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Review Article

Chronic Gastroenteropathies in Dogs: A Review

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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

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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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