 2 weeks after infection in dogs and cats. Diagnosis of infection can be done by direct examination of proglottid or direct faecal sample examination. The therapeutic management of disease is always successful in dogs and humans which can be done with any anticestode drugs. In this paper we are discussing a case of *Diphyllidium* infection in dog, its clinical manifestation, diagnosis and treatment.

*Corresponding author: drvarun15487@gmail.com

Case History and Observations

A 2.5 month old Bhotia pup was presented to Department of Veterinary Clinical Complex, College of Veterinary and Animal Sciences, SVPUAT, Meerut (U.P) with the history of dullness, anorexia, loose faeces and melena since last 4 days. White cucumber seed shaped segments in faeces and scooting behaviour was also noticed. Anamnesis revealed that the pup was due for deworming. Close physical examination revealed presence of fleas on skin coat (Fig. 4)On clinical examination,animal was unthrifty with poor hair coat condition, infested with fleas. Mucus membranes were pale and temperature was 101.5°F. Heart rate and pulse was in normal range. No abdominal pain was elicited during palpation. Faecal sample with proglottids were collected in a sterile vial and was sent to Department of Veterinary Parasitology for coproscopic examination and identification of endoparasite. The proglottids were processed by standard protocol for the identification of the endoparasite (Soulsby, 1982).

Proglottids were noticed single or in chain (Fig.2). It was white and cucumber seed shaped which was characteristic of *D. caninum.* Microscopic confirmation of the endoparasite was done in Department of Veterinary Parasitology, COVAS, SVPUAT, Meerut. The direct faecal sample examination on microscopy revealed large number of typical egg capsules of *D. caninum*. These egg capsules were round in shape and contain large number of eggs in it (Fig. 3). Dog was treated with Tab. Praziquental@ 5 mg/kg body weight orally for 3 days

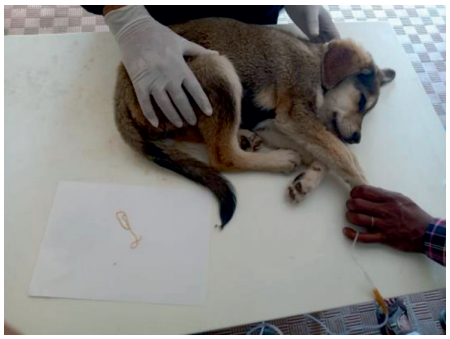

Fig. 1. Affected Dog

Fig. 2. Adult Worm from faecal sample

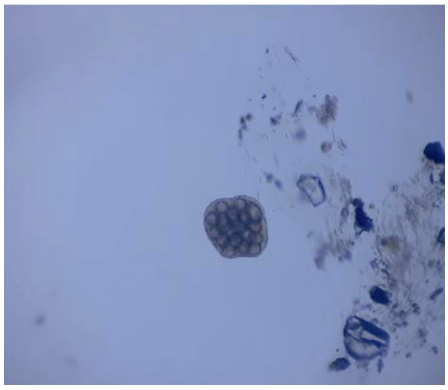

Fig. 3. Egg Capsule (x40)

Fig. 4. Dog Flea (*Ctenocephalidescanis*)

with supportive fluid therapy.

Discussion

D. caninum is very common cestode infection of dogs contracted by ingestion of fleas containing the infective cysticercoid stage (Gopinath *et al*., 2018). It is also known as flea tapeworm, cucumber tapeworm and double-pored tapeworm. Apart from the signs of worm infestation, animal frequently shows signs of flea infestation such as skin pruritis, dermatitis and anaemia(Yaphe *et al.*, 1993). In the present study,fleas were observed on the skin of dog and dog shows typical clinical manifestation of *D. caninum* infection such as anal scooting which is due to the irritation of movement of the proglottids in the anal region. The eggs were round in shapes and were inside egg capsules which is very typical of *D. caninum*. Clinical signs was successfully managed by anticestode therapy and animal recovered completely after five days of treatment. Proper and timely diagnosis of the case helps in successful management of the case. Diagnosis can be easily done at every level due to its peculiarity of eggs and proglottids. Praziquantel and epsiprantel are considered as the drug of choice for therapy against *D.caninum*.

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Received : 17.12.2022
Accepted : 27.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 101-102

Ivermectin toxicity in a dog: A case report

Manu Jaiswal, Sveta Singh, Padma Nibash Panigrahi, Arvind Kumar Tripathi, Ram Sagar*
Department of Veterinary Medicine, CVSc&AH, U.P. Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalay evam Go Anusandhan Sansthan (DUVASU), Mathura- 281001 (UP)

Abstract

A 10 year old bitch was presented at TVCC, DUVASU, Mathura with the history of acute illness and apparent blindness after being exposed with high dose of ivermectin drug. Dog was treated for tick infestation by owner with 20 mg Ivermectin. Acute onset of clinical symptom were observed by owner after 12 hr of ivermectin therapy. Initially, dog seemed to be blind, cloudiness of eye with severe lacrymation, absence of papillary light reflex, mydriasis, partial blindness, hypothermia, ataxia and certain behavioral changes. On the basis of acute clinical signs therapy started with neostigmine @ 0.05mg/kg BW SC repeated 6 hourly, atropine sulphate @ 0.02mg/kg b. wt. *iv*, dexamethasone @ 0.5 mg/kg b. wt., and neurobion 1ml *im* with infusion of 250 ml NSS *iv*. After three days of follow-up, the dog recovered from clinical condition.

Key words: Apparent blindness; ivermectin toxicity; lacrimation

Ivermectin belongs to the family avermectin produced by actinomycetes, specifically *Streptomyces avermitilis* and is a semi-synthetic macrocyclic lactone having a wide range of antiparasitic activity (Panigrahi *et al*., 2016). This is one of the most potent drug in ruminants having high margin of safety (Reinemeyer and Courtney, 2001). However, an extra-label use is common and has heen documented for the treatment of parasites in various other animal species. It has broad-spectrum efficacy against plant and animal arthropod and nematode infections (Omura, 2008).Ivermectin acts by selectively binding to glutamate-gated and gamma-aminobutyric acid (GABA)-gated chloride channels in the nervous system of insects, resulting in hyperpolarization of cell, paralysis and finally death. Safety in mammals is due to the lack of glutamate gated chloride channels in the peripheral nervous system and restriction of GABA to a central nervous system (Macdonald and Gledhill, 2007). Trematodes and cestodes are having the natural resistance against ivermectin because they do not use GABA as a PNS neurotransmitter. Ivermectin toxicity has been reported in several species of animals including dogs, cats, cattle, horses, pigs, frogs and chelonians (Dey *et al.,* 2017). Ivermectin has been demonstrated as an extremely safe drug in dogs, an increased susceptibility to the toxic effects is evident in a subpopulation of collies and collie-type dogs (Paul and Tranquilli, 1998). Clinical signs initially include salivation, vomiting, ataxia, tremors and disorientation, but these progress to weakness, recumbency, non-responsiveness, stupor and coma in some dogs (Dey *et al.,* 2017). Present report deals with a case of ivermectin toxicity and its therapeutic management.

Case History and Observations

A 10 year old bitch (nondescript), weighing about 10 kg was presented at TVCC, DUVASU, Mathura with the history of acute illness of apparent blindness after being exposed with high dose of ivermectin drug along with depression, cloudiness of eye with severe lacrimation, ataxia and certain behavior changes. Dog was treated for tick's infestation by 2 tablets of 10 mg ivermectin drug. Clinical examination revealed hypothermia (99.6^{0}F), tachycardia (140 beats/min) and oligopnea. Close physical examination revealed absence of pupillary light reflex (PLR), partially dialated pupil with severe lacrymation from protruded eye ball.

On the basis of history and clinical symptom the case was highly suggestive of ivermectin toxicity. Therapy of dog started with symptomatically with atropine sulphate @0.02mg /kg bw iv and dexamethasone @ 0.5 mg /kg bw, neurobion 1ml i/m with infusion of 200ml normal saline I/V and suitable antidote like neostigmine @

*Corresponding author: arvindvet04@rediffmail.com

0.05mg/kg BW SC with follow-up schedule of 3 days. After treatment, dog was presented in clinics with reduced symptoms of toxicity and normal body condition.

Discussion

Ivermectin have wide range of efficacy in animals for internal and external parasites. Dosage regimens vary depending on the species and parasite treated. The margin of safety for ivermectin in most breeds of dog is well over 100 times the recommended dose but in Collies it is about 16 times the usual dose(Dey *et al.,* 2017). Occurrence of toxicity in selective breeds may be due to the reason that these breeds have comparatively more permeable blood brain barrier to the drug (Houston *et al*., 1987) or due to an autosomal recessive trait (MDR-I) gene that causes a defect in the p-glycoprotein, which is a multidrug transporter in the blood brain barrier and it helps in passage of ivermectin into the brain at low dosages and thus causes toxicity (Macdonald and Gledhill, 2007). Similar clinical toxicity findings had been reported by Veena *et al*.(2016) in adult German Shepherd dog and Sheikh *et al*.(2017) in German Shepherd cross breed dog. In dogs, an oral preparation of ivermectin in sesame oil induced mydriasis at a dosage of 2.5 mg/kg, tremor at a dosage of 5 mg/kg, severe tremor and ataxia at a dosage of 10 mg/kg, and death at a dosage of 40 mg/kg (Campbell and Benz, 1984). Depression, ataxia, coma and death have followed treatment of dogs with products intended for use in horses or cattle, at a dosage of 0.2 mg/kg (Sivine *et al.,* 1985). Ivermecrtin toxicosis was observed in dogs in many studies. Hopkins *et al.,* (1990) showed tremors, dilated pupils and blindness in male Doberman pinscher dog administered ivermectin orally in a dose of 115 mg. Very low test doses are often recommended at the starts of a treatment to identify these individuals regardless of their breed. Alternatively, a blood test is now available to test for the genetic sensitivity. This genetic test (DNA test using an oral swab) for P-glycoprotein mutation will identify ivermectin sensitive dogs as also suggestive by Houston *et al*. (1987) ; Hadrick *et al*. (1995).

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Received : 07.12.2022
Accepted : 29.05.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 103-106

Primary Spontaneous Pneumothorax in Siberian Husky

Jasnit Singh[1], Raj Sukhbir Singh[2] and Swaran Singh Randhawa[2]

[1]Department of Veterinary Medicine, [2]Department of Teaching Veterinary Clinical Complex, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

Abstract

Pneumothorax, the presence of air in the pleural cavity, is a life-threatening condition in dogs that can result from various underlying causes. This case study delves into the clinical presentation, diagnostic approach, and management of pneumothorax in dogs. The patient, a 3-year-old male Siberian Husky, presented with acute respiratory distress without a history of trauma. Through a combination of physical examination and diagnostic imaging, diagnosis of pneumothorax was confirmed. The case study discusses the treatment options like chest tube placement, and autologous blood patch (ABP), with an emphasis on the importance of rapid and appropriate management.

Keywords: Pneumothorax, Pleurodesis, Dog

Pneumothorax, the presence of air in the pleural cavity, is a life-threatening condition in dogs that can result from various underlying causes.

Case History and Observations

A 3-year-old male intact Siberian husky was brought to veterinary hospital of the university with a two-day history of inappetence, melena, and acute respiratory distress. There was no history of thoracic trauma, and no externally evident punctured wounds were found on clinical examination. On physical examination, the animal was neurologically normal, with a body temperature of 102.4 °F, a heart rate of 140 beats per minute (normal rhythm and intensity), a respiratory rate of 96 breaths per minute (rapid and shallow with abdominal effort), and a capillary refill time of 2 seconds. All palpable superficial lymph nodes were normal. The haemato-biochemical parameters were unremarkable (Table 1 and 2).

On auscultation of chest, there was absence of respiratory sounds in the dorsal part of the thorax. Lateral and ventro-dorsal thoracic radiographs revealed dorsally elevated heart(Fig. 1) and atelectasis of all lung lobe edges suggestive of pneumothorax (Fig. 2). On both radiographic views, there was no evidence of bullae. On the basis of history, signalment, clinical and radiographic findings, a case of PSP was diagnosed.

Treatment

On confirmation of PSP, the dog was shifted to emergency unit for therapeutic thoracocentesis. With dog in ventral recumbency, a 22 G butterfly needle connected to a stop cock was introduced in the dorsal half of the thorax at 7th intercostal space and about 1200 ml of air was removed from both sides of the thorax. After 12 hours, the dog was brought back to the clinics with complaints of respiratory distress and tongue cyanosis, both of which were not apparent in previous clinical examination. Dog was sedated with butorphanol @ 0.2 mg/kg IM and about 7000 ml air from the sidewalls of the thorax was removed by thoracocentesis. Because of the enormous quantity of air collected in the thoracic cavity, a chest tube was placed bilaterally following proper asepsis (Fig. 3 and 4). After 5 days of intermittent air evacuation via chest tubes, no substantial response was observed due to continuous air leaking into the pleural cavity. Due to diagnostic limitations to pinpoint the source of air leakage, surgical ligation could not be undertaken. Following this, it was decided to conduct pleurodesis. Autologous blood patch (ABP) was performed (Fig. 5) by collecting patient's own blood from external jugular vein aseptically and infusing the same(20-50 ml aliquots of a total blood collected @5-10 ml/kg) through the initially placed chest tubes and dispersing the blood evenly on both sides (Theron *et al*., 2021; Satmary *et al*., 2023). There was no evidence of respiratory discomfort throughout the next week. The dog was again presented with a recurrence of respiratory distress 7 days after pleurodesis using ABP, but the animal was already collapsed. Cardio-pulmonary-cerebral resuscitation was attempted for 20 minutes, with low dosage adrenaline administered in the first 10 minutes, followed by high dose adrenaline, but all attempts failed to save the life of dog. The owners declined the request

*Corresponding author: goleejasnit34@gmail.com

Table 1. Complete blood count and biochemistry parameters

Parameter	Value
Hemoglobin (g/dL)	17.7
Total leucocyte count (/µL)	14650
Absolute neutrophils (/µL)	13432
Absolute lymphocytes (/µL)	1218
Total erythrocyte count (10^6/µL)	6.89
Packed cell volume (%)	46.7
Platelets (10^3/µL)	307
Total bilirubin (mg/dL)	0.2
AST (U/L)	81
ALT (U/L)	93
ALKP (U/L)	84
Total Protein (g/dL)	6.7
Albumin (g/dL)	3.5
GGT (U/L)	21
BUN (mg/dL)	18
Creatinine (mg/dL)	0.9
Sodium (mEq/L)	143
Potassium (mEq/L)	4.7
Chloride (mEq/L)	106
Cholesterol (mg/dL)	152
Lactate (mmol/L)	2.6
Glucose (mg/dL)	115

to perform post-mortem examination of the dog.

Discussion

The present clinical case described the history, clinical presentation, diagnosis, and management of PSP. In previous studies, depending on the severity and duration of pneumothorax, dogs were presented with a wide variety of clinical signs including anorexia, lethargy, coughing, exercise intolerance, cyanotic or pale mucous membranes, increased respiratory rate and effort, vomiting, and weight loss (Gilday *et al*., 2021). The development of respiratory signs may be quick in some dogs, while others will progress at a slower rate depending on the severity of pneumothorax (Lipscomb *et al*., 2003).Primary spontaneous pneumothorax which occurs due to rupture of pulmonary bullae or subpleural blebs, is the most common cause of spontaneous pneumothorax reported in dogs accounting for 36%-68% of cases (Lipscomb *et al*., 2003; Gilday *et al*., 2021). As in the present case, Siberian Huskies was reported to have a breed predisposition based on an over representation (Puerto *et al*., 2002). In humans with spontaneous pneumothorax, cigarette smoking was found to be an important risk factor for the occurrence of the disease (Cheng *et al*., 2009). The owner of the dog was reported to have a habit of cigarette smoking.

Table 2. Routine Urinalysis

Parameter	Value
Urobilinogen	1+
Glucose	1+
Bilirubin	2+
Ketones	Negative
Specific gravity	1.050
Blood	3+
pH	6.5
Protein	4+
UPCR	78.26
Urine sediment	Numerous RBC (>20/hpf), WBC (3/hpf), cluster of urothelial cells and bilirubin crystals

Note: Explanation to above abnormal values might be iatrogenic vessel puncture during cystocentesis as no significant pus cells were evident on urine sediment

Thoracic radiography is considered as the primary imaging modality for the diagnosis of pneumothorax in dogs with a reported sensitivity of up to 100% (Au *et al*., 2006). However, in patients with respiratory dyspnoea, sedation and oxygen supplementation is warranted before performing radiography to avoid the risk of respiratory crisis and the x-ray should be performed with patient in dorso-ventral recumbency. Although thoracic radiography could confirm spontaneous pneumothorax in dogs but it could not explain the underlying pathology (i.e., bullae) for occurrence of PSP (Gilday *et al*., 2021). While computed tomography (CT) is more sensitive than radiographs for the identification of bullae, CT still has limited utility owning to requirement of positioning the patient in different recumbencies to identify multiple bullae (Gilday *et al*., 2021).

Although the management of PSP is preferably done by exploration of thorax via thoracotomy or thoracoscopy to locate the site of air leakage, repeated thoracocentesis and ABP provide a solution in patients where surgery cannot be done due to animal condition or due to owner's financial constraints. Like present findings, Lipscomb *et al.*(2003), also did not find improvement

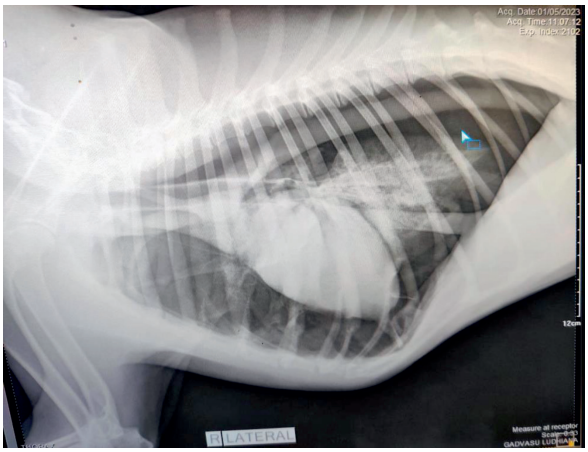

Fig. 1: Lateral radiograph of thorax indicating pneumothorax

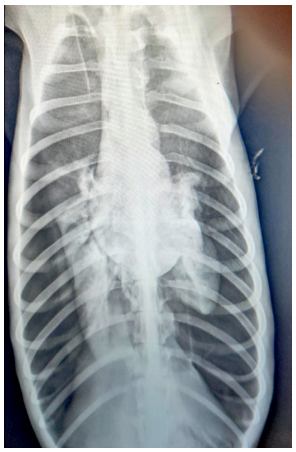

Fig. 2: Ventro-dorsal radiograph of thorax indicating atelectasis of both lungs.

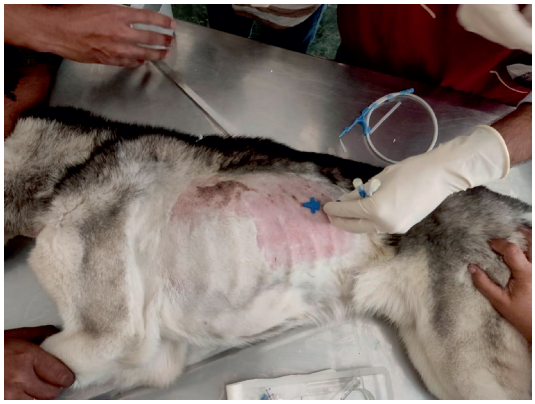

Fig. 3: Placement of chest tube by seldinger technique.

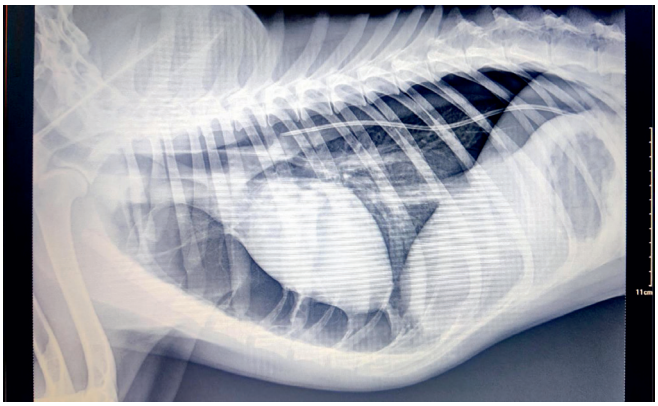

Fig. 4: Lateral radiograph of thorax showing correct placement of chest tube.

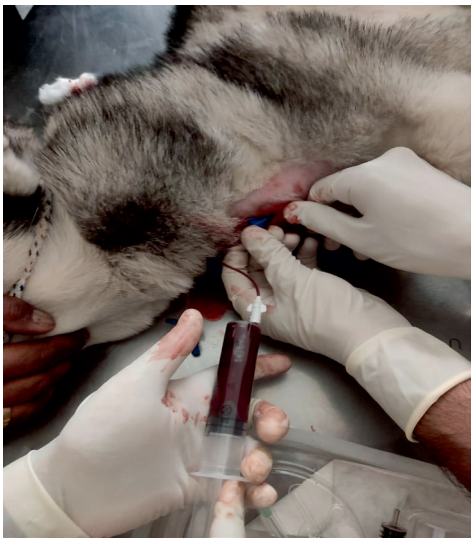

Fig. 5: Collection of whole blood from jugular vein via central line

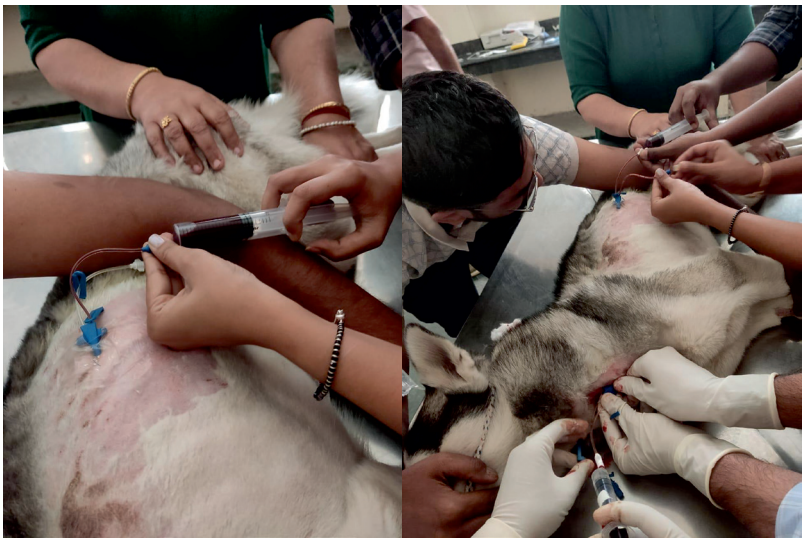

Fig. 6 and 7: Infusion of whole blood into thoracic cavity

following thoracocentesis or thoracostomy tube drainage in 12 dogs with pneumothorax secondary to bullae and blebs.

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Received : 13.03.2023
Accepted : 28.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 107-109

Management of leukopenia associated with parvo virus gastroenteritis in a Labrador puppy-A case report

M A Ensha Lomiya, R Raguvaran, Renu Motwani, Narayani Yadav, D B Mondal*
Division of Medicine, Indian Veterinary Research Institute, Bareilly, UP-243122

Abstract

A four-month-old male Labrador retriever puppy was presented to Referral Veterinary polyclinic, ICAR-IVRI with the history of anorexia, vomition, haemorrhagic diarrhoea and signs of hypovolaemic shock. The case was diagnosed as parvo virus gastroenteritis by rapid antigen detection test. Shock was managed by infusion of polyionic isotonic fluid. Haematological examination revealed severe leukopenia with WBC count of $0.3\times10^3/\mu L$, which was treated with administration of recombinant human granulocyte colony stimulating factor (Filgrastim) at 5 mcg/kg SC along with supportive therapy. Dog showed elevated WBC count and improvement in clinical signs after 48 h. Administration of granulocyte colony stimulating factor along with routine therapy enhanced the survivability in canine parvo virus gastroenteritis.

Keywords: Bone marrow, Filgrastim, Leukopenia, Parvo virus

Canine parvo virus (CPV) enteritis is a contagious disease affecting young puppies, reported to have high morbidity and mortality despite of aggressive therapy (Nandi and Kumar, 2010). CPV targets the haemopoietic progenitor cells of bone marrow and can cause direct destruction of active myeloblasts result in leukopenia. Leukopenia is also related to massive loss of neutrophils through inflamed intestinal wall as well as due to neutrophil margination in response to sepsis (Prittie, 2004). Marked leukopenia even after initiation of treatment in CPV enteritis is attributed to poor prognosis as it makes the animal more susceptible to secondary bacterial infection and that lead to septicemia (Goddard *et al*., 2008). Granulocyte colony stimulating factor (G-CSF) impart in the synthesis, development, maturation and release of neutrophils from the bone marrow (Dale *et al*., 1993). G-CSF effectively used in the management of cyclic hereditary neutropenia, neutropenia induced by chemotherapy and CPV infection. Administration of G-CSF along with routine therapy shown to improve the survival rate of CPV affected dogs in previous studies (Armenise *et al*., 2019; Punia *et al*., 2021). This report briefly describes the management of leukopenia associated with CPV enteritis.

Case History and Observations

A four-month-old male Labrador retriever puppy was presented to Referral Veterinary Polyclinic, ICAR-IVRI with the complaint of anorexia, vomiting and bloody diarrhoea for the past four days (Fig 1 and 2). Dog had received supportive therapy with intravenous fluids, antibiotics, antihistamine, antiemetic and vitamin B complex for the past two days with no improvement. Dog had 1st dose of multicomponent vaccine and dewormed one month back. Anamnesis also revealed death of another puppy showed similar clinical signs. Faecal samples were collected using sterile swabs and it was negative for parasitic oocysts and ova. Considering the age, history and clinical symptoms the case was tentatively diagnosed as parvoviral gastroenteritis and further confirmed by using rapid CPV antigen detection kit.

The dog was recumbent at the time of presentation and developed signs of hypovolemic shock. Clinical examination revealed congested and dry mucous membrane, pyrexia (103.3º F), extreme dehydration (>12%), sunken eyes, appreciable loss of skin turgor, elevated capillary refill time (>2 sec), rapid feeble pulse and cooled body extremities. The respiratory rate was 30/min and heart rate was 102 bpm. Blood examination revealed severe leukopenia with WBC count of $0.3\times10^3/\mu L$.

Treatment

Aggressive fluid therapy was given at the dose rate of 90 ml/kg intravenously with Inj. Ringer lactate and Inj. Normal Saline. The dog also received symptomatic and supportive treatment with antibiotics; amoxicillin-sulbactam (Amoxirum forte®) @ 8 mg/kg q 12h IV, metronidazole (Metrogyl®) @ 20 mg/kg q 12h IV, proton pump inhibitor; pantoprazole (Pantop®) @ 1 mg/kg q

*Corresponding author: raguivri@gmail.com

Fig 1. Clinical presentation of the dog

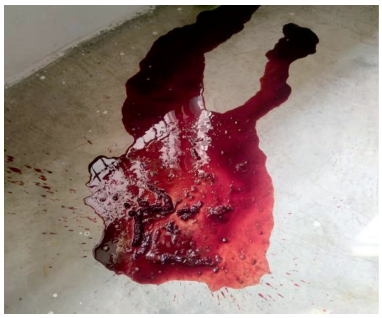

Fig 2. Haemorrhagic diarrhoea

Fig 3. Dog showing improvement after therapy

24h IV, antiemetic; ondansetron (Emeset®) @ 0.5 mg/kg q 12h IV, hemostat; hemocoagulase (Botropase®) @ 1 ml IV q 24h, vitamin B complex (Eldervit®) 1ml IM q 24h for 5 days. Acute neutropenia was treated with single injection of filgrastim (recombinant human granulocyte colony stimulating factor) (Neukine®) @ 5 mcg/kg SC. The dog was kept under observation and complete haematology was performed after 48 h and 96 h of filgrastim administration. Peripheral blood smear was prepared and differential leucocyte counting was done after 48 h and 96 h of therapy. Animal showed marked elevation in total leucocyte count and improvement in clinical condition after 48 h of filgrastim administration and had uneventful recovery at the end of treatment (Fig 3). Changes in the clinico-hematological parameters before and after treatment are depicted in the Table 1 and 2.

Discussion

Unvaccinated puppies are highly susceptible to CPV infection. In this case the dog had received one dose of vaccine prior to infection. Lack of protective immunity (Carr-Smith *et al*., 1997), interference from maternally derived antibodies in dogs less than 3 months of age (Day *et al*., 2016) and vaccine failure could be the possible reasons for the development of severe clinicopathological abnormalities. Anemia and leucopenia are the consistent findings associated with CPV enteritis (Chalifoux *et al*., 2021). Haemorrhage of the intestinal tract and suppression of erythropoiesis in the bone marrow attributed to low hematocrit and less number of circulating red blood cells during the period of infection. Acute leukopenia is an alarming sign of unsatisfactory outcome. Onset of clinical signs in CPV enteritis usually preceded the onset of

Table 1. Pre and post treatment clinical examination findings

Parameters	0th day	3rd day	5th day	Reference range
Rectal temperature	103.3°F	102.4°F	102.1°F	99.5-102.5°F
Color of mucous membrane	Congested and dry	Congested	Pale	Pale roseate
Respiration per min	30	Severe panting	30	10-30
Heart rate per min	102	-	110	80-120
Hydration status	Extreme dehydration (>12%)	Normal	Normal	Hydrated

(Reference range: Saunders Manual of Small Animal Practice, 3rd edition)

Table 2. Pre and post treatment haematology findings

Parameters	0th day	3rd day	5th day	Reference range
Haemoglobin (g%)	11.7	**7.5**	**7.8**	11.9-18.9
Total erythrocyte count (10^6/µL)	5.33	3.87	4	4.95-7.87
Total leukocyte count (10^3/µL)	0.3	27	24	5.0-14.1
Differential leukocyte count (%)	Unable to count	N:40; L:53; M:7; E:0; B:0	N:79; L:18; M:2; E:1; B:0	N:58-85; L:18-21; M: 2-10; E:0-9; B:0-1

(Reference range: The Merck Veterinary Manual, 10th edition)

neutropenia. Plasma concentration of endogenous G-CSF is remained undetectable during the onset of neutropenia and apparent when neutrophil nadir occurs (Cohn *et al*., 1999). Therefore, administration of exogenous G-CSF at the onset of neutropenia or clinical signs may be beneficial in ameliorating leukopenia induced by CPV. Filgrastim is recombinant human granulocyte colony stimulating factor reported to enhance the production and release of active neutrophils from the bone marrow within 24 h of administration. Improvement in total leukocyte count in 24 h of hospital admission increases the likelihood of survivability (Goddard *et al*., 2008). Although monocytes or lymphocytes are not target sites for the action of G-CSF, acute rise in number of these cells was observed (Duffy *et al*., 2010; Armenise *et al*., 2019) with single injection of filgrastim followed by increase in the neutrophil count.

Conclusion

The study suggests that G-CSF causes marked stimulation of lymphocytes, monocytes and neutrophils and can be effectively used as an adjunctive in treatment protocol of CPV gastroenteritis.

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Received : 11.01.2023
Accepted : 27.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 110-112

Juvenile cellulitis in a Labrador Retriever pup- A case report

Surbhi Gupta[*1], *Sushma Chhabra*[1], *Gurpreet Singh Preet*[2], *and Abrar Ul Haq*[1]
[1]Department of Veterinary Medicine [2]Department of Teaching Veterinary Clinical Complex
College of Veterinary Science, GADVASU, Ludhiana, Punjab (India)-141004

Abstract

A 2 months old Labrador retriever puppy was presented with acute onset of marked muzzle inflammation and pustular dermatitis, markedly enlarged submandibular lymph nodes, bilateral ear discharge without systemic signs involvement as such. Impression smears revealed sterile pyogranulomatous inflammation. Treatment included high-dose corticosteroids and antibiotics. One week after presentation the puppy showed a significant decrease in inflammation and healing pustules following immunosuppressive corticosteroid therapy. Animal recovered uneventfully after 14 days of therapy.

Keywords: Dogs, Juvenile Cellulitis, Puppy Strangles, Pustular Dermatitis.

Puppies can develop the idiopathic skin condition between the ages of three weeks and six months, known as juvenile cellulitis/puppy strangles. Although the illness is not fully understood, since lesions respond to glucocorticoids strongly, it appears to include an immune-mediated component (Gardbaum, 2009). It is characterized by lymphadenitis, pyogranulomatous (neutrophils and macrophages) dermatitis, and sterile granulomas and pustules. Increased prevalence in specific breeds and familial histories of the illness support hereditability. Breeds that are prone to this condition include Labrador retrievers, Siberian Huskies, Golden Retrievers, Miniature Dachshunds, and Lhasa Apsos (Snead and Lavers, 2004). Facial swelling, considerable mandibular and prescapular lymphadenopathy, oedema, exudate, papules, and pustules on the skin of the pinnae, face, muzzle, and pericocular region typically appear suddenly. Clinical symptoms, signalling, and the histology of skin biopsies and lymph nodes are used to make the diagnosis.

Case History and Observations

A 2 months old male Labrador retriever puppy was presented to small animal clinics, GADVASU, Ludhiana, India with acute onset of pustular inflammation affecting the skin primarily in the muzzle, rostral chin (Figure 1), inguinal (Figure 2), aural canals (Figure 3) and anal area. No vomiting or diarrhea was observed as such. Animal was not vaccinated till the date he was presented to the clinics. The puppy was bright, active and alert, however, there was intense itching in both ears due to pustular discharge causing head shaking and appeared restless. On physical examination, the sub-mandibular lymph nodes were mildly enlarged and the remaining features were within normal limits. Upon slight pressure on lesions, yellow exudate oozed from the facial and ear pustules. All other vital parameters like temperature, pulse rate and heart rate and respiration rate were within the normal limits. Cytological features of an impression smear from pustule exudate were examined and showed neutrophils, macrophages and with no organisms suggesting inflammation to be sterile (Figure 7). Further diagnostics were not pursued as clinical signs were clearly indicating the disease. Therefore, a provisional diagnosis of juvenile cellulitis was made based on the clinical symptoms and confirmation of sterile pus. Hematological analysis revealed relative neutrophilia with moderate left shift and mild toxic changes along with normocytic normochromic anemia. Additional diagnostics such as histopathological examination may have supported the

Figure 1: Symmetrical pustular dermatitis with marked erythema seen at muzzle area

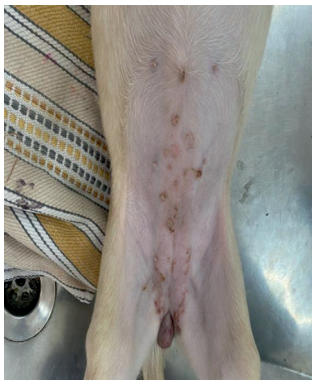

Figure 2: Pustular dermatitis was seen at inguinal area and ventral abdomen.

*Corresponding author: surrometra05@gmail.com

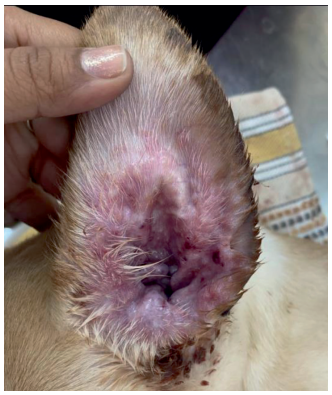

Fig. 3: Severe aural inflammation and pustules with discharge in both ears.

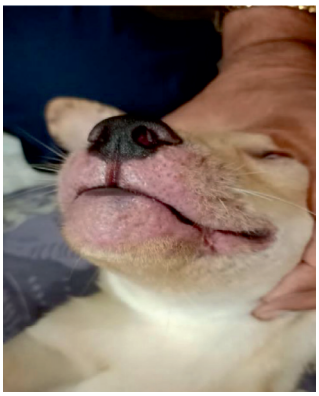

Fig. 4: Healed pustules with mild erythema and alopecia noted post 14 days of treatment.

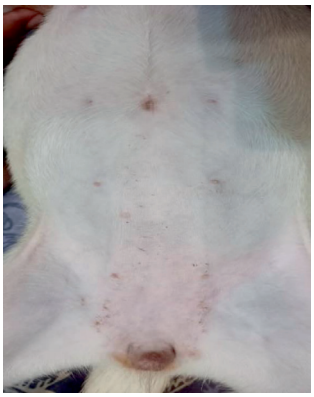

Fig. 5: Recovery of pustules post 2 weeks of treatment with corticosteroids and antibiotic.

Fig. 6: Improvement in discharge and pustules seen after 14 days treatment.

presumptive diagnosis but was not performed due to owner compliance.

The puppy was treated with oral prednisone, 1mg/kg BW, q12h for 10 d, reduced to 1mg/kg BW, q24h for 10 d, then 0.5 mg/kg BW, q24h for 10 d, and cephalexin (sporidex; Redimix), 22 mg/kg BW, PO, q12h for 10 d. Antibiotic was prescribed in order to prevent secondary infections and to treat neutrophilia with left shift. After just one week of initiating the treatment marked improvement was seen in the lesions. Animal was bright and alert, with marked decrease in inflammation, especially in ear canals and muzzle region, inguinal lesions were almost healed (Figure 4, 5, 6). Alopecia with mild erythema in the facial regions and previously affected pustules of muzzle area were almost gone (Figure 4). The aural pustules remained but were healing at a slower rate (Figure 6). The pup showed complete resolution of skin lesions and no signs of reoccurrence were noticed after one month.

Discussion

Puppy strangles, juvenile sterile granulomatous dermatitis and lymphadenitis, and juvenile pyoderma are other names for juvenile cellulitis, a rare granulomatous and pustular illness that frequently affects young dogs' faces, pinnae, and submandibular lymph nodes (Kumar *et al*., 2013, Dubey *et al*., 2013, Hutchings 2003). The age of onset typically ranges from 3 weeks to 8 months (Kumar *et al.*, 2013). Although there is no proven gender predisposition, (Mason *et al*., 1989; Scott *et al*., 2007) but greater susceptibility of several genotypes, including those of the Golden Retriever, Miniature Dachshund, Labrador Retriever, Siberian Husky, and Lhasa Apso, provides evidence of genetic predisposition (Snead and Lavers, 2004; Bassett *et al*., 2005). Fever, lymphadenopathy, and bilaterally symmetric, wet, itchy lesions in the periocular areas, face, nose, pinnae, and occasionally inguinal regions that proceed to crusting and baldness are among the clinical manifestations (Dubey *et al*., 2013). When the pustules' exudate is examined, it shows pyogranulomatous inflammation without any bacteria. Leukocytosis, neutrophilia, and normocytic-normochromic anaemia are common results on complete blood counts that are combined with cytologic and histopathologic examination to provide a definitive diagnosis (Kumar *et al*., 2013, Dubey *et al*., 2013, and Bassett *et al.,* 2005). Prednisolone, a glucocorticoid that has been shown to be an effective anti-inflammatory, should be used sparingly in a well-thought-out oral therapy regimen, either alone or in combination with

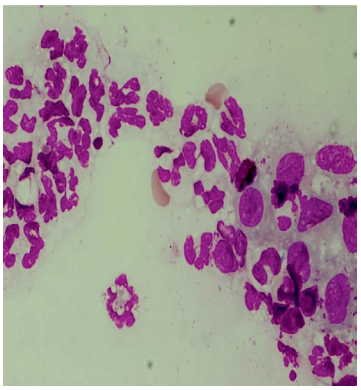

Fig. 7: Photomicrograph showing presence of abundant neutrophils and macrophages with no evidence of micro-organism (Leishman stain x100).

a broad-spectrum antibiotic, to treat canine juvenile cellulitis. Prednisolone/Prednisone at 2.0 mg/kg OD or Dexamethasone at 0.2 mg/kg OD, PO over the prescribed period have both been shown to be effective (Scott *et al*., 2001; Medleau *et al*., 2001; Hutchings, 2003; and Rhodes, 2004). A single systemic antibiotic is ineffective (Medleau *et al*., 2001; Scott *et al*., 2001; Hutchings, 2003; Bassett *et al*, 2005). By facilitating the clearance of harmful surface detritus and having a smoothing effect, topical therapy using moist magnesium or aluminium sulphate soaks can help reduce discomfort (Medleau *et al*., 2001; Scott *et al*., 2001). Canine distemper, demodicosis, bacterial pyoderma, dermatophytosis, and an unfavourable medication reaction are among the main differential diagnoses (Dubey *et al*., 2013). Sterile pus on cytology, reactivity to corticosteroids, and drug-related causes are all indicators that should be ruled out. To rule out infectious or drug-related causes, sterile pus on cytology and responsiveness to corticosteroid therapy help support a preliminary diagnosis of juvenile cellulitis.

Acknowledgement

We are thankful to Director and Head of TVCC, GADVASU Ludhiana for providing the financial support to conduct clinical study at Department of Teaching Veterinary Clinical Complex in the University.

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Received : 19.12.2022
Accepted : 25.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 113-114

Nasal tooth in a sheep- A case report

Raja Aijaz Ahmad[1], Hakim Athar[2], Abdul Qayoom Mir[3], Mujeeb-ur-Rehman Fazili[1], Shahid Hussain Dar[1], Mudasir Bashir Gugjoo[1]*

[1]Division of Clinical Veterinary Complex, [2]Division of Surgery and Radiology, [3]Research Centre for Sheep and Goat, FVSc and AH, SKUAST, Kashmir, Shuhama-Alusteng, 190006, India

Abstract

A ewe was presented with a month long history of nasal discharge, respiratory stertor and loss of weight for over a month. Clinical examination revealed unilateral nasal discharge, asymmetry of nose and a pinkish mass protruding from right nostril. Palpation of the mass with finger revealed a hard consistency. Skull radiographs were taken in lateral and dorsoventral views, which revealed a tooth in the nasal chamber. A haemostat was used to grasp and gently remove the tooth. The ewe made an uneventful recovery. Sheep with signs of nasal discharge and irritation should be examined for presence of nasal foreign bodies.

Key words: Sheep, nasal tooth, skull radiograph, bone loss

Presence of teeth in nasal cavity is described as a form of supernumerary teeth, a rare condition in humans (Chen *et al.,* 2002). The etiology of intranasal teeth is unclear with cleft palate, maxillofacial trauma, Gardner's syndrome and cleidocranial dysostosis being described as potential causes (Choudhary and Das, 2008; Lee 2001; Lin *et al*., 2004; Moreano *et al*., 1989). Although obstruction of nares in sheep is attributed to a variety of causes like papilloma, adenocarcinomas, papillary adenoma, nasal polyps, parasites and foreign bodies (Rings and Rojko, 1985; Sid *et al*., 2018; Wenzel *et al*., 2018), no report of nasal obstruction due to a tooth has been described.

Case History and Observations

An eight year old ewe (*Ovis aries*) was presented with one month history of nasal discharge and protruding mass from the right nostril.

Clinical exam revealed stertous inspiration, a pinkish round soft tissue mass visible in the external nares (Fig. 1) and mucopurulent nasal discharge from the right nostril. The ewe had a body condition score of 2 and had been losing weight since the lesion was noticed. The mass caused asymmetry of the nostrils.

On palpation, a hard, non-fluctuating mass was palpable in the right nostril. Radiograph in lateral (Fig. 2) and dorsoventral (Fig. 3) views of the skull revealed a tooth like structure in the right nasal chamber, one molar tooth was also found missing in the upper jaw with maxillary bone loss.

The ewe was sedated using diazepam (0.2mg/Kg IV) and local anaesthetic (3ml, Lignocaine HCL 2%) was sprayed into the right nasal chamber. The mass was then grasped with a tissue forceps and was retrieved after applying some pressure. Mild nasal haemorrhage noticed was controlled by local application of 1 in 1000 adrenaline. The extracted mass was found to be a tooth after removal of the surrounding granulation tissue (Fig. 4). The animal made an uneventful recovery.

Discussion

Sheep with obstruction of nasal cavity frequently rub their face against fixed objects. Frequent head shaking, sneezing, snorting, licking of nose, unilateral nasal discharge with foul odor are the typical symptoms. Differential diagnosis of nasal cavity obstruction includes foreign bodies, papillomas, adenocarcinomas, papillary adenoma, nasal polyps and parasites.

Specific pathogenesis of tooth loss in sheep is not clear. It may result from repeated episodes of acute gingivitis (Spence *et al.,* 1980; Moxham *et al*., 1990). Radiographic evidence of bone and tooth loss in maxilla suggests that the tooth migrated into the nasal chamber and subsequent to sneezing it got struck rostrally as size of the nasal chamber decreases. Nasally displaced tooth has not been reported in farm animals but there is a report of nasally displaced mesiopalatal tooth root in a miniature Dachshund dog (Taylor *et al.,* 2004). Intranasal tooth in humans are completely or incompletely embedded in the nasal mucosa and have been removed either surgically

*Corresponding author: aqmirrp@gmail.com

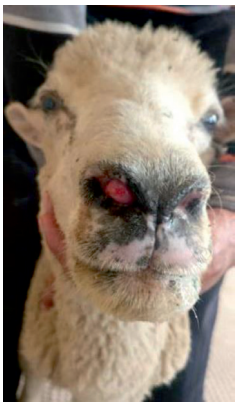

Fig. 1: Asymmetry of nose with pinkish mass protruding from right nostril of ewe

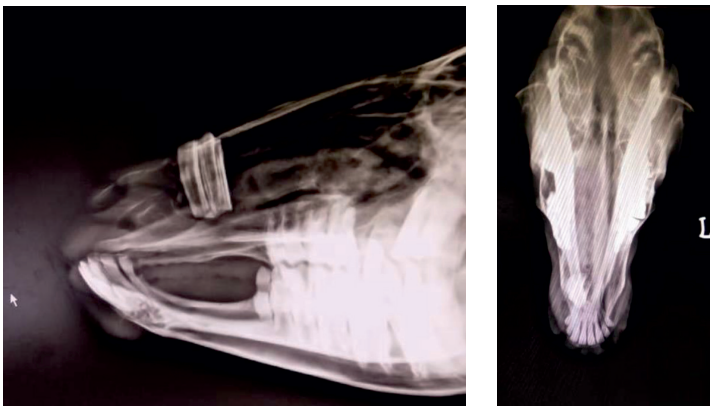

Fig. 2 & 3: Lateral and Dorsoventral radiographs of skull showing a tooth in the right nasal cavity. A missing upper molar with bone loss is visible in the right maxilla.

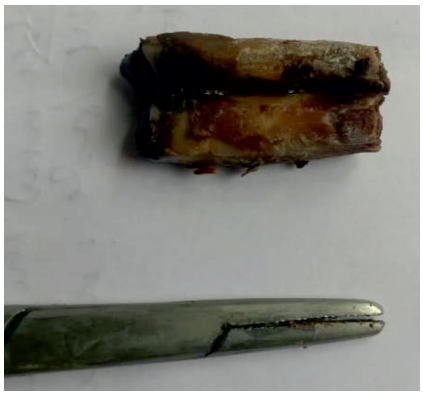

Fig. 4: Tooth removed from right nostril

or via endoscope. In the present case, the tooth was incompletely embedded in the nasal mucosa and was easily removed via nasal approach.

In conclusion, sheep with signs of nasal discharge and irritation should be examined for presence of nasal foreign bodies. Diagnostic techniques like radiography and endoscopy if available should be used to differentiate between nasal bodies and their possible retrieval.

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Received : 06.12.2022
Accepted : 22.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 115-118

A case of meningioencephalitis resembling listeriosis in a Nili Ravi buffalo calf

Adil Majid Bhat[1], Jagmeet Kaur[2], O.K. Baba[2], S.T.Singh[1], R.S.Grewal[1]*

[1]Directorate of Livestock Farms, [2]Department of Veterinary Pathology, College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab

Abstract

The present case report describes meningioencephalitis resembling listeriosis in a 25 day old niliravi buffalo calf. The calf was found in the recumbent position with clinical signs of opisthotonus, nystagmus, muscle twitching and thrashing of limbs. The animal was having elevated rectal temperature, tachypnea, tachycardia and colour of mucous membrane was brick red. Menace reflex and pupillary light reflex were negative in both eyes. CSF analysis revealed turbidity, pleocytosis, increased specific gravity and total protein concentration. Cytology of CSF revealed mix of neutrophils and monocytes with predominance of monocytes. Culture of CSF on blood agar revealed no growth. Histopathology of meninges revealed meningitis with congestion, hemorrhage & infiltration of neutrophils and mononuclear cells. In brain stem there was encephalitis and microabscess formation in the vicinity of white matter. The meningioencephalitis was characterized by accumulation of mononuclear cells and few neutrophils resulting in meningitis with vasculitis and perivasculitis, and with extensive mononuclear cuffs within the neuroparenchyma. The findings of histopathology and clinical signs were strongly suggestive of meningioencephalitis due to *L.monocytogenes*. The case highlights the occurrence of nervous form of listeriosis in buffalo calves.

Keywords: Meningioencephalitis, Calf, Microabscess, *L. monocytogenes*

Meningioencephalitisis often considered as the complication of neonatal sepsis as similar organisms are responsible for both conditions. Gram negative bacteria especially *E.coli* is the commonly reported bacterial pathogen responsible for meningitis in neonatal calves (Cordy *et al*. 1984; Green *et al*. 1992; Scott and Penny, 1993; Ferrouillet *et al.*, 1998). Several bacteria like *Enterobacterspp*., *Salmonella spp., Streptococcus spp.* and *Listeria spp.* have been reported to cause meningioencephalitis in calves (Smith, 2015). Listeriosis has been reported to cause three clinical forms in domestic animals: septicemic form affects ruminants, pigs and birds (Jones *et al*., 2000); nervous form which presents as meningioencephalitis and reproductive form that causes abortion in sheep and cattle (George *et al.*, 2002). Only one clinical form of listeriosis is reported at one time and nervous form is usually associated with *Listeria monocytogenes* (Jones *et al*., 2000). *L. monocytogenes* is distributed worldwide and occurs mainly in temperate areas. The nervous form of listeriosis shows low morbidity and high mortality (Rissi *et al*., 2010). The encephalitic form of listeria has been reported in cattle, sheep and goats (Konradt *et al*., 2017) and in buffalo only one report is available about nervous form of Listeriosis (Prado *et al*., 2019). We here report a case of meningioencephalitis in a niliravi buffalo calf.

*Corresponding author: adil.majid724@gmail.com

Case History and Observations

A 25 day old buffalo calf of niliravi breed was found in the recumbent position at the calfpen with signs of opisthotonus and muscle twitching. The animal had normal milk intake and milkman had observed neck extension during milk feeding. The calf was born normally with birth weight of 38 kgs and was fed colostrum immediately after birth. The calf had history of diarrhea and had recovered after treatment with antibiotics and fluid therapy.

On physical examination the animal was conscious, recumbent with neck extended, had nystagmus, muscle twitching and thrashing of limbs. No abnormal discharge and faecal stains were observed. The animal had elevated rectal temperature (104 F), tachypnea (65 breaths per minute), tachycardia (150 beats per minute) and colour of mucous membrane was brick red. Menace reflex and pupillary light reflex were negative in both eyes.

Clinical pathology

A complete blood cell count (CBC) (Table 1), serum biochemistry (Table 2) and CSF analysis (Table 3) was done. Blood and CSF samples collected under asceptic conditions were submitted for culture. At necropsy samples from brain were collected in 10 % neutral buffered formalin for histopathology.

Table 1. Haematological parameters of a calf with neonatal bacterial suppurative meningitis

S.No	Parameter	Values
1.	Haemoglobin (g/dl)	13.5 g/dl
2.	Leukocytes	15, 300/ul
3.	Erythrocytes	8.64 X10^6/ul
4.	PCV (%)	34.2 %
5.	Platelets	336 X 10^6/ul
6.	Neutrophils	58 (8874)
7.	Lymphocytes	40 (6120)

CBC revealed absolute neutrophillic leukocytosis with mild left shift. Serum biochemistry revealed hypoproteinemia (5.1 g/dl), hypoalbuminemia (2 g/dl), hypokalemia (3.1 mEq/l), and hypochloremia (92 mEq/l).

Analysis of CSF revealed increased turbidity, pleocytosis, increased specific gravity and total protein concentration. On cytology, there was mix of neutrophils and monocytes with predominance of monocytes. Culture of CSF on blood agar revealed no growth.

Postmortem findings and histopathology

Autopsy revealed marked congestion of brain and thickening of meninges. Histopathology of brain revealed menigoencephalitis. Meningitis was characterized by congestion, haemorrhage& infiltration of neutrophils and mononuclear cells (Fig. 1). In brain stem, there was encephalitis and microabscess formation (Fig. 2) in the white matter along with spongiosis, and haemorrhages (Fig. 3). There was also neuronal degeneration characterized by satellotosis, gliosis and neuronophagia. In addition there was marked perivascular cuffing composed mainly of mononuclear cells consisting mainly of macrophages and lymphocytes (Fig. 4).

Table 3. Cerebrospinal fluid analysis of a calf with neonatal bacterial suppurative meningitis

S.no	Parameter	Values
1.	Color	Turbid
3.	Sp gravity	1.025
4.	Total protein (g/dl)	1 g/dl
5.	Na	147 mEq/l
6.	K	19.7 mEq/l
7.	Cl	104 mEq/l
8.	Mg	1 mg/dl
9.	Glucose	20 mg/dl

Table 2. Serum biochemistry of a calf with neonatal bacterial suppurative meningitis

S.no	Parameter	Values
1.	Bilirubin (0 – 0.8 mg/dl)	0.8 mg/dl
2.	AST (45 – 110 u/l)	135 u/l
3.	Total Protein (6.2 – 8.1 g/dl)	5.1 g/dl
4.	Albumin (2.3 – 3.9 g/dl)	2 g/dl
5.	GGT (4.9 – 26 u/l)	33 u/l
6.	BUN (7.8 – 25 mg/dl)	22 g/dl
7.	Creatinine (0.5 – 1.6 mg/dl)	2.1 g/dl
8.	Sodium (135 – 148 mEq/l)	136 g/dl
9.	Potassium (4.5 – 8 mEq/l)	3.1 mEq/l
10	Chloride (96 – 109 mEq/l)	92 mEq/l
11	Calcium (8.4 – 11 mg/dl)	11.5 mg/dl
12	Phosphorus (4.3 – 7.8 mg/dl)	8.4 mg/dl
13	Magnesium (1.7 – 3 mg/dl)	2.1 mg/dl
14	Glucose	89 mg/dl

Discussion

In this case report we discuss a case of meningioencephalitis resembling listeriosis in a niliravi buffalo calf. The disease is reported in ruminants of any group and the incidence is high upto age of three years (Gary and Killinger 1996). In the present case, the affected calf was 25 days old. The animal was found in lateral recumbency with extended neck, and the other clinical signs observed include fever, nystagmus, muscle twitching and thrashing of limbs. In both cattle and sheep, the clinical signs observed include lateral recumbency, limb paralysis, ataxia and ultimately death (Rissi et al. 2010; Margineda et al. 2012). Fever has been reported in early course of disease in cattle (Smith, 2005).

The case was acute in nature and diagnosis was done on the basis of cytological examination of CSF and histopathology of brain stem. The cytological evaluation of CSF revealed increased turbidity, specific gravity (1.025), total protein concentration (1 g/dl), white cell concentration (900/ul) and presence of large number of monocytes. The CSF protein concentration and specific gravity was found to be similar to reported in ovine (Scott, 1993) and bovine listeriosis (Rebhun and Delahunta, 1982). On cytology pleocytosis was observed with a mix of neutrophils and monocytes, with predominance of monocytes. Similar findings have been reported by Scott *et al*. (1993). CBC revealed neutrophilic leukocytosis. No significant changes were observed in serum biochemical

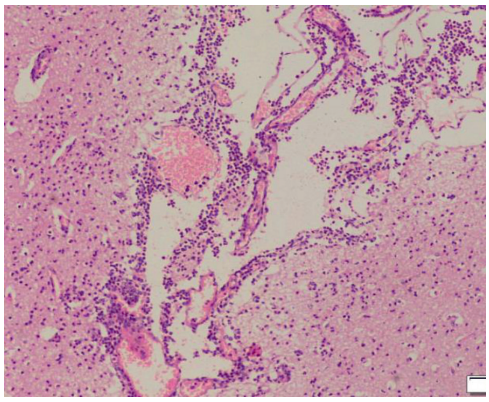

Fig. 1. Meningitis characterised by congestion, haemorrahage & infiltration of neutrophills and mononuclear cells. (H&E × 100)

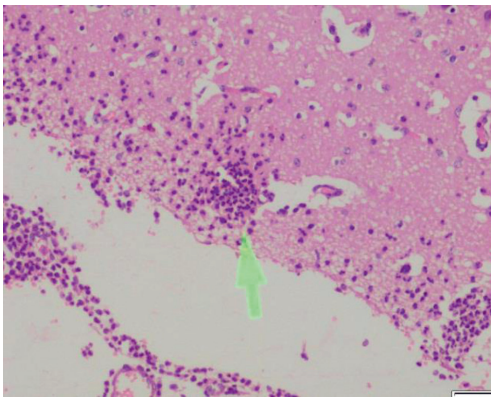

Fig. 2. Encephalitis and microabscess formation in the brain stem. (H&E × 200)

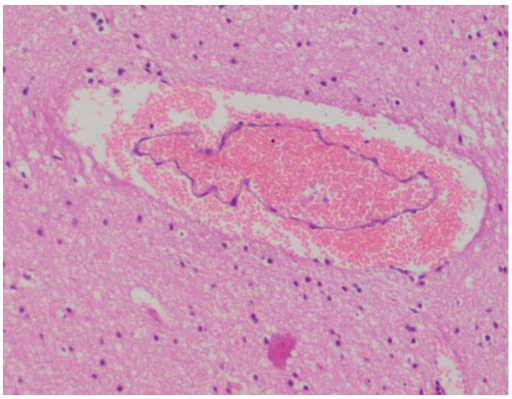

Fig. 3. Brain haemorrhage, leaking of RBC's in the perivascular space. (H&E × 400)

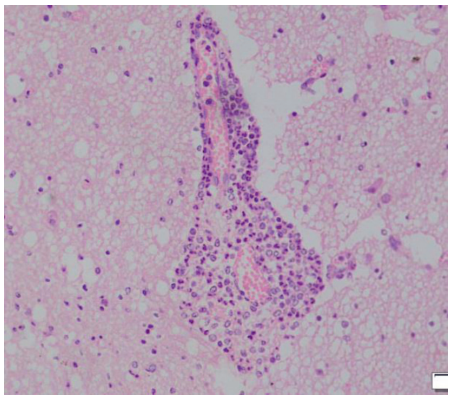

Fig. 4. Perivascular cuffing characterised by inflamatory cells including macrophages and lymphocytes present at the brain stem. (H&E × 400)

parameters.

The significant lesions present on histopathology were presence of microabscesses and perivascular cuffing in the brain stem. Similar lesions have been reported in meningioencephalitis associated with *Listeria monocytogens* in cattle (Oevermann *et al.,* 2010; Headley *et al*., 2013) and sheep (Rissi *et al.*, 2010; Headley *et al*., 2013).Neurologic form of listeriosis manifests as a multifocal brainstem disorder, diffuse meningoencephalitis or myelitis. The condition usually affects individual animals but occasionally can affect several members of a herd (Akpave and Ikhelova, 1992). Presence of microabscesses are considered pathognomonic of listeriosis and are composed of neutrophil infiltrates with varying number of macrophages. The type of cells in the microabscess help in assessment of progression of encephalopathy classifying the disease as acute when neutrophils predominate the cellular population and in cases with advanced progression macrophages are found abundantly (Oevermann *et al.,* 2010). In the present case, the microabscesses were composed of both macrophages and neutrophils. Oevermann *et al*. (2010) reported that microabscesses show presence of larger number of macrophages in cattle than sheep and goats. Prado *et al*. (2019) reported presence of large number of macrophages and multinucleated cells in a case of nervous Listeriosis in buffalo calf. The perivascular cuffs were mainly composed of mononuclear cells consisting mainly of macrophages and lymphocytes. Similar findings have been reported in cattle (Galiza *et al*., 2010, Margineda *et al*., 2012), small ruminants (Campero *et al*., 2002, Headley *et al*., 2013) and buffalo (Prado *et al*., 2019).

In India, *L. monocytogenes* and *L. ivanovii* has been recovered from milk samples of mastitic cattle and buffaloes. The recovery of pathogenic *L. ivanovii* isolate from faeces of buffalo with mastitis, could serve as a probable source of infection for the other animals (Rawool *et al*., 2007). There has been no

report of Listeriosis in buffalo calf. It was not possible to determine the source of infection but the farm has a history of abortion in pregnant animals. According to George (2002), listeriameningoencephalitis not related to feed are commonly associated with environmental contamination. In this case mothers milk could have been the source of infection, since excretion of *L.monocytogens* has been described in cattle milk after mastitis or abortion (Quinn *et al*., 2001).

In conclusion,the presence of neurological signs and histopathological findings are strongly suggest the present case as neurologic form of listeriosis. The findings in the present case report will be an important addition to literature existing on listeriosis in buffaloes.

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Received : 16.12.2022
Accepted : 15.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 119-121

Management of pyoderma in a sloth bear

A.S. Shalini[1], V.M. Dhoot[1], S.V. Upadhye[1], M.D. Pawshe [1] and S.M. Kolangath[1]*
Wildlife Research and Training Centre, Gorewada, Nagpur

Abstract

A male sloth bear about 4.5 yrs was brought from Bramhapuri, Chandrapur (Dist.) to Wildlife Research and Training Centre, Gorewada, Nagpur with the history of injury at the abdominal region. On Clinical examination, it was found that the animal had intense pruritus, diffuse alopecia, purulent and foul smelling discharge with slugging of skin at the ventral side of the abdomen. Evaluation of skin scrapping revealed that it was negative for mange parasites and skin impression smear was found to be negative for yeast infection while Gram staining revealed gram positive cocci in clusters indicating staphylococcus infection. Haematological examination was done and it was found that there was neutrophilia along with leukocytosis. Serum Biochemistry (BUN, Cr, Total protein, albumin, Globulin, SGOT, SGPT, ALP) was within normal range. On the basis of clinical, haemato-biochemical and skin scrapping examination, it was confirmed to be a case of pyoderma. The animal was treated with Inj. Amoxicillin and clavunate, Inj. Dipyrone and Inj. Phernaramine maleate given intramuscularly for a period of 7 days. Tab. Bcozyme C forte given perorally for a period of 30 days. Also, dressing of ventral abdomen was done by spraying povidine iodine. The Sloth made uneventful recovery.

Key words: Sloth Bear, Pyoderma, Haemotology, Skin Scrapping

Pyoderma refers to any pyogenic infection of the skin and is most commonly used in reference to bacterial skin infections. It results from impaired local defense mechanisms, which permit secondary bacterial invasion of the skin (Diaz, 2020). Dermatitis and alopecia are frequent findings and have been tied to atopy, mange, and dermatophilosis in several bear species. More commonly, hair loss results from abrasion on artificial rockwork or concrete floors with secondary superficial bacterial dermatitis (Federick *et al.,*2018). Based on the depth of infection in skin layers, it is of two types deep pyoderma and superficial pyoderma. In deep pyoderma infection from distal parts of hair follicle extends beneath and beyond the confines of hair follicles (Paradis *et al.,* 2001). The primary pathogen involved in pyoderma is Staphylococcus spp. however; other gram negative bacteria are also involved (Reddy *et al.,* 2011). The exact cause and pathogenesis of the disease is due to increased susceptibility to Staphylococcus species which mostly proceeds to juvenile cellulitis. The lesions are mostly granular and pustular type, erythematous in appearances with crusts in outline (Kalim *et al.,* 2017). Pyoderma represents a large group of canine skin diseases that are difficult to treat. These are mostly inflammations of secondary nature linked to coagulase-positive Staphylococcus spp. Purulent skin inflammation is not a definitive diagnosis, but only a clinical symptom, which masks the main (primary or secondary) cause of the disease; sometimes several factors can play a role in triggering the disease. A major problem consists in increased pruritus which prevents the skin from healing. Self-mutilation due to the pruritus causes other infective skin changes (Sprucek *et al.,* 2007).

*Corresponding author: a.sshalini@yahoo.com

Case History and Observations

A male sloth bear about 4.5 yrs was brought from Bramhapuri, Chandrapur (Dist.) to Wildlife Research and Training Centre, Gorewada, Nagpur with the history of injury at the abdominal region. On Clinical examination, it was found that the animal had intense pruritus, diffuse alopecia, purulent and foul smelling discharge with sloughing of skin at the ventral side of the abdomen. The animal was ruled out for mange infection by examination of skin scrapping. Skin impression smear was found to be negative for yeast infection. For bacteriological examination, sterile swabs were immersed in sterile normal saline and samples of skin lesions were collected from 2-3 sites. Thin smears on glass slide were made, air dried and Gram-stained. After microscopical examination, gram+ cocci in clusters were identified indicating staphylococcus infection. Haematological examination was done and it was found that there was neutrophilia along with leukocytosis. Serum Biochemistry (BUN, Cr, Total protein, albumin, Globulin, SGOT, SGPT,

Fig 1. Pretreatment photo of sloth bear with diffuse pyoderma.

Fig 2. Recovered skin coat of sloth bear after successful treatment

ALP) was within normal range. On the basis of clinical, haemato-biochemical and skin scrapping examination, skin impression smear and presence of Gram + cocci in the smear, it was confirmed to be a case of pyoderma.

Treatment and Discussion

The animal was treated with Inj. Inj. Amoxicillin and clavunate combination @20mg/kg b.wt Inj. Dipyrone@ 40mg/kg b.wt and Inj. Phernaramine maleate 0.5 mg/kg.b.wt, given intramuscularly for a period of 7 days along with Tab. Bcozyme C forte given perorally for a period of 30 days. Also, dressing of affected area was done by spraying povidine iodine. The Sloth bear made uneventful recovery.

Staphylococcus sp is a normal commensal of animals skin but due to some change of the skin macro and micro environment, it becomes pathognomic and causes pyoderma. An appropriate antibacterial therapy is required in most cases of pyoderma, in association with topical therapy (Kalim *et al.*, 2017).

A recent systematic review found the evidence for efficacy of systemic anti-microbial drugs for treatment of superficial pyoderma to be good for cefovecin, fair for amoxicillin–clavulanate, clindamycin, cefadroxil, trimethoprim–sulphamethoxazole and sulfadimethoxine–ormetoprim and insufficient for cefalexin, cefpodoxime, ibafloxacin, marbofloxacin and lincomycin (Hillier *et al.*, 2014).

Amoxicillin being bactericidal -has activity against penicillin-sensitive gram-positive bacteria as well as some gram-negative bacteria. It targets and kills bacteria by inhibiting the biosynthesis of peptidoglycan layer of the bacterial cell wall and also readly diffuses into most body tissues/ fluids while clavulanate extends the spectrum of activity of amoxicillin to include beta-lactamase producing E. coli, Klebsiella, Proteus, and Staphylococcus species. On the other hand, the higher-generation cephalosporins have broad-spectrum activity against gram-negative bacteria. The third-generation cephalosporins and fluoroquinolones increase the incidence of extended-spectrum β-lactamase—producing bacteria, which are frequently multidrug resistant. Given the risk of widespread multidrug resistance, human and veterinary health organizations have developed consensus statements and guidelines regarding the use of higher-generation cephalosporins and fluoroquinolones. The Swedish Veterinary Association guidelines state that "third- or fourth-generation cephalosporins should only be used in situations where their use is considered of the utmost importance to the animal's welfare and where there is a sound basis to suspect that alternative treatments will not have the desired effect". In addition to this, the American College of Veterinary Internal Medicine consensus statement indicates that "limiting use of classes such as the third-generation cephalosporins and fluoroquinolones is widely accepted and consistent with principles of antimicrobial stewardship (Bloom, 2011)

Acknowledgement

The authors are thankful to MAFSU, Nagpur and FDCM Ltd. for facilities provided for smooth conduct of research.

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Received : 09.12.2022
Accepted : 19.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 122-123

Therapeutic Management of Spirocercosis In Labrador Dog

Y.R. Game, G.R. Bhojne, V.M. Dhoot, C.G. Panchbhai, V.V. Dhoot, S.P. Kale.*
Department of Veterinary Clinical Medicine, Ethics & Jurisprudence, Nagpur Veterinary College, Seminary Hills, Nagpur- 440 006, Maharashtra

Abstract

A male seven-year-old Labrador dog was presented to Veterinary Clinical Complex, Nagpur, with a history of chronic vomiting since last three weeks, inappetence and coughing. Radiographic examination shows a radiopaque structure in the mediastinal area. On faecal sample, examination revealed the presence of eggs of nematode *Spirocerca lupi.* For confirmatory diagnosis, an endoscopy was performed, which validated the presence of an oesophageal granulomatous nodule. The case was successfully treated with Doramectin @ 400 mcg/kg once weekly for seven weeks, along with supportive treatment.

Keywords: Spirocercosis, Oesophageal granuloma, Chronic vomiting

The nematode *Spirocerca lupi* is primarily a parasite of dogs, which causes typical lesions of esophageal nodular granulomas, aortic aneurysms, and spondylitis (Lavy E *et al*., 2002). Canines are infected by ingesting an intermediate host (coprophagus beetles) or other paratenic hosts (e.g., birds, lizards, mice, and rabbits). Larval stage three (L3) penetrates the stomach wall and migrates in the walls of gastric arteries to the thoracic aorta to the oesophagus. Adult S.lupi generally live in esophageal and gastric nodules. Clinically significant lesions are related to the parasite's migration route and final destination (Lobetti R *et al*., 2012). Esophageal lesions are associated with regurgitation and or persistent vomiting, ptyalism, and dysphagia, followed by weakness and emaciation. Sudden death may be caused by the rupture of an aortic aneurysm induced by the migration of worms in the aortic wall (Hylton Bark *et al*., 2003).

Case History and Observations

A seven-year-old male Labrador was presented to the Veterinary Clinical Complex, Nagpur, with a chief complaint of chronic vomiting since last three weeks, inappetence, regurgitation, and coughing with inspiratory dyspnea. On physical examination, the rectal temperature was 101.2°F. Stridor sound was heard on auscultation in the cranial thorax; for further investigation, thoracic radiography was performed, which revealed the presence of a radiopaque structure in the mediastinal area above the carina along with narrowing of the trachea (Fig. 1). Faecal sample examination was performed, and the sample was found positive for eggs of *Spirocerca lupi.* For confirmatory diagnosis, an esophagoscopy was performed, which validated the presence of an oesophageal granulomatous nodule(Fig. 2). Complete blood count(CBC) revealed increased neutrophilic leukocytosis, whereas other parameters were within the normal range (Table 1).

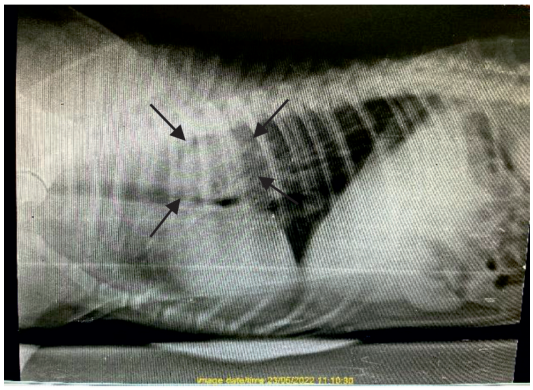

Fig. 1. Lateral radiograph showing a radiopaque structure in the mediastinum region.

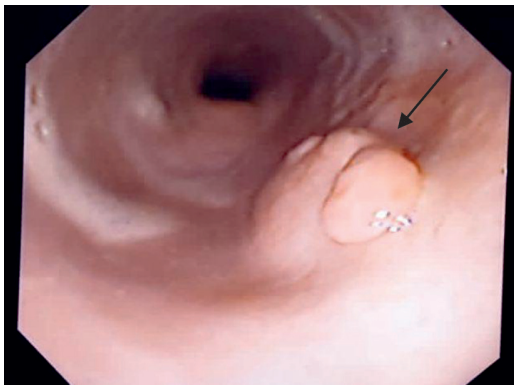

Fig. 2. Endoscopy showing an oesophageal granulomatous nodule

*Corresponding author: vinoddhoot@mafsu.in

Table 1. Complete Blood Count report

Parameter	Observed values
WBC (10^3)	20
PCV (%)	38
Neutrophils (%)	80
Thrombocytes (10^3/mm^3)	475

Treatment

The dog was treated with Doramectin @ 400 mcg/kg once in week s/c for seven weeks along with Inj.Ranitidine @ 2 mg/kg b.wt BID, Inj Ondansetron @ 0.3 mg/kg b.wt BID, Inj Amoxicillin &clavulanic acid 20 mg/kg b.wt BID with fluid therapy for three days. Regurgitation reduced after one week of treatment and the dog regained his appetite. Coughing decreased significantly in two weeks.

Discussion

In spirocercosis, lesions are caused by migration and persistent presence of larvae and adult organisms in the tissues, where oesophageal granulomas, aortic scars, and aneurysms are most commonly seen lesions. Michal Mozaki (2002) mentioned that large breeds were predisposed to infection compared to small breeds, among which the Labrador Retriever was significantly over represented. Hylton (2003) stated that the size of granulomas decides the severity of clinical signs and symptoms such as regurgitation, persistent vomiting, difficulty in swallowing, and ptyalism. Oesophageal granuloma appears on radiograph when they are large enough. Esophagoscopy is a confirmatory and sensitive diagnostic modality that directly visualises typical broad base protuberance with nipple like orifice (Mathios *et al*., 2008). Several anti-helminthics (diethylcarbamazine, disophenol, levamisole, albendazole, and fenbendazole) are used to treat canine spirocercosis but have limited efficacy, whereas avermectins; ivermectin and doramectin have better efficacy (Collies and other breeds are excluded). Lavy (2002), reported that multiple subcutaneous injections of doramectin (400 microg/kg) were shown to be effective and safe in the treatment of canine spirocercosis.

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Received : 11.12.2022
Accepted : 27.04.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 124-126

A Study of Chronic Fibrosis of Teat Canal in Bovines Treated with Homeopathy

S.S. Makker[1], S.S. Randhawa and S. Arora[3]*

[1]Department of Animal Husbandry, Govt. of Punjab, [2]Director Clinics, GADVASU Ludhiana and [3]Guest Faculty, Dr. B. R. Sur Homeopathic Medical College, Motibagh, New Delhi

Abstract

Fibrosis of Teat canal is commonly observed in most of the lactating animals where a hard fibrous cord like structure is observed in the teat which ultimately create hindrance during milking. Exact cause of this condition is not clear. However, repeated trauma due to mechanical injuries, thumb milking and calf suckling are the main contributory factors. Sometimes mastitis can also result into fibrosis of quarter followed by teat canal. This fibrotic cord will obstruct the teat canal and will create hindrance during milking. Fibrosed mastitic cattle do not usually respond to conventional antibiotic therapy and the affected teat is ultimately rendered non functional resulting in a considerable economic loss to cattle owners. The present study was therefore undertaken with an objective of evaluating the extent of efficacy of homeopathic treatment in chronic teat fibrosis. This study was conducted under field conditions on One hundred eight (108) out of which 38 were cows and 70 were Buffaloes of variable age and lactation that were suffering from varying degrees of teat fibrosis either diffuse or in form of fibrotic nodules of varying size near the base of teat cistern or tip of the teat or as hard fibrous cord like structure palpated in the teat cistern were selected. Animals were randomly allotted to three groups, A (n=14 Cow, 28 Buff.), B (n=14 Cow, 28 Buff.), and C (n=10 Cow, 14 Buff.), A recovery rate of 64.28% in Cows and 67.85% in Buffaloes in A group and 85.71% in Cows and 89.28% in Buffaloes in B group was achieved following oral administration of Homeopathic medicines, Phellandrium 30C and Carbo Animalis30C for a period of 21 and 42 days in group A and group B respectively. Whereas group C was kept as untreated control. In light of these reports and present observation it can be inferred that combination of homeopathic medicines, Phellandrium and Carbo Animalis can be effectively used in the treatment of Teat fibrosis in mastitis in cows and Buffaloes. Although the course of treatment is protracted yet it is safe and cost effective.

Key Words: Phellandrium, Carbo Animalis, Teat fibrosis.

Teat fibrosis, a common sequel of mastitis develops so gradually that it may escape observation until most of the secretary tissues are destroyed. Fibrosis may be diffused, involving whole quarter or local varying in size from pea like lesion to bigger masses near the base or tip of the teat (Blood *et al.,* 2006) or hard stone like swelling in teats. Mastitis is an economically important disease of cows and buffaloes. In India economic losses due to mastitis are estimated at 526 million US dollars annually. Conventional veterinary treatment relies on costly antibiotics; cure rate is only 60% in field conditions with a problem of milk residues.

Fibrosed mastitic cows and buffaloes do not usually respond to conventional antibiotic therapy and the affected quarter is ultimately rendered non functional resulting in a considerable economic loss to cattle owners. The present study was therefore undertaken with an objective of evaluating the extent of efficacy of homeopathic treatment in chronic Teat Fibrosis in bovines.

Clinical Observations

The study was conducted under field conditions on hundred eight cows and buffaloes of variable age and lactation. The cows and buffaloes showing varying degrees of fibrosis either diffuse or in form of fibrotic nodules of varying size near the base of teat cistern or tip of the teat or as hard fibrous cord like structure palpated in the teat cistern were selected. All the animals were reportedly treated earlier with conventional allopathic therapy with no improvement. The animals were randomly allotted to three groups. A (n=14 Cow, 28 Buff.)) 1ml of Phellandrium 30C in 5 ml of Luke warm water was administered orally thrice a day to each animal with help of Syringe directly in Mouth of each Cow and Buffalo. Carbo Animalis-30C was also administered in same dose and route keeping a time gap of half an hour between

*Corresponding author: dr.ssmaker@gmail.com

Table: 1 Recovery percentage following treatments of different duration

Group	No. of Cows Treated	No. of Buffaloes Treated	No. of Cows recovered	No. of buffaloes recovered	Percent recovery in cows	Percent recovery in buffaloes	Duration of Treatment (days)
A.42	14	28	9	19	64.28%	67.85%	21
B.42	14	28	12	25	85.71%	89.28%	42
C.24 (untreated control)	10	14	-	-	-	-	-

two administrations. The treatment was carried out for 21 days. In group B, (n=14 Cow, 28 Buff.) the same treatment regime was continued for 42 days while group C (n=10 Cow, 14 Buff.), did not receive any treatment and served as control. All the animals were examined weekly for signs of recovery up to 60 days. The percent recovery was calculated on the basis of clinical improvement observed following the treatment. The diagnosis of Teat fibrosis and recovery criterion was based on physical examination of teat and milk and certification of the concerned farmer. Bacteriological analysis and somatic cell count were not performed.

A marked response to treatment was observed within a week. Flakes in certain cases started coming out of fibrosed teats on stripping and a complete recovery was achieved in 9 Cows and 19 buffaloes of group A and in 12 Cows and 25 Buffaloes of group B (Table 1). Animals of group C did not show any improvement during the course of trial. Relapsing of the signs was not noticed in any of the recovered cases up to next 30 days. Over all recovery rate of 64.28% in Cows and 67.85% in Buffaloes in A group and 85.71% in Cows and 89.28% in Buffaloes in B group was achieved following oral administration of Homeopathic medicines, Phellandrium 30C and Carbo Animalis30C for a period of 21 and 42 days in group A and group B, respectively.

Discussion

Fibrosis of Teat canal is commonly observed in most of the lactating animals where a hard fibrous cord like structure is observed in the teat. Exact cause of this condition is not clear. However, repeated trauma due to mechanical injuries, thumb milking and calf suckling are the main contributory factors. Sometimes mastitis can also result into fibrosis of quarter followed by teat canal. This fibrotic cord will obstruct the teat canal and will create hindrance during milking. In such cases, initially hot water fomentation followed by these two remedies gives us best possible results which were not possible with conventional therapies.

Phellandrium**:** Unplugged milk ducts. Infection causes pain, swelling, redness, and increased temperature of the udder. It can occur when bacteria, often from the Calf ‘s mouth, enter a milk duct through a crack in the nipple. This causes an infection and painful inflammation of the udder & teats.

Carbo Animalis: is one of the deep-acting, long-acting medicines. Suitable in complaints that come on insidiously, that develop slowly, that become chronic and often malignant in character. Lumps in the mammary glands. A purple lump the size of a hen’s egg will form in the mammary gland. It does not go on to suppuration, It does not enlarge much, but it is hard. A gland becomes inflamed, hard and remains so. Carbo animalis stands at the head of the list of remedies that have that condition. Carbo Animalis is useful in the treatment of clotting of the blood inside the veins, and the formation of spider webs on the skin.

Conclusion

In light of these reports and present observation it can be inferred that combination of homeopathic medicines, Phellandrium and Carbo Animalis can be effectively used in the treatment of Teat fibrosis of mastitic bovines. Although the course of treatment is protracted yet it is safe and cost effective.

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Received : 13.12.2022
Accepted : 28.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 127-128

Radiographic diagnosis and medicinal management of foreign body in the gastrointestinal tract of Dog

H. Singh[1], Vikash[1] , S. Purohit[1,], G. Kumar[1], R.P. Pandey[1] and A. Srivastava[2]*

[1]Department of Surgery and Radiology,[2]Department of Veterinary Medicine,College of Veterinary Science and Animal Husbandry, DUVASU, Mathura – 281 001 (UP)

Abstract

A 4-month-old Labrador dog was presented with the history of swallowing some inanimate objects and consequently suffering from anorexia, vomiting and voiding scanty faeces. Clinical and radiographic examination confirmed the presence of non-linear small irregular radio-opaque foreign bodies in the gastrointestinal tract of the dog. Therapeutic management of the case is discussed.

Keywords: Dog, foreign body, gastrointestinaltract, medicinal management.

Gastrointestinal foreign body is anything that cannot be digested or is slowly digested. Common intestinal foreign bodies include bones, balls, toys, rocks, cloth, metal objects and linear objects (Fossum, 2007). Foreign bodies that pass the oesophagus and stomach may lodge in the smaller diameter intestine and causes partial or complete obstruction. The presence of foreign bodies in the gastrointestinal tract is one of the common life-threatening ailments in dogs. The puppies by nature love to play and chew inanimate objects and may accidentally or intentionally swallow inedible materials (Rani *et al.*, 2010). Smaller foreign bodies can pass the gastrointestinal tract without causing obstruction when managed therapeutically. Larger foreign bodies may cause obstruction and lead to severe gastrointestinal complications (Kathirvel *et al.*, 2012). Complete, proximal and strangulating obstructions are more severe and acute than partial, distal and simple obstructions respectively (Papazoglou *et al.*, 2003).

Case History and Observations

A 4-month-old Labrador dog presented at TVCC, DUVASU Mathura with the history of ingestion of gravel present on the floor, occasional vomiting,lethargy, reduced frequency of defecation and intermittent anorexia.

Clinical examination revealed the dog was dull and dehydrated with normal body temperature, heart rate and respiratory rate and elevated pain on abdominal palpation. Packed Cell Volume and total proteins were slightly elevated. A slight increase in leucocytes, blood urea nitrogen, creatinine and alkaline phosphatase was recorded. Dorsal and lateral radiographs confirmed the presence of radio-opaque foreign bodies in the gastrointestinal tract of the dog which was about 2.4 cm in length and 1.9 cm in width (Fig 1, 2).

The dog was treated immediately to avoid shock and further gastrointestinal complications. Radiography did not indicate peritonitis. A non-surgical management protocol was planned to manage the case. A combination of Ringer's Lactate and Dextrose Normal Saline was administered @ 10 ml/Kg/hour intravenously. To counter dehydration and electrolyte imbalance. Pantoprazole @1 mg/Kg BW intravenously and Cefotaxime were given @ 50 mg/kg BWintravenously to address acidity and to prevent secondary infection.Liquid paraffin @ 1ml/Kg was administered orally. Metoclopramide was administered @ 0.2 mg/Kg BW intravenously. For nutritional supplement, Vitamin B complex was given. Foreign body advancement was continuously monitored by radiography and the dog was clinically evaluated on regular basis. The radiographs were taken after 36 hours since ingestion revealed the absence of foreign bodies and owner-reported foreign bodies passed out through defecation (Fig 3, 4). Treatment was continued for 5 days and the animal recovers uneventfully and was active and responsive at the time of discharge from the hospital.

Discussion

The differential diagnosis includes intussusception, acute gastritis, acute pancreatitis, peritonitis and parvo-viral enteritis in young pups. The small rounded non-linear foreign bodies can be removed 30 minutes after the dog has been fed a regular meal by inducing vomiting (Slatter, 1993). Radiographic

*Corresponding author: spurohit2000@gmail.com

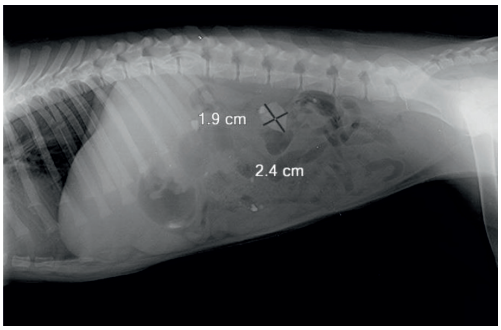

Fig. 1: Non-linear radio-opaque foreign body and Small irregular radio-opaque densities (Lateral view)

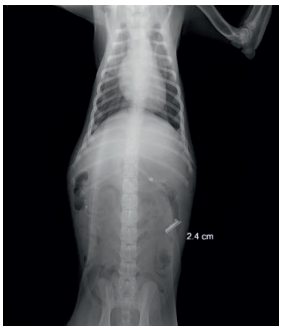

Fig. 2: Ventrodorsal view

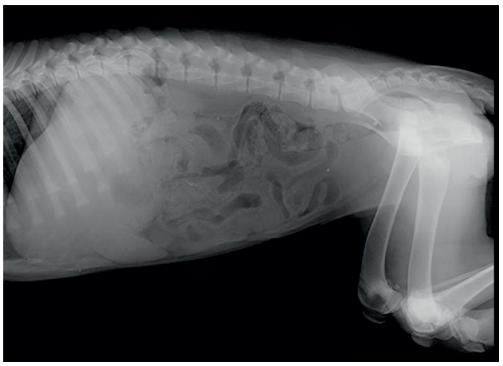

Fig. 3: Radiograph after 36 hours revealed the absence of foreign bodies (Lateral view)

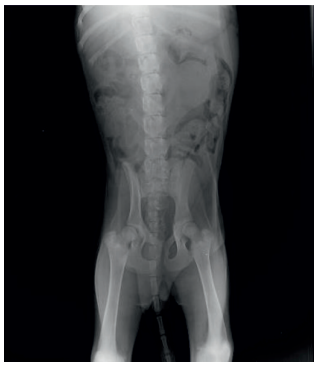

Fig. 4: Ventrodorsal view

examination is the best diagnostic aid for definitive diagnosis and identification of the location of the foreign body (Chiang and Chou, 2005). Radiolucent intestinal foreign bodies may be identified based on the radiographic signs, which include distended intestinal loops that lie layers parallel to each other and unequal gas-fluid interfaces seen in lateral recumbency(Papazoglou *et al.*, 2003). Failure of the foreign body to move within 8 hours since ingestion or failure of the foreign body to pass within 36 hours since swallowing is the indication for surgical management.

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Received : 15.02.2023
Accepted : 29.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 129-131

Anaplasma platys infection in puppy: a case report

Rajat Sagare[1] and Varun Kumar[2]*
[1]Department of Veterinary Medicine, [2]Department of Veterinary Pathology, Veterinary College Bengaluru

Abstract

A case of Labrador pup with history of anorexia and fever was presented in Medicine department at Veterinary College Hospital, KVAFSU, Bengaluru, Karnataka. On presentation, the pup was recumbent with high temperature and severe respiratory distress. Hematobiochemical studies and blood smear examination revealed thrombocytopenia with neutrophilic leukocytosis and smear examination revealed positive for *A.platys*. Treatment involved Doxycycline @ 10 mg/kg with parenteral injections, fluids, antihistaminic and B-complex administration and Tab Doxycycline continued for 15 days with hematinics and platelet booster. The pup recovered by 2 weeks after initiation of treatment.

Canine anaplasmosis is caused by *Anaplasma phagocytophilum* and *Anaplasma platys*. These are tickborne, gram-negative, obligately intracellular bacteria that belong to the family Anaplasmataceae. *Anaplasma platys* infects and forms inclusions within platelets and is the cause of canine cyclic thrombocytopenia, or thrombocytotropic anaplasmosis. In dogs *A. platys* organisms infect peripheral blood platelets and form basophilic inclusions in the cells, so called morulae, which contain one or more subunits (Alvarado *et al.,*2003). Both, the appearance of the pathogen in the platelets and the following thrombocytopenia are cyclic (Dyachenko *et al.,* 2012). The initial thrombocytopenia may develop primarily because of direct injury to platelets by replicating organisms. In general, the infection is accompanied by unspecific and mild clinical manifestation including anorexia, depression, generalized lymph node enlargement, pale mucous membranes and elevated rectal temperatures (Aguirre *et al.,*2006). Nevertheless, a severe course of *A. platys* infection can show ecchymotic hemorrhages on body.

Case History and Observations

A Labrador female dog aged 52 days was presented to Teaching Veterinary Clinical Complex, Bengaluru, KVAFSU with complaint of anorexia, fever, and lethargy for 5 days. The deworming and vaccination status was up to-date. Upon general examination the animal was recumbent and clinical examination, revealed elevated rectal temperature (105.6 °F) with labored respiration and mild tachycardia, bilateral lymphadenopathy, pallor, and buccal mucosal hemorrhages. Blood sample was collected from saphenous vein before institution of therapy and after a week during treatment for complete blood count, blood smear examination, kidney function test (KFT) and liver function test (LFT). The complete haematological observations are given in Table 1 and Fig 1 to 3 which showed non-significant changes throughout treatments except platelet count and neutrophil count which came to normalcy at culmination of the treatment. Blood smear examination revealed positive for *Anaplasma platys* on staining with Giemsa stain. The kidney function and liver parameters were in normal range throughout the treatment (Table. 1 and Fig. 4).

Treatment and Discussion

Fact that the animal had lower platelet count and smear indicated platelets with anaplasma organisms, the dog was first treated with Inj. Doxycycline @ 10 mg/kg slow IV on first day then Tab Doxycycline @ 10 mg/kg PO for 14 days and other supportive treatments like syrup Advaplate™ to cover up the platelet and Dexorange™ as hematinic syrup for 15 days. After two weeks of the treatment the platelet count was under normal reference range. *Anaplasma platys* infects and forms inclusions within platelets and is the cause of canine cyclic thrombocytopenia, or thrombocytotropic anaplasmosis. DNA has been found in other tick species, such as *Dermacentor auratus* ticks in Thailand, *Rhipicephalus turanicus* ticks from Israel, and Haemaphysalis spp. and *Ixodes nipponensis* ticks from Korea (Chae *et al.,* 2008) Ticks are probable reason for the infection in the present study. Different strains of *A. platys* exist that appear to vary in pathogenicity.

Thrombocytopenia due to a monoinfection with *A. platys* has a cyclic character and is considered the result of the destruction of blood platelets by the

*Corresponding author: drvarun15487@gmail.com

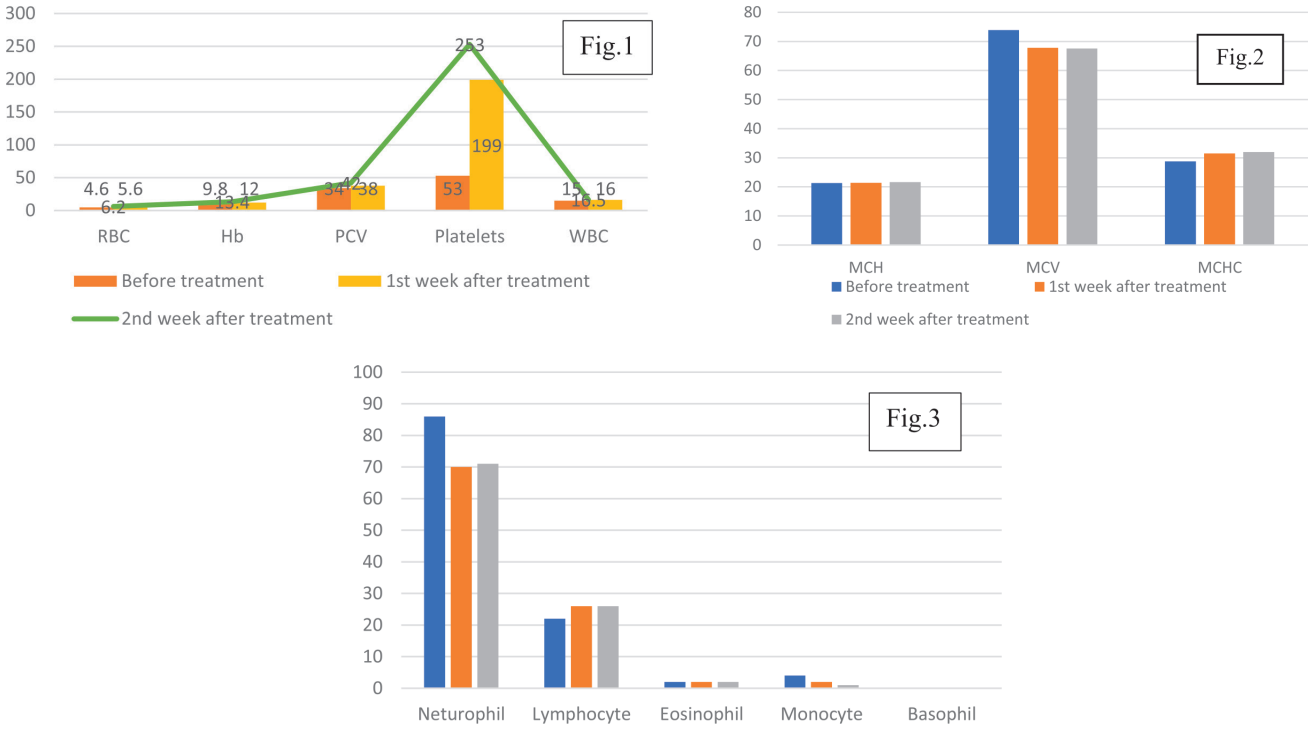

Fig. 1,2,3. Hematological parameters of dog affected with anaplasmosis before and after treatment

proliferating pathogen during initial phase of infection, which probably triggers immunologic mechanisms in the subsequent course of the infection. The recommended treatment for thrombocytopenic dogs infected with *A. platys* is doxycycline. The optimum dose and duration of treatment is unknown, but it is apparently eliminated using regimens effective for treatment of *E. canis* infection. Infection could not be detected with PCR for a 3-week followup period after just 8 days of doxycycline treatment (10 mg/kg PO q24h), which was initiated in the acute phase of infection. The same has been opined by Chang *et al.* (1997).

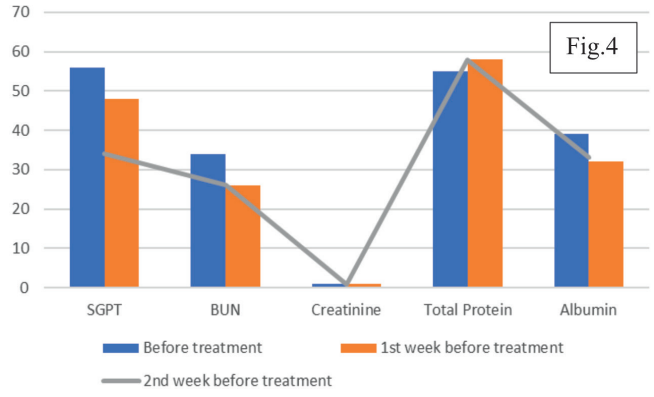

Fig. 4. Biochemical parameters of dog affected with anaplasmosis before and after treatment

Initial episode is associated with the highest number of organisms in platelets, as detected using light microscopic examination of stained blood smears (Harvey 2012). The platelet count nadir occurs 2 to 3 weeks post infection and in some dogs may be lower than 20,000 platelets/µL. Visible organisms then disappear from platelets, and the platelet count returns to normal or near-normal limits within 3 to 4 days. This also corresponds with a decrease in organism load and failure to detect the organism in peripheral blood with real-time PCR, although bone marrow and splenic aspirates may remain positive (Eddlestone *et al.,* 2007). *A. platys* infection may be made by finding organisms within platelets on stained blood films. In many instances, this method of diagnosis is not reliable because of false-negative results when the parasites are either absent or present in very low numbers.

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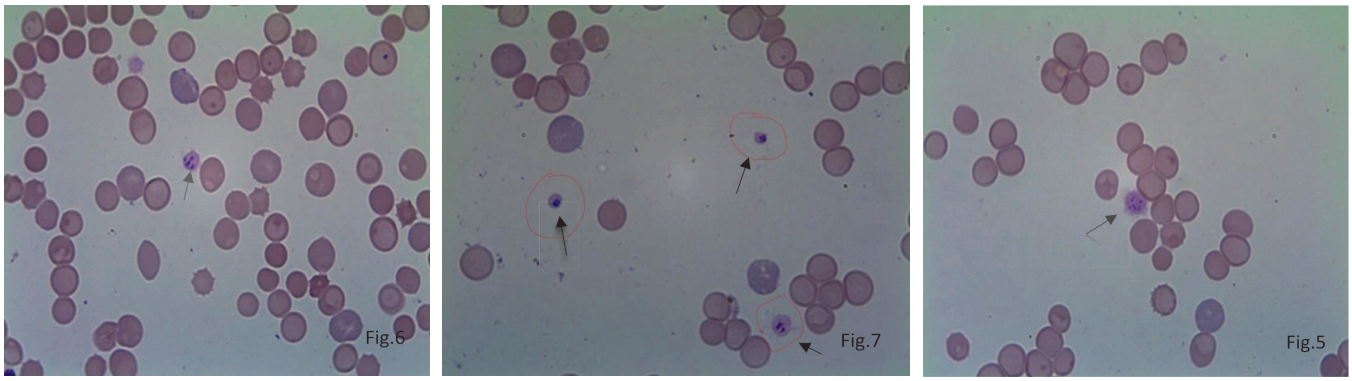

Fig.5,6,7. Blood smear of dog affected with anaplasmosis (Gimesa staining 100X) → Indicates the platelets affected with *Anaplasma platys*

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Received : 27.12.2022
Accepted : 17.06.2023

Indian J. Vet. Med. Vol. 43, No. 1, 2023 pp. 132-133

Acute Glaucoma in a ShihTzu dog

Apurv Kaushik[1], Kanchan Walwadkar[2], Sapna Sharma[1] and Venkata Vinay Varma Manthena[3]*
[1]Teaching Associate, IPVS, DUVASU, Mathura, U.P. [2]Assistant Professor, Co.V.Sc.&A.H., NDVSU, Rewa, M.P.
[4]Veterinary officer, EMRI Green Health Services, Konaseema, A.P.

Abstract

This case study describes the effective management of Acute Glaucoma in a 2-year-old female Shih Tzu named Kelly. The dog presented with sudden ocular discomfort and impaired vision in the left eye, displaying signs of pain and irritation. Clinical examination revealed elevated intraocular pressure, conjunctival hyperaemia and corneal edema. Diagnostic tests confirmed Acute Glaucoma with gonioscopy and ophthalmic ultrasound revealing characteristic changes. Prompt treatment was initiated, combining topical medications (Timolol, Dorzolamide, Prednisolone), systemic therapy (Oral Mannitol), and pain relief (Carprofen). Follow-up appointments demonstrated significant improvement with normalized intraocular pressure and alleviated discomfort. Medication adjustments were made progressively, and after one month, Kelly's left eye exhibited marked improvement, warranting positive long-term prognosis. This case underscores the importance of swift intervention, comprehensive treatment, and diligent follow-up in managing Acute Glaucoma, ensuring both short-term relief and long-term eye health.

Keywords: Acute Glaucoma, Intraocular Pressure (IOP), Gonioscopy

Case History and Observations

Kelly, a 2-year-old female Shih Tzu, was presented to the Teaching Veterinary Clinical Complex, DUVASU, Mathura, with acute onset of ocular discomfort and visual impairment in its left eye. The owner reported that Kelly had been showing signs of eye pain for the past 12 hours, including squinting, excessive tearing, bulge on cornea and rubbing its left eye. There was no history of recent trauma or eye infections. The eye of dog presented is shown in the Fig. 1.

Fig. 1

Physical examination revealed that the patient was alert and responsive. Vital signs, including heart rate, respiratory rate, and temperature, were within normal limits. No abnormalities were detected during the rest of the physical examination.

Ocular Examination: The left eye exhibited moderate conjunctival hyperaemia and chemosis. The left cornea appeared hazy with extensive oedema. The left eye showed increased Intraocular Pressure (IOP) upon palpation compared to the right eye. The menace response was absent in the left eye. The pupillary light reflex was sluggish in the left eye.

Introcular pressure (IOP) was measured using a tonometer, and the left eye's pressure was significantly elevated at 35 mm of Hg (normal range: 10-25 mm of Hg). The right eye's IOP was within the normal range at 15 mm of Hg. Gonioscopy: Gonioscopy was performed to assess the drainage angle of the affected eye. It revealed a closed or nearly closed angle in the left eye, confirming the diagnosis of primary or Acute Glaucoma. Ophthalmoscopy: Ophthalmoscopic examination through ophthalmoscope was performed to assess the status of the lens, optic disk and posterior segment of the eye. The examination showed a shallow anterior chamber and increased retinal thickness in the left eye, consistent with Glaucoma-induced changes. Based on the clinical findings, Kelly was diagnosed with Acute Glaucoma in its left eye. The elevated IOP and clinical signs were indicative of the disease, causing damage to the optic nerve and subsequent vision loss.

Treatment

Immediate intervention was required to alleviate pain and reduce the IOP. The treatment plan included:

*Corresponding author: sapna.perfect@gmail.com

1. Topical Medications:
   - Timolol maleate 0.25% eye drops: Administered 2 drops every 12 hours to reduce IOP. Dorzolamide 2% eye drops: Administered 2 drops every 8 hours to further decrease IOP. Prednisolone acetate 1% eye drops: Administered 1 drop every 6 hours to control inflammation.
2. Systemic Medications include
   - Oral Mannitol administered as an osmotic diuretic to rapidly reduce IOP. A dose of 1 g/kg body weight was given intravenously.
3. For Pain Management:
   - Carprofen 2.2 mg/kg body weight was administered orally every 12 hours for pain relief and to reduce inflammation. The owner was instructed to administer all medications as prescribed and schedule a follow-up visit in 7 days.

Day 7: At the follow-up appointment (Day 7), Kelly's ocular discomfort had significantly decreased. The IOP in its left eye had normalized and the corneal oedema had reduced. The conjunctival hyperaemia was subsided and the mid-dilated pupil had shown some improvement.

Day 15: On the one-week follow-up (Day 15), Kelly's condition had improved further. The conjunctival hyperaemia had subsided completely, and the cornea had cleared upto much extent. The IOP in its left eye remained within the normal range, and the pupil had returned to its normal size with a slight pupillary light reflex. The eye at day 15 is shown in Fig. 2.

Fig. 2

On Day 30 after one month of continuous treatment, Kelly's left eye had shown substantial improvement. There was no pain or discomfort reported by the owner. Ocular examination revealed a fully responsive pupil, a clear cornea, and a normal IOP. The eye at day 30 is shown in Fig. 3.

Fig. 3

The topical medications were gradually tapered over the next two weeks. The Timolol eye drops were reduced to once daily for another week, while the Dorzolamide eye drops were continued once daily for two more weeks before being discontinued. The Prednisolone eye drops were tapered and eventually stopped after four weeks of initial treatment.

Conclusions

Kelly, the Shih Tzu dog, presented with Acute Glaucoma in its left eye, causing severe discomfort and visual impairment. Prompt and comprehensive treatment with topical and systemic medications, along with pain management, led to a successful resolution of its condition. Regular follow-up visits were crucial to monitor its progress and make appropriate adjustments to the medication regimen. Kelly's overall prognosis for a pain-free and functional left eye is excellent, but long-term monitoring will be necessary to ensure the condition does not reoccur.

Received : 11.01.2023
Accepted : 25.05.2023

Indian Journal of Veterinary Medicine
Vol. 43 No. 1 (June, 2023)

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INDIAN JOURNAL OF VETERINARY MEDICINE

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2.	Periodicity of its publication	:	Bi-annual
3.	Printer's Name	:	Mr. Kamal Chopra
	Nationality	:	Indian
	Address	:	Foil Printers 2051, Gobind Nagar, Ludhiana-141 001, Punjab
5.	Editor's Name	:	Swaran Singh
	Nationality	:	Indian
	Address	:	Department of Veterinary Medicine College of Veterinary Science Guru Angad Dev Veterinary and Animal Sciences University Ludhiana-141004, Punjab
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Dated: June, 2023 **Swaran Singh**

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