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ULTRASONOGRAPHIC STUDIES ON GASTROINTESTINAL DISORDERS IN CANINE

K. SINDHU

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DECLARATION

I hereby declare that the thesis entitled **"ULTRASONOGRAPHIC STUDIES ON GASTROINTESTINAL DISORDERS IN CANINE"** is a record of research work done by me during the course of research and this thesis has not previously formed the basis for the award of any degree, diploma, fellowship or associateship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that the thesis, entitled **"ULTRASONOGRAPHIC STUDIES ON GASTROINTESTINAL DISORDERS IN CANINE"** is a record of research work done independently by **Smt. K. Sindhu,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associateship or fellowship to her.

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SINDHU. K.

Dedicated to my
Mother and Husband

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LIST OF ABBREVIATIONS

°F	- Fahrenheit
Hz	-Hertz
MHz	- Mega Hertz
mEq/L	- milliequivalants per litre
EDTA	- Ethylene Diamine Tetra Acetate
g	- Gram
min.	- Minute
cmm	- cubic millimetre
dl.	- decilitre
spp.	-species

Introduction

1. INTRODUCTION

Gastrointestinal disorders are most common complaints in small animal practice and can present a considerable challenge to the diagnostic and therapeutic skills of the clinician. Common clinical signs were vomiting, anorexia, enteritis, and abdominal pain. Although the clinical signs do not indicate a serious disorder, it was frequently a sign of many life threatening diseases.

Ultrasonography can be useful for the diagnosis of gastrointestinal disorders. Ultrasonic scanning is safe, non invasive, fast and requires minimum patient preparation. Ultrasound provides information about size, shape, location and details of architecture of structures being studied. Difficulties in gastrointestinal ultrasonography included the presence of gas within intestinal tract which impedes penetration of the ultrasound beam, obscuring structures beyond it and introducing reverberation, shadowing and comet tail artifacts. Gas may be displaced by administering water by stomach tube, or it may be avoided to certain extent by applying the ultrasound probe to the dependent surface of the abdomen. The gastric and intestinal wall has a characteristic ultrasonographic appearance which is observed while using high frequency transducers.

Ultrasonography was based on pulse echo principle; the unique physical properties of ultrasound allow detection and characterization of mass lesion and pathology associated with gastro intestinal structures (Nyland and Mattoon, 1995). Ultrasonography is a well recognized method to evaluate gastro intestinal diseases in people. Ultrasound is superior to radiography in some circumstances but has limitations in other area.

Gastrointestinal disorder seldom produces pathagnonomic, haematologic or serum biochemical abnormalities. Diagnosis of this condition must be based on a combination of certain laboratory results, the clinical signs and the patient history. Routine clinico-laboratory investigations are often inadequate for diagnosis of disease of gastrointestinal system.

Considering these views present study "Ultrasonographic studies on gastrointestinal disorders in canine", was taken up with objective of

(1) Detailed study of ultrasonographic features in gastro intestinal disorders.

(2) Assess the haematologic and serum biochemical changes in gastrointestinal disorder.

(3) Correlate the clinico-pathologic changes with ultrasonography.

Review of Literature

2. REVIEW OF LITERATURE

Gastro-intestinal diseases

Gastro-intestinal diseases are of most common problems encountered in small animal practice and can present a considerable challenge to the diagnostic and therapeutic skills of the clinician. Main clinical signs of gastrointestinal disease are vomiting and diarrhoea, weight loss, abdominal pain, tenesmus, constipation are relatively nonspecific and had a variety of causes including disease of other organ systems. So the need for a logical approach to a diagnosis including not only a detailed history and a thorough clinical evaluation but also the use of relevant diagnostic procedures. Diagnosis was important to initiate rational therapy and the emerging knowledge of underlying pathophysiologic mechanisms (Burrow *et. al* 1995).

Disease that result in structural lesions of the gastrointestinal tract and disease that cause abnormal gastrointestinal motility are potentially detectable using diagnostic imaging techniques, whereas disorders of the gastrointestinal tract are manifested only as histological lesions or metabolic dysfunction are not (Lamb, 1999).

2.1 Signalment

Age

Animals less than 2 years are more prone to inflammatory bowel disease (Strombeck and Guilford, 1991).

Chronic hypertrophic pyloric gastropathy reported in small, middle to old aged dogs (3-15 years) (Strombeck and Guilford, 1991).

Gastric neoplasia occurred in animals with mean age of 10 years (Strombeck and Guilford, 1991; Evans *et al.,* 1994; Nyland and Mattoon, 1995). Animals aged 3 months to 16 years were more prone to foreign body syndrome.

Lamb and Mantis (1998). reported that intestinal intussusception was more common in 3 months to 7 year old dogs.

Sex

Males were more affected with gastric neoplasia (61 per cent) than females (Strombeck and Guilford, 1991).

Breed

Labrador retriever and Doberman pinschers were prone to ingestion of foreign body (Evans *et al.,* 1994).

2.2 Etiology

2.2.1 Gastritis

Happe *et al.,* (1981). reported that the causes of pyloric obstruction in poodle and maltese were congenital hypertrophic stenosis, pylorospasm, acquired hypertrophy of the pylorus, neoplasms and foreign bodies.

Acute gastritis associated with ingestion of spoiled food stuffs, plants, parasites like *physaloptera spp.* ascarid and tapeworm, spirochetes, chemical irritants include heavy metals, antibiotics like cephalosporins, infectious agents and bacterial fungal toxins were also acted as contributing factor (Wingfield and Twedt, 1986; Strombeck and Guilford, 1991 and Hall and Simpson, 2000).

Etiologies of acute gastritis included: sudden change in diet, food intolerance, dietary indiscretion (eg:- garbage), foreign bodies (eg:- bones, plants, plastic, rocks, hair balls), drug induced (eg:- aspirin, glucocorticoids), gastric foreign bodies, toxins, intestinal parasites, infectious agents cause idiopathic

haemorrhagic gastroenteritis and neonatal ancylostomosis (Strombeck and Guilford, 1991).

Tams (1992). opined that the use of non-steroidal anti-inflammatory drugs resulted gastric and intestinal erosions .

Twedt (1992). reported that the causes of gastric outlet obstructions can be either extrinsic or intrinsic. Extrinsic lesions are uncommon and cause extragastric compression (eg:- inflammatory masses, adhesions, neoplasia). Intrinsic lesion involves the pylorus and result from either hypertrophy of circular muscle fibers or from infiltrative neoplastic lesions and ulcers. Obstructive lesions are intraluminal obstructions that mechanically block passage through the pyloric canal (eg:- foreignbody, ulcers, polyps and hypertrophic pyloric gastropathy.

Grooters *et al.*, (1994). observed that the gastrointestinal disorders were common complications of uremia in dog, these disorders may be the result of physiologic effects, uremic toxins acting on the chemoreceptor trigger zone cause structural changes.

Penninck and Tidwell (1997). reported that the main cause of gastric ulceration was with the use of anti-inflammatory drugs, neoplasia and metabolic disorders including liver and renal disease.

Chronic gastritis was a common cause of chronic and episodic vomiting in dog (Johnson *et al.*, 2000).

2.2.2 Enteritis

Appel *et al.*, (1978). identified canine parvoviral infection as a causative agent of haemorrhagic gastroenteritis in dogs.

Sherding and Burrow, (1992); Hall and Simpson, (2000). observed that pathogenesis of small intestinal diarrhoea included decreased absorption of fluid

and electrolytes, incomplete absorption of nutrients and increased secretion of fluid and electrolytes, whereas the large intestine diarrhoea resulted in decreased absorption of fluid and electrolytes.

Sherding and Johnson, (2000). reported that causes of enteritis are indiscriminant eating and chewing behaviour was common in dogs. Dietary indiscretions included overeating, ingestion of spoiled garbage, undigestable foreign material (eg:- bones, stones, hair, plants, wood, cloth, plastics) that cause trauma in the gastrointestinal mucosa, enteritis may also caused by abrupt change in diet, intolerance of foods, nonsteriodal anti-inflammatory agents (eg:- asprin, ibuprofen), enterotoxins, insecticides, intestinal parasites, viral infections, bacterial and antifungal infections.

2.3 Clinical signs

2.3.1 Gastritis

Patnaik *et al.*, (1980). reported that the clinical signs of duodenal adenocarcinoma were anorexia, post prandial vomiting and depression, occasional signs were black, tarry tools and ascites.

Happe *et al.*, (1981). observed that the dog with pyloric stenosis had clinical signs like chronic vomiting and weight loss.

Huxtable *et al.*, (1982). opined that the dog with chronic hypertrophic gastritis had clinical signs of anorexia, listlessness, anaemia.

Wingfield and Twedt, (1986); Hall and Simpson, (2000). reported that vomiting was the principle clinical sign of acute gastritis.

Maclachlan *et al.*, (1988). reported that a specific gastrointestinal disease occurs in Basenji dogs, characterized by chronic diarrhoea, profound weight loss and eventual death. The changes within the gastrointestinal tract of affected dogs included gastric rugal hypertrophy and lymphocytic plasmacytic gastroenteritis.

Clinical signs of primary gastric neoplasia included vomiting, anorexia and weight loss. Primary gastric neoplasms are found equally in the pylorus and in the body of the stomach (Strombeck and Guilford, 1991; Twedt, 1992).

Chronic intermittent vomiting was the common presenting complaint in veterinary medicine with no specific time relation to eating and variable appetite (Tams, 1992).

Biller *et al.*, (1994). observed that chronic intermittent vomiting occurs a few hours after eating is the common sign of chronic hypertrophic pyloric gastropathy.

The most common clinical signs of gastric ulcer were vomiting, hematemesis, melena, weight loss and anaemia (Nyland and Mattoon, 1995; Penninck and Tidwell, 1997).

Depending on the cause, chronic gastritis, irritable bowel syndrome and gastric motility disorders might have diarrhoea, lethargy, inappetence and salivation. Chronic intermittent vomiting was the common presenting complaint. Clinical signs of protothecosis included bloody large bowel diarrhoea, vomiting, ataxia, blindness (CNS) and death (Sherding and Johnson, 2000; Jergans and Willard, 2000).

Hall and Simpson, (2000). reported that acute or chronic vomiting with or without hematemesis was the most common clinical sign of gastrointestinal ulcer.

Johnson *et al.*, (2000). reported that vomiting as a common clinical sign associated with many gastrointestinal disorders in dogs. Vomiting was the characteristic clinical sign of gastritis and vomitus may contain evidence of grass, bile, froth, frank blood or digested that appears like coffee grounds.

Lee *et al.*, (2005). reported that a dog with pylorogastric intussusception had ten day history of inappetance, vomiting, polyuria and polydipsia.

2.3.2 Enteritis

Bernstein, (1977). observed that clinical signs of hemorrhagic gastroenteritis were sudden onset of emesis and profuse bloody diarrhoea.

Clinical signs of inflammatory and neoplastic diseases included vomiting, diarrhoea, melena, abdominal pain or mass, lethargy and weight loss (Penninck *et al.*, 2003).

2.3.3 Miscellaneous.

Thrall *et al.*, (1978). reported that vomiting, anorexia and depression for several days or weeks were the most consistent clinical signs of intestinal obstruction.

Felts *et al.*, (1984). reviewed common clinical signs of gastrointestinal linear foreign body in cat were persistent vomiting, partial to complete anorexia and depression.

Lamb, (1990). observed that clinical signs of gastrointestinal diseases were vomiting and abdominal pain.

Sherding and Burrows, (1992). reported that diarrhoea is a clinical sign resulting from excessive fecal water content.

Willard, (1992). opined that vomiting was the most common clinical signs of intestinal obstruction. Linear foreign bodies cause vomiting secondary to peritonitis, pain and obstruction.

Evans *et al.*, (1994). reported that gastrointestinal linear foreign bodies often were found in cats but less common in dogs. Common clinical signs included vomiting, anorexia and depression. Duration of clinical signs ranged from 12 hours to 2 months.

Lamb and Mantis, (1998). reported that the predisposing causes of intestinal intussusception are change of diet, enteritis, intestinal parasitism, linear foreign body and previous abdominal surgery.

Lamb and Mantis, (1998). observed that clinical signs of intestinal intussusception were usually the result of partial intestinal obstruction, bacterial overgrowth, ischemia, vomiting, diarrhoea, depression or abdominal pain (Levitt and Bauer, 1992)

Riedesel, (2002). suggested that most common clinical signs of intestinal disease in small animal included vomiting, diarrhoea, weight loss, abdominal pain and palpable mass at the mid abdominal areas.

Beck *et al.,* (2001). reported that the clinical signs of gastric neoplasia included anorexia, vomiting and weight loss.

Paoloni *et al.,* (2002). observed that the common clinical signs in dogs with intestinal carcinoma included anorexia, weight loss, vomiting, diarrhoea, hematochezia and tenesmus.

Louvet and Denis, (2004). reported that clinical signs of five month history of dog having intestinal lymphangectasia were diarrhoea, dysorexia and weight loss.

Papazoglou *et al.,* (2004). cited anorexia, vomiting, diarrhoea as the main clinical signs of intestinal obstruction in dogs.

Hall and Simpson, (2000). opined that primary sign of gastrointestinal disease was diarrhoea; secondary signs were vomiting, weight loss, hematemesis, melena, anorexia, abdominal pain, abdominal distension, dehydration, polydipsia, ascites and shock.

Kahan, (2005). observed that the hemorrhagic gastroenteritis was characterized by an acute onset of vomiting and bloody diarrhoea, anorexia and

depression. It was also reported that in intestinal obstruction the clinical signs included lethargy, anorexia, vomiting, diarrhoea, abdominal pain, subnormal temperature, dehydration and shock.

2.3.4 Uremic gastropathy

Thornhil, (1983). reported that hypergastrinemia due to decreased renal clearance of gastrin may cause gastric wall thickening and acid hypersecretion which could contribute to gastric lesions.

Grooters *et al.,* (1994). observed vomiting, anorexia, polydipsia, lethargy, haemorrhagic enteritis in uremic dog.

Schulman and Krawiec, (2000). stated that uremic gastroenteritis could be manifested as vomiting, diarrhoea and anorexia.

2.4 Physical examination

2.4.1 Gastritis

Wingfield and Twedt, (1986). reported that the animal had gastritis on physical examination revealed pain in the region of stomach.

2.4.2 Enteritis

Biswas *et al.,* (2005). opined that haemorrhagic enteritis with haemorrhagic or non haemorrhagic vomiting were most important cardinal signs of canine parvoviral enteritis in dogs, usually accompanied by severe fluid and electrolyte imbalances.

Rudorf *et al.,* (2005). reported that clinical sign of idiopathic inflammatory bowel disease were chronic diarrhoea.

2.4.3 Intestinal obstruction

Wilson and Burt, (1974); Weaver, (1977). reported that in intestinal intussusception, abdominal palpation revealed an elongated mass. It was also reported that pain on palpation was minimal.

Willard, (1992). observed that physical examination of intussusception reveals curvilinear mass "Sausage loop" or a thickened bowel loop during abdominal palpation.

Evans *et al.,* (1994). opined that in dogs with gastrointestinal linear foreign bodies physical examination revealed dehydration (53 per cent), pain on palpation (47 per cent) and a palpable abdominal mass (38 per cent).It was also reported that gastrointestinal linear foreign bodies on physical examination, findings included dehydration, pain elicited during abdominal palpation and a palpable abdominal mass.

Kull *et al.,* (2001). reported that in case of intestinal lymphangiectasia abnormal physical examination findings included dehydration, ascites, and signs of pain on palpation of abdomen.

Papazoglou *et al.,* (2004). stated that dog with intestinal obstruction on physical examination revealed depressed and mildly dehydrated. Abdominal palpation of a dog with intestinal obstruction revealed the presence of impacted intestinal loops.

2.5 Ultrasonography

2.5.1 Principle

Ultrasound is defined as sound waves of frequencies greater than those audible to the human ear, i.e., >20,000 Hz. Diagnostic ultrasound usually employs sound waves of frequencies between 1 and 10 MHz.

The ultrasound transducer, or scanner, contains one or more crystals with piezo-electric properties. When electrically stimulated, the crystal becomes deformed and consequently emits sound waves of a characteristic frequency. Ultrasound image was based on pulse-echo principle. When the transducer is placed in contact with the surface of the body, the sound waves travel through the tissues. Interfaces between tissues of differing acoustic impedance reflect part or all of the beam back towards the transducer. The returning echoes are received by the same crystal and converted by means of the piezo-electric effect into electrical signals, which are analyzed according to the strength and depth of reflection, and displayed on an oscilloscope screen. (Barr, 1988; Lamb, 1990 Cartee *et al.,* 1993; Nyland and Mattoon, 1995)

2.5.2 Principles of image interpretation

The conventional display format for ultrasound scans is a white image on a black background. A number of terms are used to describe the image and some common synonyms are listed below.

Hyperechoic; echogenic – Bright echoes, appearing white on conventional scans. Represent highly reflective interfaces (eg:- bone and air).

Hypoechoic; relatively echolucent – Sparse echoes, appearing dark grey on conventional scans. Represent intermediate reflection/transmission (eg:- soft tissues).

Anechoic; echolucent; sonolucent; transonic – Absence of echoes, black on conventional scans. Represent complete transmission of sound (eg:- fluids).

Fluid, whether free in a body cavity or contained within a viscus, is anechoic. Because the sound waves pass unimpeded through fluid, there is often a bright area immediately deep to the fluid. This is the phenomenon of acoustic enhancement and it is a normal finding. (Nyland and Mattoon, 1995).

Bone, other mineral accumulations and gas reflect the sound waves totally. The surface of the bone or gas is thus shown on the image as an intensely echogenic line. There is no penetration of sound beyond this surface, so structures deep to the surface are not imaged. This is the phenomenon of acoustic shadowing.

Soft tissues appear as various shades of grey depending on their proportions of fat, fibrous tissue and fluid (Barr, 1988; Nyland and Mattoon, 1995).

Barr, (1988); Nyland and Mattoon, (1995). explained various modes of display, the equipment and principle of image interpretation.

2.5.3 Indications

Penninck *et al.,* (1989). described the normal sonographic appearance of stomach, small bowel and colon in healthy dogs.

Penninck *et al.,* (1990). cited the ultrasonographic appearance of gastrointestinal neoplasms, gastrointestinal obstruction, ileal intussusceptions, inflammatory gastrointestinal diseases and congenital disorders.

Tidwell and Penninck, (1992). reported the ultrasonographic findings of animal having gastrointestinal foreign bodies.

Lamb, (1999). reported that ultrasonography is an excellent diagnostic test for intussusceptions which included a series of concentrical rings (in a transverse image) or parallel lines on longitudinal image that reflect the folded layers of intestinal wall making up the lesion.

2.5.4 Limitations

Park *et al.,* (1981). found that bone and air had highly reflective interfaces and effective examination with ultrasound could not be done through either bone or air.

Nyland and Mattoon, (1995). opined that ultrasound might suggest the disease process but cannot provide a histopathologic diagnosis.

2.6 Anatomy

2.6.1 Stomach

The stomach lies mostly in a transverse position, more to the left of midline, and when empty is located within the rib cage. The relations of the stomach are the liver cranially and the pancreas, spleen and transverse colon caudally. The stomach was divided into the cardia was a small area surrounding the esophageal entrance. The fundus is a blind region that extends to the left and dorsally of the cardia. The body of the stomach was its largest region. The body communicates directly with both the cardia and the fundus. Most of the gastric body lies to the left of the midline, with its terminal portions extending across the midline to blend with the pyloric region. The pyloric region of the stomach, the terminal portion of the stomach extends between the body and the duodenum. The pyloric region had the pyloric antrum and the pyloric canal. The pyloric antrum forms the first two-thirds of the pyloric region; this portion of the pyloric region was the widest. The pyloric canal tapers to approximate the diameter of the duodenum. The pylorus was the muscular sphincter that surrounds the pyloric canal where it joins the duodenum (Miller *et al.*, 1964).

2.6.2 Intestine

The small intestine comprises from cranial to caudal, the duodenum, jejunum, and ileum. Duodenum lies to the right of the midline and is held close to the dorsal abdominal wall by its short mesentery. The cranial portion of the duodenum continues directly from the pylorus and is short and passes through the tight cranial duodenal flexure. The descending duodenum course directly caudally adjacent to the right body wall. The ascending duodenum takes a some

what oblique course cranially angled toward the midline. The duodeno-jejunal flexure was the point at which the duodenum joins the jejunum.

Jejunum was the longest and most mobile portion of the small intestine. The jejunum occupied most of the free space within the abdominal cavity.

The ileum was the short terminal portion of the small intestine. The ileum which beings at the jejunoileal junction and ends at the ileocolic sphincter. The termination of the ileum was positioned near the dorsal body wall just lateral to the ascending duodenum.

The large intestine is divided into the cecum, colon and rectum. The cecum exists as a blind diverticulum associated with the proximal colon by means of the cecocolic orifice. It begins at the ileocolic valve where the short ascending colon courses cranially and turns from right to left at the right colic flexure to become the transverse colon. Both the cecum and ascending colon lie to the right of the median plane. From the right colic flexure the transverse colon runs cranial to the mesenteric root to the left colic flexure, and becomes the descending colon. The descending colon, the longest colonic segment, continues caudally along the left abdominal wall through the pelvic canal to the anus as the rectum (Miller *et al.*, 1964).

2.7 Preparation and Scanning Technique

Ventral abdominal hair should be shaved and cleaned with spirit to avoid dirt and grease and applied ultrasonic gel to the skin prior to scanning procedure. Animals are usually scanned in dorsal recumbency, but in some instances animals are turned to the left or the right or standing position to displace intraluminal fluid to the area of interest and to provide an acoustic window. Right lateral recumbency assists the evaluation of the pyloric region, while left lateral recumbency assists the evaluation of the fundus. The standing position is most appropriate for the evaluation of the ventral aspect of the pylorus and body of the stomach.

A sector scanner with a 5.0 MHz or 3.5 MHz or 7.5 MHz transducer is used. 5.0 MHz probe is recommended for evaluation of gastrointestinal wall layers. Transverse and longitudinal views of gastrointestinal tract segments are required to completely assess the size and echogenicity of a segment.

For better ultrasonographic evaluation of the gastrointestinal tract requires little patient preparation, but fasting for 12 hours is recommended and fluid administration via a stomach tube 15 ml/kg may enhance visualization of suspected intramural or luminal lesions of upper segments of the gastrointestinal tract. A fluid-filled stomach provides a useful acoustic window for visualizing other abdominal structures such as pancreas and hilus of the liver (Nyland and Mattoon, 1995).

2.8 Ultrasonography of the Normal Gastrointestinal Tract

Penninck *et al.,* (1989). described the normal sonographic appearance of stomach, small bowel and colon of healthy dogs. The stomach wall ranged from 3 mm to 5 mm in thickness and the small and large bowel wall ranged from 2 mm to 3 mm in thickness. Peristalsis was routinely observed in the stomach and small bowel, but not in the colon. Ultrasonic identification of five gastrointestinal wall layers corresponding to the mucosal surface, mucosa, submucosa, muscularis propria, and subserosa/serosa.

Cartee *et al.,* (1993). reported that normal ultrasonographic appearances of stomach, walls of intestines are alternating layers of hyperechoic and hypoechoic, lumen usually hyperechoic with gas, peristaltic waves visible normally. Large colon usually hyperechoic with no through transmission.

Nyland and Mattoon, (1995). described the normal sonographic appearance of stomach, small and large bowel of dogs. Normal ultrasonographic appearance of stomach provides important land marks for differentiating anatomic variants from pathologic changes. The stomach is recognized by the presence of rugae and regular peristaltic activity. Small and large bowel is

recognized by the appearance of the bowel wall varies with the degree of distension and the nature of gastrointestinal contents. The spleen is used as an acoustic window to examine underlying bowel, segments.

It was also reported that three normal luminal patterns, each dependent on the contents.

Mucous pattern: The mucous pattern is the appearance of a bowel segment in its collapsed state, characterized by echogenic contents (mucus) without acoustic shadowing.

Fluid Pattern: The fluid pattern is characterized by anechoic luminal contents. This pattern facilitates the visualization of wall layers.

Gas pattern: The gas pattern appears as intraluminal highly hyperechoic reflective interfaces with acoustic shadowing.

Riedesel, (2002). observed that ultrasound evaluation is a valuable method of diagnostic imaging of small intestine. The normal intestinal wall pattern consists of alternating hyper and hypo echoic line represents the lumen. From the lumen to the serosa echogenicity are as follows: mucosa-hypoechoic, submucosa - hyperechoic, muscularis - hypoechoic and serosa - hyperechoic.

2.9 Ultrasonography of gastrointestinal disorders

2.9.1 Inflammatory Diseases

Penninck *et al.*, (1990). described that the ultrasonographic appearance of inflammatory gastrointestinal diseases varies with the type of pathologic process, the extent of involvement and occurrence of complications like perforation and peritonitis. Extensive thickening of the gastrointestinal wall as the most common ultrasonographic finding in inflammatory disease. Inflammation characterized by extensive and symmetric wall thickening with retained layer identification while

neoplasia by localized and a symmetric wall thickening with disrupted wall layer identification.

2.9.1.1 Gastritis

Penninck *et al.,* (1990); Penninck and Tidwell, (1997). observed that localized marked thickening of the stomach wall with disruption of the mucosal layer "Crater" was seen in ulcerative gastritis secondary to longstanding aspirin treatment. Gas bubbles or blood clots accumulate at the ulcer site and appear hyper echoic.

Cartee *et al.,* (1993). observed that the ultrasonographic appearance of hypertrophy, hyperplasia and neoplasia of stomach greater than 5 mm thickened duodenum greater than 3 mm thickened.

Biller *et al.,* (1994). reported that ultrasonographically chronic hypertrophic pyloric gastropathy in dogs was diagnosed by visualizing an evenly thick hypoechoic layer surrounding the pyloric lumen.

Grooters *et al.,* (1994). reported that ultrasonographic features in uremic gastropathy in dog included thickened gastric wall and thickened rugal folds and a hyperechoic line at the mucosal-luminal interface due to mineralization of the gastric mucosa.

Ultrasonographically chronic hypertrophic gastritis was characterized by a thick hypo echoic layer surrounding the pyloric lumen. Gastric wall thickness was greater than or equal to 9 mm (Nyland and Mattoon, 1995).

Gastritis (acute/chronic), diffuse or localized stomach wall thickening identified on ultrasound (Penninck, 1995).

Ultrasonographic features of gastric ulcer included local thickening of gastric wall, loss of five layer structures, the presence of a wall defect or "Crater", fluid accumulation in the stomach and diminished gastric motility. The

localized gastric wall thickening varied from 9 to 16 mm (Nyland and Mattoon, 1995; Penninck and Tidwell, 1997).

Beck *et al.*, (2001). reported ultrasonic features of gastric neoplasia are hypoechoic gastric wall thickening with altered layering.

Mahaffey and Barber, (2002). observed that chronic gastritis resulted from various causes included chronic atrophic gastritis, chronic hypertrophic gastritis, pythiosis and zygomycosis were infrequently diagnosed.

2.9.1.2 Enteritis

Diarrhoea is defined as an abnormal increase in the frequency, fluidity or volume of faeces. This is cardinal sign of small intestine malfunction (Sherding and Burrows, 1992).

Argenzio, (1992). observed that diarrhoea was primarily as result of abnormal fluid and ion transport by the mucosa of the small or large intestine. Loss of fluid by the intestine was a result of malabsorption of solutes, water and hypersecretion of solutes and water.

Lim and Jeong, (1994). discovered that ultrasonography was very sensitive in detecting changes like segmental or diffuse mural thickening in case of inflammatory bowel disease in humans.

Nyland and Mattoon, (1995). described enteritis may produce different ultrasonographic appearance. Normal intestinal wall thickness, normal layering, distended bowel loops and lack of peristalsis were indicative of generalized ileus with parvoviral enteritis. Ultrasonic findings of enteritis in dogs included generalized fluid distention of the small bowel with lack of intestinal motility and normal bowel wall thickness (3 mm) and appearance.

Ultrasonic findings of enteritis in dogs included generalized fluid distention of the small bowel with lack of intestinal motility and normal bowel wall thickness (3 mm) and appearance (Penninck, 1995).

Acute diarrhoea is characterized by a sudden onset of watery or watery mucoid faeces which can be bloody in severe cases (Hall and Simpson, 2000).

Kull *et al.*, (2001). observed that the dog ultrasonographic appearance of intestinal lymphangiectasia in dog was characterized by intestinal wall thickening, hyperechogenic intestinal mucosal layer, wall corrugation and indistinct wall layering small intestinal hyper motility.

Undulating hyperechoic line of the mucosa/lumen interface and/or sub mucosa were identified by ultrasound had been associated with pancreatitis and small intestinal lymphangiectasia (Moon *et al.*, 2003).

Dogs with mild to moderate enteritis had a median small intestinal wall thickness of 6 mm (Penninck *et al.*, 2003).

Lymphocytic plasmocytic enteritis of a dog with chronic vomiting was examined by ultrasound revealed a prominent gastric wall especially within regions of gastric folds (Rousseau, 2005).

2.9.2 Congenital disorders

Penninck *et al.*, (1990). described case of hypertrophic pyloric stenosis ultrasonographically the pyloric wall measured between 8-9 mm thickness and the thickening was circumferentially uniform. The stomach had decreased motility and was fluid filled.

2.9.3 Neoplasms

2.9.3.1 Stomach

Penninck *et al.*, (1990). reported that the ultrasonographic examination of dog having chronic intermittent vomiting revealed a homogeneous, small, sessile,

echogenic mass where in a dog are suggested of gastricleiomyoma. Canine gastric lymphomas were characterized by a uniform, hypo echoic thickening of the stomach wall.

Primary gastric neoplasms are disease of older dogs with mean age of 10 years. Males are affected more frequently up to 61 per cent. Adenocarcinoma is the common malignant gastric tumor in dogs. Ultrasound features included thickening of the stomach wall, distortion of the normal layered appearance of the wall and decreased echogenicity (Strombeck and Guilford, 1991; Beck *et al.,* 2001).

Gastric carcinoma was pseudo layering of the stomach wall which is thought to be associated with uneven distribution of tumor in the layers of the stomach wall. Concurrent regional lymphnode enlargement and ulceration of the affected were seen in both gastric carcinoma and lymphosarcoma. Gastric wall measurements greater than 6-7 mm indicates pathologic (Nyland and Mattoon, 1995).

In dogs ultrasonographic examination of small intestine has been used to identify gastrointestinal tumors (Penninck, 1995; Penninck *et al.,* 2003).

2.9.3.2 Small and Large intestine neoplasm

Intestinal lymphomas characterized by infiltrative wall thickening and loss of architecture of the wall layers. Uniformly decreased echogenicity of the bowel segment. Intestinal leiomyosarcomas are seen as exophytic and complex Cystic and Solid masses. Intestinal adenocarcinoma appeared as an asymmetric thickening of the wall with localized loss of wall layers. Polyps were the common colorectal neoplasms occur in dogs. This was localized and associated with regional lymphadenopathy (Penninck *et al.,* 1990).

Lam and Grierson, (1999). reviewed the ultra sonograaphic appearance of primary gastric neoplasm. Thickening of gastric wall of 12-26.5 mm in case of

carcinoma, leiomyoma and 3-43 mm in leiomyosarcoma and 6-16.7 mm lymphoma. All layers affected, hypoechoic sessile mass obliterating the mural layers.

Graham *et al.,* (2000). reported that pythiosis is a chronic pyogranulomatous infection of the gastrointestinal tract caused by *Pythium insidiosum.* Sonographic features included thickening of the gastrointestinal wall and absence the normal layered appearance.

Paoloni *et al.,* (2002). reported that ultrasonic features of gastrointestinal tumors were transmural wall thickening with complete loss of normal wall layering.

Yam *et al.,* (2002). reported that ultrasonographic examination of gastrointestinal lymphoma included thickened hypoechoic intestinal wall with loss of visible wall layers, hyperechoic luminal interface with acoustic shadowing and absence of motility.

Louvet and Denis, (2004). reported that an ultrasonographic finding of intestinal lymphangiectasia was a focal area of intestinal thickening with loss of layering. A neoplastic or severe inflammatory condition was suspected and intestinal lymphangiectasia was diagnosed histopathologically.

2.9.4 Gastrointestinal obstruction

Alteration in intestinal motility, intestinal ischemia or mechanical obstruction of the lumen of the bowel could be manifested as abdominal pain. In partial simple obstruction caused by linear foreign bodies increased peristalsis could be present both proximal and distal to the obstruction as reported by Kahan, (2005).

2.9.4.1 Foreign bodies

Felts *et al.*, (1984). reviewed gastrointestinal linear foreign body in cat less than four year old. The common clinical signs were persistent vomiting, partial to complete anorexia and depression. Diagnosis was confirmed by surgery.

Penninck *et al.*, (1990). stated that the sonographic appearance of gastric foreign objects such as ball might be variable depending on the physical properties (cohesion, elasticity, air content). It was also the curvilinear shadowing is suggestive of a ball, also represent a large amount of gas and or ingesta in the stomach and administration of water should help to confirm the diagnosis of gastric foreign object.

Tidwell and Penninck, (1992). opined that acoustic pattern arising from each foreign body varied depending on its physical properties and interaction with ultrasound beam. Linear foreign bodies were seen as echogenic lines surrounded by plicated bowel. Distension of the stomach and intestine consistent with mechanical obstruction, hyperperistalsis of the gut and wall thickness were identified.

Evans *et al.*, (1994). reported that gastrointestinal linear foreign bodies often are found in cats but less common in dogs. Most of the linear foreign bodies lodged in the pylorus in the dog. Ultrasonogrpahic features that were evaluated included location, length, wall thickness, fluid accumulation proximal to the lesion with complete loss of wall layering.

Jayaprakash *et al.*, (1999). reported a case of linear foreign body (cotton thread) in a dog presented with the history of vomiting and hematochezia.

Habeeb, (2000). conducted a clinical survey of incidence of gastrointestinal foreign bodies in dogs and the incidence is 0.48 percentage (57/11989 cases).

Gastric foreign bodies may be identified by ultrasound. The ability to detect these objects depends on the presence of gastric contents (eg:- gas, fluid and food), the position of the object relative to sound beam and object composition. Strong acoustic shadow with or without an echogenic acoustic interface are suggestive of foreign body (Riedesel, 2002).

Armbrust *et al.*, (2003). stated that foreign bodies in the subcutaneous and underlying soft tissue structures are problematic because they are not often recognized by physical examination. Ultrasonic features of hyper echoic structure interpreted as a foreign body had variable degrees of clean or dirty far field acoustic shadowing.

Boysen *et al.*, (2003). reviewed that gastrointestinal perforation is a common cause of septic peritonitis. Sonographic features of gastrointestinal perforation included peritoneal effusion, fluid-filled stomach or intestine, thickening of gastro intestinal wall, loss of gastrointestinal wall layering, presence of free air, corrugated intestines and presence of mass.

2.9.4.2 Intussusception

Bojrab, (1986); Levitt and Bauer (1992). observed that intussusception in young dogs commonly occurred at the ileocecocolic junction.

Ultrasonographic appearance of an intussusception is a series of concentric of rings (in a transverse image) or parallel lines in a longitudinal image that reflect the folded layers of intestinal wall that make up the lesion (Penninck *et al.*, 1990; Cartee *et al.*, 1993; Penninck, 1995 and Prathaban *et al.*, 2001).

Ultrasonographic examination of animal having history of acute onset of vomiting, depression and anorexia revealed a large echogenic mass extended into the lumen of the gastric fundus. The left side of the mass, outlined by fluid in the stomach, spiraled and tapered to a round edge, suggestive of gastrogastric

intussusception. The stomach wall was thickened measuring 13 mm and wall layers were not visualized (Huml *et al.*, 1992).

Levitt and Bauer, (1992). stated that many intussusceptions were idiopathic.

Tidwell and Penninck, (1992). opined that acoustic pattern arising from each foreign body varied depending on its physical properties and interaction with ultrasound beam.

The typical appearance of an intussusception in transverse images has given rise to descriptive terms like target sign or bulls eye sign. (Penninck, 1995)

Watson, (1997). reported that a large craniodorsal abdominal mass with laminated appearance of duodenal wall suggestive of gastro-duodenal intussusception.

Lee *et al.*, (2005). reported that ultrasonographic examination of a dog with pylorogastric intussusseption revealed distension of the stomach filled with fluid. Multiple concentric echogenic and echolucent rings were visible are suggestive of pylorogastric intussusception.

2.10 Clinical Pathology

2.10.1 Haematology

Jain, (1986). postulated the reference range of haematological parameters for normal dogs.

Erythrocytes	5.5 – 8.5 x 10^6 cells per microlitre
Haemoglobin	12 – 18 grams per deciliter
Packed cell volume	37 – 55 per cent
Leucocytes	6000 – 17000 cells per microlitre
Neutrophils	3000 – 11500 cells per microlitre
Bands	0 – 300 cell per microlitre

Lymphocytes	1000 – 4800 cells per microlitre
Monocytes	150 – 1350 cells per microlitre
Eosinophils	100 – 1250 cells per microlitre
Basophils	rare

Wilson and Burt, (1974); Weaver, (1977). observed neutrophilic leucocytosis in cases associated with intestinal intussusceptions.

Hall and Simpson, (2000). reported that the animal with gastritis and enteritis showed packed cell volume (per cent) was greater than 60 per cent and haemoglobin (g/dl) decreased. It was also reported that leukopenia in case of gastroenteritis and lymphopenia in case of lymphangiectasia.

Jose, (2001). reported leucocytosis and lymphocytosis in upper alimentary tract obstruction and normal leucocyte count with neutrophilia in lower alimentary tract obstructions. Packed cell volume and total erythrocyte count was low in both cases.

2.10.2 Serum biochemistry

2.10.2.1 Sodium, potassium, chloride

Twedt, (1992). reported that gastric vomiting would result in loss of water containing sodium, chloride, hydrogen and potassium and hypokalemia as the most frequent electrolytes disturbance.

Benjamin, (1985). recorded normal serum sodium, potassium and chloride levels in healthy dogs as 143 (range 137-149) milliequivalents per litre, 4.4 (3.7 – 5.8) milliequivalents per litre and 106 (99-110) milliequivalents per litre respectively.

Benjamin, (1985). observed that the dog had history of prolonged vomiting and diarrhoea showed hypokalemia hyponatremia and hypocholremia.

Cornelius, (1992). reported that the causes of hyponatremia, hypokalemia and hypocholremia in dogs were mainly due to gastrointestinal losses like vomiting and diarrhoea.

Richter, (1992). stated that vomiting of gastric contents caused hypernatremia, hypokalemia and alkalosis, while gastric or proximal duodenal obstruction resulted in hyponatremia, hypocholremia, hypokalemia and metabolic alkalosis.

Evans *et al.,* (1994). reported hypokalemia and hyponatremia in 31 per cent and 22 per cent respectively, of dogs with gastrointestinal linear foreign bodies.

Kaneko *et al.,* (1997). observed that the causes of hyponatremia, hypokalemia and hypocholremia in dogs were mainly due to gastrointestinal losses like vomiting and diarrhoea.

Phillips and Polzin, (1998). observed that hypokalemia resulting from decreased total body potassium seen in dogs with gastric vomiting.

Andrews and Grindem, (2000). reported that gastrointestinal diseases like vomiting and diarrhea cause hyponatremia, hypokalemia and hypochloremia. It was also reported the common cause of metabolic alkalosis was the loss of gastric hydrochloric acid resulted from persistent vomiting.

Jergans and Willard, (2000). observed that the dog with colonic disease showed electrolyte disturbances (hypokalemia, hypercalcemia).

Materials and methods

3. MATERIALS AND METHODS

The study was conducted in the Department of Clinical Medicine, College of Veterinary and Animal Sciences, Mannuthy during the period from July 2005-June 2006.

Dogs brought to the University Veterinary Hospital, Kokkalai and Veterinary College Hospital, Mannuthy with clinical signs suggestive of gastrointestinal disorders were selected and utilized for the present study.

3.1 Selection of Cases

Dogs showing specific signs of gastrointestinal disorders like persistent vomiting, diarrhoea, constipation, inappetance, anorexia and abdominal distension which do not respond to routine treatments were selected.

They were subjected to ultrasound scanning of abdomen, in addition to detailed clinical examination, haematology and serum biochemistry.

3.1.1 Clinical Cases

The clinical cases selected for detailed study were grouped as follows, based on ultrasonographic changes

Group I - consisted of four dogs with gastritis.

Group II - consisted of four dogs with enteritis.

Group III - consisted of five dogs with gastrointestinal tract obstructions.

Group IV - consisted of two dogs with uremic gastropathy.

3.2 Parameters studied

History

Signalment

Clinical signs

Physical examination

Abdominal ultrasonography

Clinical pathology

Haematology

Hemoglobin (Hb) concentration - (gm per dl)

Volume of Packed Red Cells (VPRC) - (%)

Total Leucocyte Count (TLC) - cells per cmm

Differential Leucocyte Count (DLC)-(%)

Serum biochemistry

Sodium - mEq/ L

Potassium - mEq/ L

Chloride - mEq/ L

3.3 Outline of study

3.3.1 Clinical examination

Detailed clinical examination of all animals under study was carried out as described by Radostits *et al.*, (2000).

3.3.2 Ultrasonography

3.3.2.1 Equipment

Ultrasound scanning of abdomen was carried out using "L&T Symphony 4.0 and HONDA HS 200 VET Ultrasound Scanners" having 3.5, 5.0 and 7.5 MHz mechanical sector transducer. Images of the scanning were recorded in a Video Cassette Recorder and still pictures were taken from the monitor after freezing the picture.

3.3.2.2 Ultrasound scanning procedure (Plate - 1)

The hair on the ventral abdomen was clipped and the animal was placed on dorsal recumbency for scanning. Occasionally the animals were put on lateral recumbency or made to stand to facilitate visualization of the organ of interest. Coupling gel was applied liberally to the skin to displace air before scanning.

The transducer was placed on the skin and moved cranial to caudal abdomen and from left to right side to make scans in longitudinal and transverse planes of the entire abdomen. The echopatterns were observed on the monitor. Absence of echo produced black dots (referred as anechoic) and return of a strong echo as white dots (referred as hyperechoic). Echos of intermediate intensity were represented on the monitor as gray shades of dots. Multiple sweeps of these organs in both longitudinal and transverse planes were taken to assess and characterized the lesions as per Nyland and Mattoon,(1995). Measurements were obtained using the in built electronic callipers wherever required.

3.4 Clinical Pathology

3.4.1 Collection of Clinical Materials

Relevant clinical materials were collected at the time of admission. Five millilitre of whole blood was collected from saphenous or cephalic vein of the

affected dog in dry glass vials with EDTA at the rate of 1-2 mg per millilitre as anticoagulant (Benjamin, 1985).

Ten ml of blood was collected in another test tube for separating serum for biochemical analysis. Sera thus separated were stored at –20°C till further analysis.

3.4.2 Examination of clinical material

3.4.2.1 Haematology

Haemoglobin concentration, Volume of Packed Red Cells, Total Leucocyte Count (TLC) and Differential Leucocyte Count (DLC) were estimated as per the method described by Schalm *et al.*,(1975).

3.4.2.1.1 Haemoglobin

Haemoglobin concentration was estimated using Sahli's haemoglobinometer and expressed as grams per deciliter (Schalm *et al.*,1975).

3.4.2.1.2 Volume of Packed Red Cells

Volume of Packed Red Cells was measured using microhaematocrit tube as described by Schalm *et al.*,(1975).

3.4.2.1.3 Total Leucocyte Count

The total leucocyte count was estimated by standard dilution technique using Thomas fluid as diluent (Benjamin, 1985).

3.4.2.1.4 Differential Leucocyte Count

The differential leucocyte count of blood smears were obtained by staining with Leishman's stain and examined under oil immersion (Benjamin, 1985) and counting was done by Meanderx method. Hundred cells were counted and

tabulated namely, neutrophils, lymphocytes, monocytes, eosinophils and basophils and expressed in percentage.

3.4.2.2 Serum Biochemistry

3.4.2.2.1 Serum Sodium

Serum Sodium was analysed by emission flame photometry as described by Oser, (1971).

3.4.2.2.2 Serum Potassium

Serum Potassium was analysed by emission flame photometry as described by Oser, (1971).

3.4.2.2.3 Serum chloride

Serum chloride was estimated by modified thiocyanate method, using commercially available reagent kits* (Schonfeld and Lowellen, 1964).

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* - AGAPPE diagnostics, Kerala.

Results

4. RESULTS

The present study was conducted in the Department of Clinical Medicine, College of Veterinary Animal Sciences, Mannuthy during the period of July 2005-June 2006. Fifty cases which exhibited gastrointestinal signs like persistent vomiting, diarrhoea, constipation, inappetance, anorexia and abdominal distension and not responded to routine medical treatment were subjected to detailed clinical examination and ultrasonography. Among them, fifteen dogs which were suffering from gastritis, enteritis, gastrointestinal tract obstructions and uremic gastropathy were selected and grouped as Group I, Group II, Group III and Group IV, respectively. Sonological lesions were studied in detail.

Signalment of animals of Group I consist of four dogs with following details.

	Breed	Age	Sex
Case no. 1	Dachshund	41/2 months	Female
Case no. 2	Dachshund	9 months	Male
Case no. 3	Labrador	4 year	Male
Case no. 4	Labrador	41/2 year	Male

Signalment of animals of Group II consist of four dogs with following details.

	Breed	Age	Sex
Case no. 5	Germen Shepherd	9 months	Male
Case no. 6	Non-descript	9 months	Male
Case no. 7	Dachshund	41/2 months	Male
Case no. 8	Rottweiler	7 months	Male

Signalment of animals of Group III consist of five dogs with following details.

	Breed	Age	Sex
Case no. 9	Spitzs	8 months	Male
Case no. 10	Greatdane	4 months	Male
Case no. 11	Non-descript	7 months	Male
Case no. 12	Labrador	21/2 year	Male
Case no. 13	Pomeranian	2 year	Male

Signalment of animals of Group IV consist of two dogs with following details.

	Breed	Age	Sex
Case no. 14	Labrador	8 months	Female
Case no. 15	Labrador	2 year	Female

4.1 Epidemiology of gastrointestinal disorders

Fifty cases which exhibited gastrointestinal signs like persistent vomiting, diarrhoea, constipation, inappetance, anorexia and abdominal distension and not responded to routine medical treatment were subjected to detailed clinical examination and ultrasonography. Among these fifty cases gastrointestinal disorders were prevelant in Labrador (11 cases), followed by German Shepherd and Dachshund (9 cases each), Pomeranian and Non-descript (5 cases each), Greatdane (4 cases), Spitzs (3 cases), Rottweiler and Dobermann (2 cases each). Thirty cases (60 percent) were below the age of two years, 16 cases (32 percent) were within the age of 2 to 4 years and 4 cases (8 percent) were above 4 years. Among them, fifteen dogs which were suffering from gastritis, enteritis, gastrointestinal tract obstructions and uremic gastropathy were selected and grouped as Group I, Group II, Group III and Group IV, respectively. Sonological lesions were studied in detail.

4.2 Normal ultrasonography of gastrointestinal tract

4.2.1 Stomach

The normal stomach wall appears three to five distinguishable layers. The rugae in empty stomach appear cauliflower like in the ultrasonography. Highly echogenic gastric contents usually mask the gastric wall (Plate- 2 and 3)

4.2.2 Intestine

The normal small bowel appears as five distinguishable echogenic layers. The innermost hyperechoic layer corresponds to the surface of the mucosa and innermost hypoechoic layer represents the mucosa. The mid hyperechoic layer is the submucosa. Outer hypoechoic layer is the muscularis propria and the outer hyperechoic layer is the subserosa/serosa (Plate- 4)

In the case of large intestine these layers can not be differentiated separately.

4.3 Group I

Four dogs with clinical signs of gastritis were included in this group (Case no. 1 to 4).

4.3.1 History

In all the four cases, gastritis was associated with a history of sudden onset of vomiting. The vomiting episodes were frequent, consisting of either food or gastric fluid. The animals become anorectic and taking a little quantity of water and followed by immediate vomiting. In Case no. 1, 3 and 4 it was reported that the signs of gastric pain characterized by tendency to place the epigastric region on cold floor while lying down.

Case no. 1 to 3 had a history of sudden change in the diet; none of these animals exhibited diarrhoea.

4.3.2 Clinical Examination

Table- 1 Clinical data of Group I

	Rectal temperature (°F)	Pulse (per min.)	Respiration (per min.)	Mucous membrane
Case no. 1	102.2	100.0	20.0	Congested
Case no. 2	105.2	115.0	23.0	Congested
Case no. 3	101.2	90.0	21.0	Congested
Case no. 4	103.2	100.0	24.0	Congested
Mean	102.95	101.25	22.0	-

Rectal temperature of affected animals ranged from 101.2 to 105.2°F with a mean value of 102.95 °F. Pulse rate of affected animals ranged from 90.0 to 115.0 per min. with a mean value of 101.25 per min. Rate of respiration of affected animals ranged from 20.0 to 24.0 per min. with a mean value of 22.0 per min.

All the animals of this group had congested mucous membrane.

Popliteal lymphnodes were palpable in all the cases.

Clinical signs included vomiting, anorexia, and signs of abdominal pain. Frequency of vomiting in Case no.3 was approximately four times a day. Case no.1 and 4 preferred sternal recumbancy with epigastric region pressing on the floor.

4.3.3 Physical examination

In the dog with mild gastritis (Case no. 2) no physical abnormalities were evident, while Case no. 1, 3 and 4 showed pain in the epigastric area on palpation and abdominal muscles were held tensely.

4.3.4 Ultrasonography

Ultrasonographic examination of Case no. 3 and 4 revealed dilated stomach with fluid and ingesta. Diffused thickening of the stomach wall with loss of normal wall layers were observed (Plate- 5).

Ultrasonographic abnormalities could not be detected in Case no. 1 and 2.

4.3.5 Clinical Pathology

4.3.5.1 Haematology

Table - 2 Haematological values of Group I

	Haemoglobin (g/dl)	Volume of Packed Red Cells (percent)	Total Leucocyte Count (cells/cmm)	Differential Leucocyte Counts (percent)			
				Neutrophils	Lymphocytes	Monocytes	Eosinophils
Case no.1	14.2	46.0	12200.0	70.0	30.0	-	-
Case no.2	13.0	45.0	14200.0	72.0	28.0	-	-
Case no.3	15.0	50.0	9500.0	70.0	26.0	-	4.0
Case no.4	15.0	48.0	12000.0	73.0	23.0	-	4.0
Mean	14.3	47.25	11975.0	71.25	26.0	-	2.0

4.3.5.1.1 Haemoglobin

The haemoglobin concentration in dogs of this group were ranged from 13.0 to 15.0 grams per decilitre with a mean value of 14.3 grams per decilitre.

The haemoglobin concentration in all the cases of this group were within normal range.

4.3.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in dogs of this group were ranged from 45.0 to 50.0 percent with a mean value of 47.25 percent.

The volume of packed red cells in all the cases of this group were within normal range.

4.3.5.1.3 Total Leucocyte Count (TLC)

The total leucocyte counts in dogs of this group were ranged from 9500.0 to 14200.0 cells per microlitre with a mean value of 11975.0 cells per microlitre.

The total leucocyte count in all the cases of this group were within normal range.

4.3.5.1.4 Differential Leucocyte Counts (DLC)

The percentage of neutrophils in dogs of this group ranged from 70.0 to 73.0 with a mean value of 71.25 percent. The above values were within normal range.

The percentage of lymphocytes, monocytes and eosinophils in all the cases of this group were within normal range.

4.3.5.2 Serum biochemistry

Table- 3 Serum biochemical values of Group I

	Sodium (mEq/L)	Potassium (mEq/L)	Chloride (mEq/L)
Case no. 1	129.0	3.3	88.0
Case no. 2	116.0	3.5	98.0
Case no. 3	138.0	3.2	100.0
Case no. 4	141.0	3.4	102.0
Mean	131.0	3.35	97.0

4.3.5.2.1 Serum Sodium

The serum sodium concentration in Case no. 1, 2, 3 and 4 were 129.0, 116.0, 138.0 and 141.0 milliequivalents per litre respectively with a mean value of 131.0 milliequivalents per litre.

The serum sodium concentration in all the cases of this group were below the normal range.

4.3.5.2.2 Serum Potassium

The serum potassium concentration in Case no. 1, 2, 3 and 4 were 3.3, 3.5, 3.2 and 3.4 milliequivalents per litre respectively with a mean value of 3.35 milliequivalents per litre.

The serum potassium concentration in all the cases of this group were below the normal range.

4.3.5.2.3 Serum Chloride

The serum chloride concentration in Case no. 1, 2, 3 and 4 were 88.0, 98.0, 100.0 and 102.0 milliequivalents per litre respectively with a mean value of 97.0 milliequivalents per litre.

The serum chloride concentration in all the cases of this group were below the normal range.

4.4 Group II

Dogs which had shown the clinical signs of enteritis were included in this group (Case no. 5 to 8).

4.4.1 History

Case no. 5 and 6 had a history of sudden change in the diet, anorexia, vomiting, diarrhoea with or without blood or mucus in feces for period of more than three days.

In Case no. 7 and 8 had parvoviral enteritis characterized by vomiting and foul smelling diarrhoea.

Case no. 5, 7 and 8 had not completed the vaccination schedule while Case no. 6 had a proper vaccination history.

4.4.2 Clinical examination

Table- 4 Clinical data of Group II

	Rectal temperature (°F)	Pulse (per min.)	Respiration (per min.)	Mucous membrane
Case no. 5	103.0	110.0	23.0	Congested
Case no. 6	102.0	106.0	22.0	Congested
Case no. 7	102.2	100.0	21.0	Congested
Case no. 8	104.0	100.0	22.0	Congested
Mean	102.8	104.0	22.0	-

Rectal temperature of affected animals ranged from 102.0 to 104.0°F with a mean value of 102.8°F. Pulse rate of affected animals ranged from 100.0 to 110.0 per min. with a mean value of 104.0 per min. Rate of respiration of affected animals ranged from 21.0 to 23.0 per min. with a mean value of 22.0 per min.

Case no. 5, 6, 7 and 8 had congested mucous membrane and popliteal lymphnodes were enlarged in all the cases.

Case no. 5 and 7 had sudden onset of watery or watery mucoid diarrhoea with duration of 1 to 3 days. Case no. 6 and 8 had vomiting, diarrhoea mixed with blood or mucus. Case no. 6, 7 and 8 had abdominal pain and dehydration. Case no. 5 and 8 had fever.

4.4.3 Physical examination

Abdominal palpation of all cases revealed pain in the epigastric area and distended intestinal loops.

4.4.4 Ultrasonography

Transverse scan of small intestine of all the cases revealed anechoic luminal content with concentric multilayered appearance and longitudinal scan of the large intestine showed dilated fluid filled loop with indistinct thickened wall layers (Plate- 6).

4.4.5 Clinical Pathology

4.4.5.1 Haematology

Table - 5 Haematological values of Group II

	Haemoglobin (g/dl)	Volume of Packed Red Cells (percent)	Total Leucocyte Count (cells/cmm)	Differential Leucocyte Counts (percent)			
				Neutrophils	Lymphocytes	Monocytes	Eosinophils
Case no.5	16.0	59.0	10000.0	79.0	21.0	-	-
Case no.6	16.4	60.0	12300.0	79.0	20.0	1.0	-
Case no.7	16.2	61.0	10100.0	77.0	23.0	-	-
Case no.8	14.0	55.0	13100.0	72.0	23.0	5.0	-
Mean	15.65	58.75	11375.0	76.75	21.75	1.5	-

4.4.5.1.1 Haemoglobin

The haemoglobin concentration in dogs of this group were ranged from 14.0 to 16.4 grams per decilitre with a mean value of 15.65 grams per decilitre.

The haemoglobin concentration in all the cases were above normal range.

4.4.5.1.2 Volume of Packed Red Cells (VPRC)

The volume packed red cells in dogs of this group were ranged from 55.0 to 61.0 percent with a mean value of 58.75 percent.

The volume of packed red cells in all the cases were above normal range.

4.4.5.1.3 Total Leucocyte Count (TLC)

The total leucocyte count in dogs of this group were ranged from 10000.0 to 13100.0 cells per microlitre with a mean value of 11375.0 cells per microlitre.

The total leucocyte count in all the cases were within normal range.

4.4.5.1.4 Differential Leucocyte Counts (DLC)

The percentage of neutrophils in dogs of this group ranged from 72.0 to 79.0 with a mean value of 76.75 percent.

The values were above normal range.

The percentage of lymphocytes, monocytes and eosinophils in all the cases were within normal range.

4.4.5.2 Serum biochemistry

Table- 6 Serum biochemical values of group II

	Sodium (mEq/L)	Potassium (mEq/L)	Chloride (mEq/L)
Case no. 5	116.0	3.4	86.0
Case no. 6	129.0	3.3	88.0
Case no. 7	131.0	3.9	99.0
Case no. 8	140.0	3.8	85.0
Mean	129.0	3.6	88.75

4.4.5.2.1 Serum Sodium

The serum sodium concentration in Case no. 5, 6, 7 and 8 were 116.0, 129.0, 131.0 and 140.0 milliequivalents per litre respectively with a mean value of 129.0 milliequivalents per litre.

The serum sodium concentration in all the cases were below the normal range.

4.4.5.2.2 Serum Potassium

The serum potassium concentration in Case no. 5, 6, 7 and 8 were 3.4, 3.3, 3.9 and 3.8 milliequivalents per litre respectively with a mean value of 3.6 milliequivalents per litre.

The serum potassium concentration recorded in all the cases were below the normal range.

4.4.5.2.3 Serum Chloride

The serum chloride concentration in Case no. 5, 6, 7 and 8 were 86.0, 88.0, 99.0 and 85.0 milliequivalents per litre respectively with a mean value of 88.75 milliequivalants per litre.

The serum chloride concentration in all the cases were below the normal range.

4.5 Group III

Dogs which had shown the symptoms of gastrointestinal obstruction were included in this group (Case no. 9 to 13).

4.5.1 History

All the animals had the habit of ingestion of unconventional materials like plastics, food wrappers, scrubbers, bone pieces, wood, toys, carpet pieces, belts, mud, clothes, stones and mango fruits.

Animals of this group had a history of vomiting, anorexia, constipation for more than one week. All the cases showed vomiting, immediately after taking water. In Case no. 12 vomitus was greenish in colour.

4.5.2 Clinical examination

Table- 7 Clinical data of Group III

	Rectal temperature (°F)	Pulse (per min.)	Respiration (per min.)	Mucous membrane
Case no. 9	101.0	100.0	22.0	Congested
Case no. 10	103.0	96.0	23.0	Congested
Case no. 11	102.2	110.0	22.0	Congested
Case no. 12	102.0	110.0	23.0	Congested
Case no. 13	102.0	100.0	23.0	Congested
Mean	102.0	103.2	22.6	-

Rectal temperature of affected animals ranged from 101.0 to 103.0°F with a mean value of 102.0°F. Pulse rate of affected animals ranged from 96.0 to 110.0 per min. with a mean value of 103.2 per min. Rate of respiration of affected animals ranged from 22.0 to 23.0 per min. with a mean value of 22.6 per min.

Mucous membranes were congested in Case no. 9, 10, 11, 12 and 13.

The clinical signs included vomiting, anorexia, depression, abdominal pain, constipation in all the cases.

4.5.3 Physical examination

Physical abnormalities could not be appreciated in Case no. 10, 11 and 13.

Abdominal palpation of Case no. 9 revealed pain at the epigastric area and distended intestinal loops. In Case no. 12 a hard mass could be felt and animal evinced pain on palpation.

4.5.4 Ultrasonography

In Case no. 9 a foreign body was identified as an echogenic mass in a fluid filled stomach. Thickened layers of the gastric wall could be identified ultrasonographically. Longitudinal scan of small bowel distal to the duodenum revealed inhomogenous bright linear mass. Wall layers were not recognized. (Plate- 7). Later it was confirmed as piece of cloth after gastrotomy and enterotomy. The pieces of cloth were located in stomach and small bowel distal to the duodenum (Plate- 13A).

Ultrasonographic examination of Case no. 10 and 11 revealed intraluminal highly reflective interfaces with acoustic shadowing in the small bowel. Later it was confirmed as stone after enterotomy (Plate 8).

Ultrasonographic examination of Case no. 13 revealed transonic gastric foreign body (ball) in the stomach which could be appreciated as an echogenic bright mass in the scan (Plate- 9). Later it was confirmed as a ball during gastrotomy (Plate- 13B).

Transverse scan of abdomen of Case no. 12 revealed a layer of anechoic fluid filled stomach with an echogenic wall (Plate 10). Dilated fluid filled bowel segments with peristaltic movements were also observed (Plate 11). Later it was confirmed as mangokernal during enterotomy (Plate- 13C).

4.5.5 Clinical Pathology

4.5.5.1 Haematology

Table - 8 Haematological values of Group III

	Haemoglobin (g/dl)	Volume of Packed Red Cells (percent)	Total Leucocyte Count (cells/cmm)	Differential Leucocyte Counts (percent)			
				Neutrophils	Lymphocytes	Monocytes	Eosinophils
Case no.9	13.4	38.0	39400.0	75.0	24.0	-	1.0
Case no.10	14.2	40.0	14300.0	71.0	26.0	2.0	1.0
Case no.11	15.2	42.0	14900.0	73.0	26.0	-	1.0
Case no.12	14.0	39.0	41200.0	79.0	20.0	-	1.0
Case no.13	14.0	32.0	13800.0	74.0	25.0	-	1.0
Mean	14.16	38.2	24720.0	74.4	24.2	0.4	1.0

4.5.5.1.1 Haemoglobin

The haemoglobin concentration in dogs of this group were ranged from 13.4 to 15.2 grams per decilitre with a mean value of 14.16 grams per decilitre.

The haemoglobin concentration in all the cases of this group were within normal range.

4.5.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in dogs of this group were ranged from 32.0 to 42.0 percent with a mean value of 38.2 percent.

The volume of packed red cells in all the cases of this group were within in normal range.

4.5.5.1.3 Total Leucocyte Count (TLC)

The total leucocyte count in dogs of this group were ranged from 14300.0 to 41200.0 cells per microlitre with a mean value of 24720.0 cells per microlitre.

Leucocytosis was observed in Case no. 9 and 12.

4.5.5.1.4 Differential Leucocyte Count (DLC)

The percentage of neutrophils in dogs of this group ranged from 71.0 to 79.0 with a mean value of 74.4 percent.

Case no. 9 and 12 showed neutrophilia where as in Case no. 10, 11 and 13 it was within normal range.

Case no. 9 and 12 showed lymphopenia where as in Case no. 10, 11 and 13 percentage of lymphocytes were within normal range. The percentage of monocytes and eosinophils in all the cases were within normal range.

4.5.5.2 Serum biochemistry

Table- 9 Serum biochemical values of Group III

	Sodium (mEq/L)	Potassium (mEq/L)	Chloride (mEq/L)
Case no. 9	142.0	3.0	79.0
Case no. 10	129.0	3.5	83.0
Case no. 11	125.0	4.0	85.0
Case no. 12	134.0	2.6	92.0
Case no. 13	140.0	2.4	73.0
Mean	134.0	3.1	82.4

4.5.5.2.1 Serum Sodium

The serum sodium concentration in Case no. 9, 10, 11, 12 and 13 were 142.0, 129.0, 125.0, 134.0, and 140.0 milliequivalents per litre respectively with a mean value of 134.0 milliequivalents per litre.

The serum sodium concentration in all the cases of this group were below the normal range.

4.5.5.2.2 Serum Potassium

The serum potassium concentration in Case no. 9, 10, 11, 12 and 13 were 3.0, 3.5, 4.0, 2.6 and 2.4 milliequivalents per litre respectively with a mean value of 3.1 milliequivalents per litre.

The serum potassium concentration in all the cases of this group were below the normal range.

4.5.5.2.3 Serum Chloride

The serum chloride concentration in Case no. 9, 10, 11, 12 and 13 were 79.0, 83.0, 85.0, 92.0, and 73.0 milliequivalents per litre respectively with a mean value of 82.4 milliequivalents per litre.

The serum chloride concentration in all the cases of this group were below the normal range.

4.6 Group IV

Dogs which had shown the symptoms of uremic gastropathy were included in this group (Case no. 14 and 15).

4.6.1 History

Case no. 14 and 15 had a history of anorexia for a week but taking water as usual and animal exhibit vomiting immediately after taking water.

4.6.2 Clinical Examination

Table- 10 Clinical data of Group IV

	Rectal temperature (°F)	Pulse (per min.)	Respiration (per min.)	Mucous membrane
Case no. 14	102.0	100.0	22.0	Congested
Case no. 15	100.0	110.0	24.0	Congested
Mean	101.0	105.0	23.0	-

Rectal temperature, rate of pulse and respiration in Case no. 14 were 100.0°F, 100.0 per min. and 22.0 per min. respectively and the corresponding values in Case no. 15 were 102.0°F, 110.0 per min., 24 per min. respectively. In both cases mucous membranes were congested and animals showed anorexia,

abdominal pain, vomiting, polyuria, polydypsia, hematochezia or melena and halitosis.

4.6.3 Physical examination

In both cases physical examination revealed pain on epigastric area. Abdominal palpation revealed distended intestinal loops.

4.6.4 Ultrasonography

In both cases ultrasonographic examination revealed marked thickening and nonhomogenous texture of mucosa of stomach wall and rugal folds. The normal layers of the gastric wall could not be identified separately (Plate 12). The gastric mucosal surface was lined by hyperechoic rim at its interface with the gastric lumen. This hyperechoic line did not produce any acoustic shadowing.

Intestinal loops were distended and fluid filled.

Ultrasonographic examination of kidney revealed increased echogenicity of cortex with corticomedullary indistinction. Later it was confirmed as renal failure on postmortem examination.

4.6.5 Clinical Pathology

4.6.5.1 Haematology

Table- 11 Haematological values of Group IV

	Haemoglobin (g/dl)	Volume of packed red cells (percent)	Total leucocyte count (cells/cmm)	Differential leucocyte counts (percent)			
				Neutrophils	Lymphocytes	Monocytes	Eosinophils
Case no.14	9.0	27.0	18800.0	76.0	20.0	-	4.0
Case no.15	11.0	33.0	18200.0	77.0	22.0	-	1.0
Mean	10.0	30.0	18500.0	76.5	21.0	-	2.5

4.6.5.1.1 Haemoglobin

The haemoglobin concentration in Case no. 14 and 15 were 9.0 and 11.0 grams per decilitre respectively.

The haemoglobin concentrations in both the cases were below normal range.

4.6.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in Case no. 14 and 15 were 27.0 and 33.0 percent respectively.

The volume of packed red cells in both the cases were below normal range.

4.6.5.1.3 Total Leucocyte Count (TLC)

The total leucocyte count in Case no. 14 and 15 were 18800.0 and 18200.0 cells per microlitre respectively with a mean value of 18500.0 cells per microlitre.

Leucocytosis was evident in both the cases.

4.6.5.1.4 Differential Leucocyte Counts (DLC)

The percentage of neutrophils in Case no. 14 and 15 were 76.0 and 77.0 respectively.

Neutrophilia with lymphopenia were observed in both the cases.

The percentage of monocytes and eosinophils in both the cases were within normal range.

4.6.5.2 Serum biochemistry

Table- 12 Serum biochemical values of Group IV

	Sodium (mEq/L)	Potassium (mEq/L)	Chloride (mEq/L)
Case no. 14	146.0	4.4	99.0
Case no. 15	156.0	4.7	104.0
Mean	151.0	4.6	101.5

4.6.5.2.1 Serum Sodium

The serum sodium concentration in Case no. 14 and 15 were 146.0 and 156.0 milliequivalents per litre respectively with a mean value of 151.0 milliequivalents per litre.

The serum sodium concentration in both the dogs were above the normal range.

4.6.5.2.2 Serum Potassium

The serum potassium concentration in Case no. 14 and 15 were 4.4 and 4.7 milliequivalents per litre respectively.

The serum potassium concentration recorded in both the dogs were within normal range.

4.6.5.2.3 Serum Chloride

The serum chloride concentration in Case no. 14 and 15 were 99.0 and 104.0 milliequivalents per litre respectively.

The serum chloride concentration in both the cases were within normal range.

Plate-1:-Ultrasound scanning procedure

Plate-2:- Normal sonogram of stomach - Cauliflower like appearance of the rugae are visible.

Plate 1

Plate 2

Plate-3:-Normal sonogram of stomach - Different layers of stomach wall could be appreciated.

Plate-4:-Normal sonogram of intestine - Different layers of intestine wall could be appreciated. Spleen is used as an acoustic shadowing.

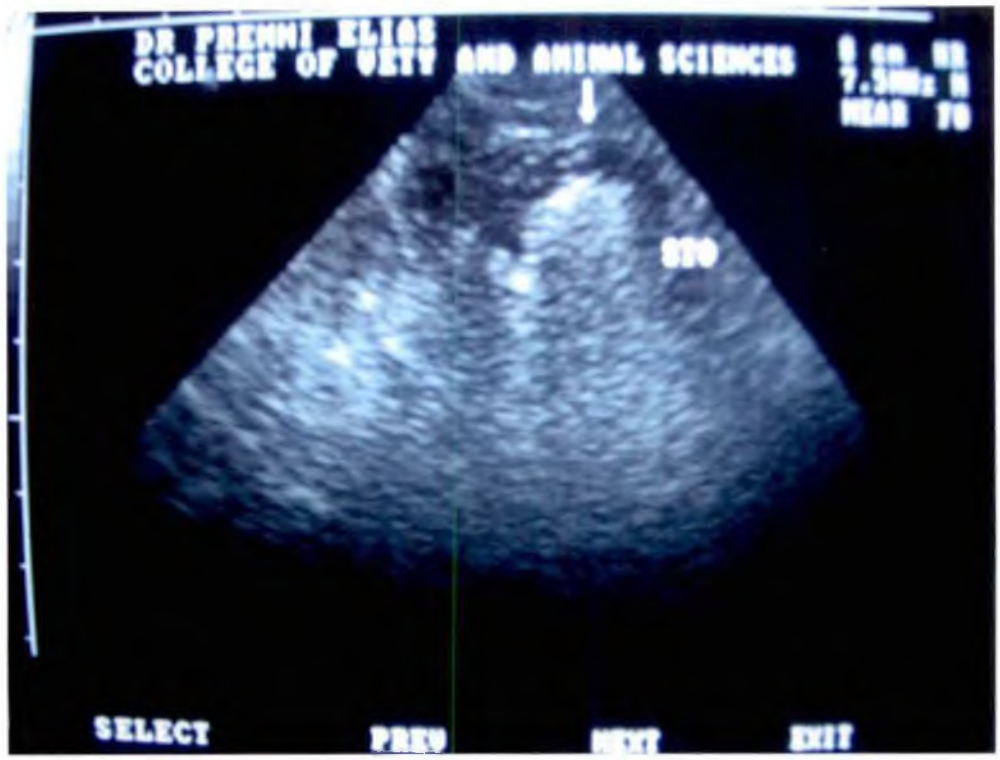

Plate 3

Plate 4

Plate-5:-Sonogram of stomach with gastritis - Thickened stomach wall with loss of wall layers.

Plate-6:-Sonogram of intestine with enteritis - Transverse scan showing dilated fluid filled loops.

Plate 5

Plate 6

Plate-7:- Sonogram of gastrointestinal linear foreign body (cloth) - Thickened layers of gastric wall in transverse scan is seen. Longitudinal scan reveals inhomogenous bright linear mass in intestine.

Plate-8:-Sonogram of gastrointestinal foreign body (stone) - Intraluminal highly reflective interface with acoustic shadowing in the small bowel.

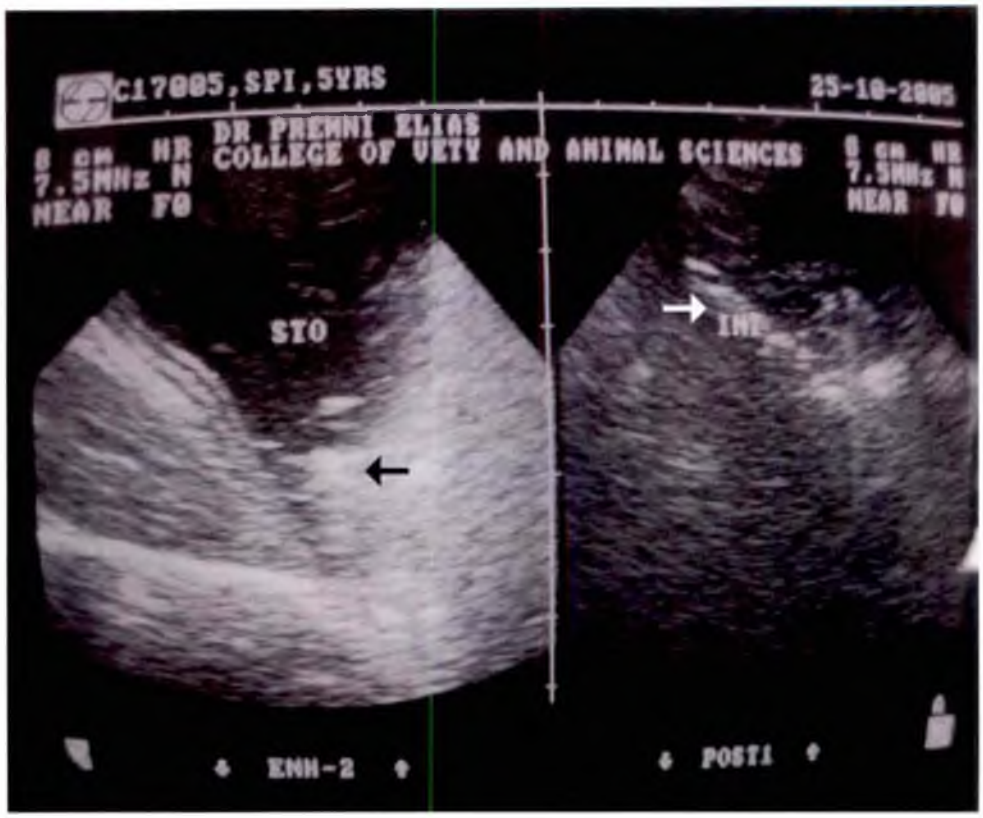

Plate 7

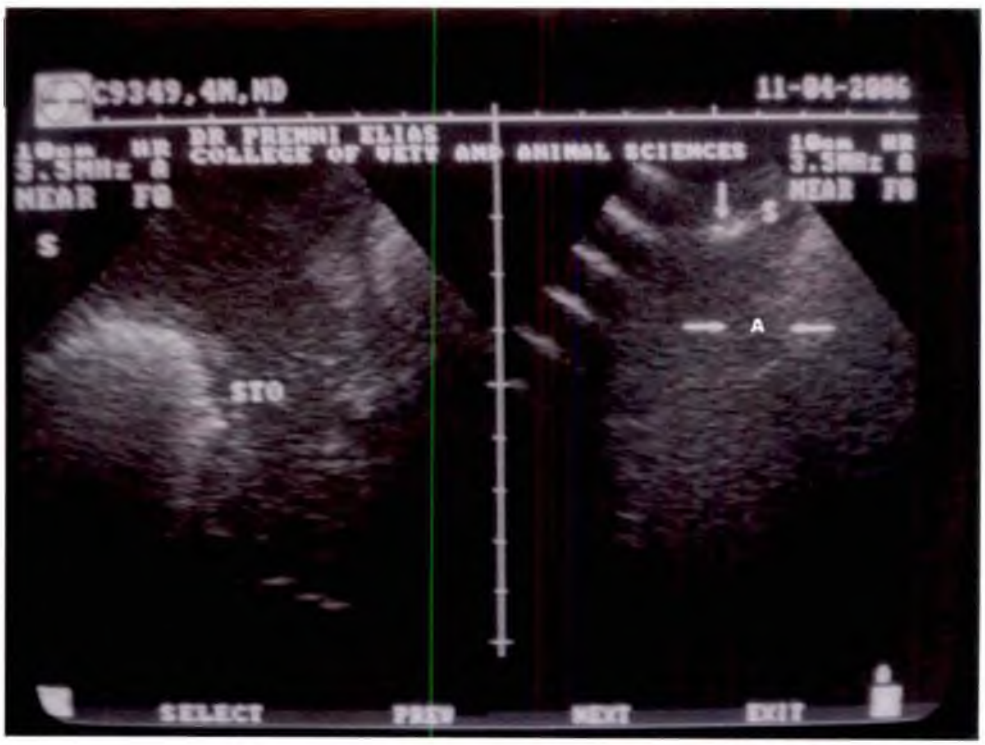

Plate 8

Plate-9:-Sonogram of gastrointestinal foreign body (ball) - Transonic gastric foreign body which could be appreciated as echogenic bright mass.

Plate-10:-Sonogram of gastrointestinal foreign body (mangokernal)- Transverse scan of anechoic fluid filled stomach with echogenic wall.

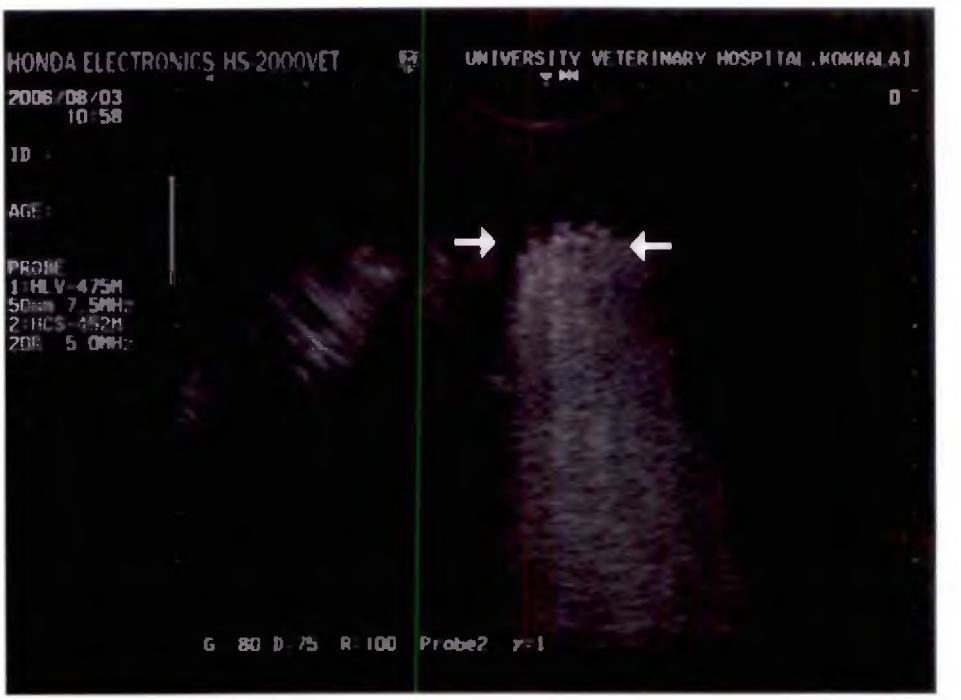

Plate 9

Plate 10

Plate -11:-Sonogram of gastrointestinal foreign body (mangokernal)- Dilated fluid filled bowel segments.

Plate -12:-Sonogram of stomach in uremic gastropathy – marked thickening and nonhomogenous texture of mucosa and rugal folds. Normal wall layers could not be identified.

Plate 11

Plate 12

Plate -13:- Photographs of gastrointestinal foreign bodies recovered in Case no. 9, 13 and12.

Plate -13A - Cloth

Plate -13B - Rubber ball

Plate -13C - Mangokernal

Plate 13

A

B

C

Discussion

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5. DISCUSSION

Fifty cases which exhibited gastrointestinal signs like persistent vomiting, diarrhoea, constipation, inappetance, anorexia and abdominal distension and not responded to routine medical treatment were subjected to detailed clinical examination and ultrasonography. Among them, fifteen dogs which were suffering from gastritis, enteritis, gastrointestinal tract obstructions and uremic gastropathy were selected and grouped as Group I, Group II, Group III and Group IV, respectively. Sonological lesions were studied in detail.

5.1 Epidemiology

Among these fifty cases gastrointestinal disorders were prevalent in Labrador (11 cases), followed by German Shepherd and Dachshund (9 cases each), Pomeranian and Non-descript (5 cases each), Greatdane (4 cases), Spitzs (3 cases), Rottweiler and Dobermann (2 cases each). Thirty cases (60 percent) were below the age of two years, 16 cases (32 percent) were within the age of 2 to 4 years and 4 cases (8 percent) were above 4 years.

This agrees with the observations made by Evans *et al.*, (1994).

The main causes of these disorders are due to dietary habits and indiscriminant chewing behaviour, increased consumption of canned or tinned food, intestinal parasitism, unhygienic kennels etc.

This agrees with findings of Kelly, (1974) that the incidence of foreign body in the stomach of dog was greatest in animals up to one year of age.

5.2 Normal ultrasonography of gastrointestinal tract

5.2.1 Stomach

The normal stomach wall appears three to five distinguishable layers. The rugae in empty stomach appear cauliflower like in the ultrasonography. Highly echogenic gastric contents usually mask the gastric wall (Penninck *et al.*, 1989; Cartee *et al.*, 1993; Nyland and Mattoon, 1995).

5.2.2 Intestine

The normal small bowel appears as five distinguishable echogenic layers. The innermost hyperechoic layer corresponds to the surface of the mucosa and innermost hypoechoic layer represents the mucosa. The mid hyperechoic layer is the submucosa. Outer hypoechoic layer is the muscularis propria and the outer hyperechoic layer is the subserosa/serosa. In the case of large intestine these layers can not be differentiated separately. (Penninck *et al.*, 1989; Cartee *et al.*, 1993; Nyland and Mattoon, 1995).

5.3 Group I

Four dogs of age ranging from 41/2 months to 41/2 years and showing signs of gastritis were included in this group.

5.3.1 History

All the cases in the group had history of gastritis due to dietary indiscretion was frequently associated with vomiting.

Common etiologies were foreign body ingestion like rocks, toys, food wrappings, bone piece and plastic bags can cause mechanical irritation of gastric mucosa (Strombeck and Guilford, 1991).

5.3.2 Clinical examination

In all the cases the clinical data were within normal range; except elevated temperature in Case no. 2 and 4. In all the cases mucous membranes were congested. This could be due to dehydration associated with vomiting and mild inflammation associated with gastritis (Strombeck and Guilford, 1991).

These findings agree with reports made by Benjamin, (1985) suggested that rise of temperature above the normal range upto the extent of 1 to 1.5°F indicates mild fever.

Most common clinical signs observed in gastritis were vomiting, anorexia and abdominal pain.

Case no. 3 had severe vomiting and that animal vomits four times a day. This finding agrees with reports made by Wingfield and Twedt, (1986); Hall and Simpson, (2000).

5.3.3 Physical examination

In Case no. 2 the physical examination was unremarkable. According to Radostits *et al.,* (2000) physical examination findings in dogs with mild gastritis was usually unremarkable. The animal may or may not be dehydrated. Gastritis usually mild, self limiting resolves within twenty four to forty eight hours after symptomatic treatment.

Physical examination of Case no. 1, 3 and 4 revealed presence of pain in the epigastric area and abdominal muscles were held tensely (Twedt and Magne, 1989; Sherding and Johnson, 2000).

5.3.4 Ultrasonography

Ultrasonographic examination of Case no. 3 and 4 revealed dilated stomach with fluid and ingesta. Diffused thickening of the stomach wall with loss of normal wall layers were observed.

In the present study thickening with retained layers of the gastric wall was an indication of inflammation.

Ultrasonographic abnormalities could not be detected in Case no. 1 and 2.

Normal ultrosonographic appearance of stomach provides an important land marks for differentiating anatomic variants from pathologic changes. The stomach is easily recognized by presence of rugae and regular peristaltic activity. The rugae are recognized as is the layered appearance of the stomach wall. In gastritis (acute or chronic) diffused or localized stomach wall thickening may be identified on ultrasonography (Penninck, 1995).

Pathological thickening should be suspected when the stomach wall thickness measures more than six to seven millimeters (Penninck *et. al.,* 1989).

Ultrasonographic changes observed may be due to physical, chemical, biological and systemic disorders that damaged the gastric mucosal barrier and cause increased permeability to luminal acids. These acids damage vasculature causes release of histamines stimulates further gastric acid secretion resulted gastritis (Strombeck and Guilford, 1991; Hall and Simpson, 2000).

5.3.5 Clinical Pathology

5.3.5.1 Haematology

5.3.5.1.1 Haemoglobin

The haemoglobin concentration in all the cases in the group were within normal range. This was agreeable with reports made by Jain, (1986).

5.3.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in all the cases were within normal range. This was agreeable with reports made by Jain, (1986).

5.3.5.1.3 Total Leucocyte Count

The total leucocyte count in all the cases were within normal range. These findings are agreeable with Hall and Simpson, (2000).

5.3.5.1.4 Differential Leucocyte Count (DLC)

The differential count of leucocytes in all the animals were within normal range. These findings are agreeable with Hall and Simpson, (2000).

5.3.5.2 Serum biochemistry

5.3.5.2.1 Serum Sodium

The serum sodium concentration in all dogs were below the normal range. This may be due to excess loss of sodium through vomiting. These findings agree with reports made by Benjamin, (1985).

5.3.5.2.2 Serum Potassium

The serum potassium concentration recorded in all the dogs were below the normal level. This may be due to excess loss of potassium through vomiting.

These findings are agreeable to the reports of Benjamin, (1985); Cornelius, (1992); Phillips and Polzin, (1998); Andrews and Grindem, (2000).

5.3.5.2.3 Serum Chloride

The serum chloride concentration in all the cases were below the normal range. This may be due to excess loss of chloride through vomiting.

These findings agree with reports made by Benjamin, (1985), Andrews and Grindem, (2000).

5.4 Group II

Four dogs of age ranging from 41/2 months to 9 months and showing signs enteritis were included in this group.

5.4.1 History

Case no. 5 and 6 had a history of sudden change in the diet, anorexia, vomiting, diarrhoea with or without blood or mucus in feces for period of more than three days.

Enteritis in Case no. 5 and 6 were caused by sudden change in diet. This agrees with findings of Sherding and Johnson, (2000) that enteritis may also be caused by abrupt change in diet and intolerance of foods. Enteritis resulted from abnormal fluid and ion transport by the mucosa of the small or large intestine. Loss of fluid by the intestine is a result of malabsorption of solutes, water or hypersecretion of solutes and water. (Sherding and Johnson, 2000).

Case no. 5, 7 and 8 had a history of incomplete vaccination while Case no. 6 had a proper vaccination history. Case no. 7 and 8 had a history of parvoviral enteritis characterized by foul smelling diarrhoea. Severe life threatening diarrhoea

may occur in young animals with infectious enteritis, haemorrhagic gastroenteritis and neonatal ancylostomosis (Appel *et. al.,* 1978, Sherding and Johnson, 2000).

5.4.2 Clinical examination

In all the cases rate of respiration and pulse were with in normal range.

Rectal temperature of Case no. 5 and 8 was above the normal range where as in Case no. 6 and 7 it was within normal range. This variation in temperature may be due to difference in severity of lesion. This high temperature may be due to stress, infection or inflammatory process. These findings agree with reports made by Benjamin, (1985) suggested that rise of temperature above the normal range upto the extent of 1 to 1.5°F indicates mild fever.

Initial viraemia may be responsible for high temperature in parvoviral enteritis (Biswas *et al.*, 2005)

Case no. 5, 6, 7 and 8 had congested mucous membrane and popliteal lymphnodes were enlarged in all the cases. This could be due to an acute inflammatory condition. This study agrees with the findings made by Strombeck and Guilford, (1991).

5.4.3 Physical examination

Abdominal palpation of all the cases revealed distended intestinal loops and sometimes pain in the epigastric area.

5.4.4 Ultrasonography

In Case no. 5, 6, 7 and 8 transverse scan of small intestine of all the cases revealed anechoic luminal content with concentric multilayered appearance and longitudinal scan of the large intestine showed dilated fluid filled loop with indistinct thickened wall layers. Present findings agree with observations made by Nyland and Mattoon, (1995). Enteritis may produce different ultrasonographic appearance; normal intestinal wall thickness, normal layering, distended bowel

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loops and lack of peristalsis were indicative of generalized ileus with parvoviral enteritis. Ultrasongraphic findings of enteritis in a dog included generalized fluid distention of small bowel with lack of intestinal motility and normal bowel wall thickness and appearance.

Dogs with mild to moderate enteritis had a median small intestinal wall thickness of 6 mm (Penninck *et al.*, 2003).

5.4.5 Clinical Pathology

5.4.5.1 Haematology

5.4.5.1.1 Haemoglobin

The haemoglobin concentration in all the cases were above normal range. This was agreeing with reports made by Jain, (1986).

5.4.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in all the cases were above the normal range.

This may be due to dehydration associated with vomiting and enteritis. These findings were agreeable with Hall and Simpson, (2000).

This may also be due to stress, trauma, inflammatory process and dehydration as reported by Benjamin, (1985), Penninck *et al.*, (1990).

5.4.5.1.3 Total Leucocyte Count

The total leucocyte count in all the cases were within normal range.

5.4.5.1.4 Differential Leucocyte Count (DLC)

Neutophilia could be observed in all the cases. This may be due to secondary bacterial infection or stress associated with enteritis. These findings were agreeing with reports made by Biswas *et al.*, (2005).

Slight lymphopenia observed under present study may be relative.

5.4.5.2 Serum biochemistry

5.4.5.2.1 Serum Sodium

The serum sodium concentration in all the cases were below the normal range. This may be due to excess loss of sodium ions through diarrhoeic faeces.

These findings are agreeable with reports made by Benjamin, (1985).

5.4.5.2.2 Serum Potassium

The serum potassium concentration all the cases were below the normal level. This may be due to excess loss of potassium ions through diarrhoeic faeces.

These findings were agreeable with reports made by Benjamin, (1985).

Phillips and Polzin, (1998); Andrews and Grindem, (2000) also observed similar findings in enteritic dog. The cause of hypokalemia is due to vomiting of gastric contents leading to decreased total body potassium.

5.4.5.2.3 Serum Chloride

The serum chloride concentration in all the cases were below the normal range. This may be due to excess loss of chloride ions through diarrhoeic faeces.

These findings are agreeble with reports made by Benjamin, (1985).

5.5 Group III

Five dogs suspected to have gastrointestinal tract obstruction were included in this group.

5.5.1 History

All the cases had habbit of ingestion of foreign materials like stones, plastics, carpets, rubber balls, clothes, bones, mango kernel etc. with history of vomiting, anorexia and constipation for more than one week. All the cases showed vomiting, immediately after taking water.

Foreign body ingestion was noticed by the owner in Case no. 9.

According to Sherding and Johnson, (2000) foreign bodies are the most common cause of gastrointestinal obstruction in dogs which was mainly due to their dietary habits and indiscriminant chewing behaviour.

Foreign bodies frequently ingested seen in dogs included stones, plastics, carpets, super balls and small toys, clothes, bones, rocks, metallic sewing needle and a fragment of tennis ball. (Penninck *et al.*, 1990; Penninck, 1995).

Common linear foreign bodies encountered in dogs and cats are thread, fabric, carpet, pantyhose and strings (Evans *et al.*, 1994; Jayaprakash *et al.*, 1999).

5.5.2 Clinical examination

The clinical data in all the cases of this group were within normal range.

The most common clinical signs included vomiting, anorexia, depression, abdominal pain and constipation. This was agreeing with observations of Kelly, (1974).

5.5.3 Physical examination

Abdominal palpation of Case no. 12 revealed a hard mass intra-abdominally and animal evincing pain. Case no. 9 revealed pain at epigastric area and distended or thickened intestinal loops on abdominal palpation and no physical abnormalities could be detected in other cases.

It was difficult to identify the presence of foreign body in the stomach by means of palpation because in many cases in which it causes signs, it is lodged in the pyloric area. Palpation of the abdomen would elicit a pain but it may not determine the site or nature of obstruction (Kelly, 1974).

All these cases were confirmed later by ultrasonography.

5.5.4 Ultrasonography

In Case no. 9 a foreign body was identified as an echogenic mass in a fluid filled stomach. Thickened layers of the gastric wall could be identified ultrasonographically. Longitudinal scan of small bowel distal to the duodenum revealed inhomogenous bright linear mass. Wall layers were not recognized. Later it was confirmed as piece of cloth after gastrotomy and enterotomy. The pieces of cloth were located in stomach and small bowel distal to the duodenum.

In the present study thickening with retained layers of the gastric wall was an indication of inflammation, may be due to foreign body lodged for a period of few days. Indiscrimination of the entire wall layers may be due to perforation at the site.

The present findings agree with Tidwell and Penninck, (1992) acoustic pattern arising from each foreign body varied depending on its physical properties and interaction with ultrasound beam. Linear foreign bodies were seen as echogenic line surrounded by plicated bowel as reported in dog with linear fragment of cloth as foreign body.

The gastrointestinal linear foreign bodies often are found in cats but less common in dogs. Most of the linear foreign bodies lodged in the pylorus in the dog. Ultrasonogrpahic features that were evaluated included location, length, wall thickness, fluid accumulation proximal to the lesion with complete loss of wall layering (Evans *et al.,* 1994)

A case of linear foreign body (cotton thread) in a dog presented with the history of vomiting and hematochezia (Jayaprakash *et al.*, 1999).

Ultrasonographic examination of Case no. 10 and 11 revealed intraluminal highly reflective interfaces with acoustic shadowing in the small bowel. Later it was confirmed as stone after enterotomy.

In this study curvilinear shadowing was considered, highly suggestive of a hard object which caused severe attenuation of ultrasound beam.

Acoustic pattern arising from each foreign body varied depending on its physical properties and interaction with ultrasound beam. Objects that transmit the beam are more accurately represented; their non-anatomic shape often intimates that they are foreign. Objects that attenuate the sound beam by both reflection and absorption, or by absorption alone, produce acoustic shadowing. This artifact, when seen in association with the lumen of the G I tract, appears to be a useful indicator of foreign material. The echogenic borders seen with objects having a reflective near surface are often characteristic of the object's shape (Tidwell and Penninck, 1992).

Gastric foreign bodies may be identified by ultrasound. The ability to detect these objects depends on the presence of gastric contents (eg: - gas, fluid and food), the position of the object relative to sound beam and object composition. Strong acoustic shadow with or without an echogenic acoustic interface are suggestive of foreign body (Riedesel, 2002).

Ultrasonographic examination of Case no. 13 revealed transonic gastric foreign body (ball) in the stomach which could be appreciated as an echogenic bright mass in the scan. Later it was confirmed as a ball during gastrotomy.

Round echogenic appearance of the mass (ball) may be due to multiple internal echos which were uniform in distribution.

The present study agrees with Penninck *et al.*, (1990). Sonographic appearance of gastric foreign objects such as ball might be variable depending on the physical properties (cohesion, elasticity, air content). Curvilinear shadowing is also suggestive of a ball. Large amount of gas and or ingesta in the stomach may interfere with diagnosis; in such condition administration of water should help to confirm the diagnosis of gastric foreign object.

Transverse scan of abdomen of Case no. 12 revealed a layer of anechoic fluid filled stomach with an echogenic wall. Dilated fluid filled bowel segments with peristaltic movements were also observed. Later it was confirmed as mangokernal during enterotomy.The presence of fluid and hyperperistalsis of stomach and small intestine indicating an obstruction at posterior aspect.

The present study agrees with observations made by Tidwell and Penninck, (1992). Ultrasonographic evaluation of the entire abdomen often aided diagnosis when the foreign object was not readily apparent. The presence of fluid or gas distention and hyperperistalsis of the stomach or small intestine mandated a careful search for an obstructing lesion.

5.5.5. Clinical Pathology

5.5.5.1 Haematology

5.5.5.1.1 Haemoglobin

The haemoglobin concentration in all cases were with in normal range.

5.5.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in all cases were within normal range.

5.5.5.1.3 Total Leucocyte Count

The total leucocyte count in Case no. 10, 11, and 13 were within normal range where as in Case no. 9 and 12 leucocytosis was evident.

Severe leucocytosis was observed in Case no. 9 and 12 (linear foreign bodies). As the peristalsis continues the foreign bodies became taut and comes to lie on the mescentric side of the intestinal lumen. Then it become irritate and devitalizes the intestinal mucosa and peritoneal contamination and peritonitis might have developed. Diagnosis was confirmed during surgery.

Evans, *et al.*, (1994) also reported that majority of affected animals had either a normal leucogram or a mild leucocytosis in (38 percent of cases)

gastrointestinal foreign body syndrome. This may be due to stress, trauma and inflammatory process associated with disease.

5.5.5.1.4 Differential Leucocyte Count (DLC)

The percentage of neutrophils of Case no. 9, 10, 11 and 13 were within normal range where as Case no. 12 had neutrophilia. This may be due to stress, trauma and inflammatory process as reported by Benjamin, (1985).

The proportion of lymphocytes, monocytes and eosinophils in all the animals of the group were within normal range, except in Case no. 12 which had relative lymphopenia.

5.5.5.2 Serum biochemistry

5.5.5.2.1 Serum Sodium

The serum sodium concentration in all the cases were below the normal range. This may be due to excess loss of sodium ions in vomiting.

These findings were agreeing with reports made by Benjamin, (1985); Moore, (1992). Prolonged vomiting and diarrhoea associated with gastrointestinal obstruction may result in hyponatremia, hypokalemia and hypocholremia.

Hypokalemia and hyponatremia were observed in 32 dogs with gastrointestinal linear foreign bodies (Evans *et al.*, 1994).

5.5.5.2.2 Serum Potassium

The serum potassium concentration in all the cases were below the normal level. This may be due to excess loss of potassium ions in vomiting.

Similar observations were made by Moore, (1992); Evans *et al.*, (1994); Phillips and Polzin, (1998).

5.5.5.2.3 Serum Chloride

The serum chloride concentration in all the cases were below the normal range. This may be due to excess loss of chloride ions in vomiting.

These findings were agreeing with reports made by Moore, (1992); Kaneko *et al.*, (1997) dogs with a history of vomiting and diarrhoea showed, hyponatremia, hypokalemia and hypocholremia.

5.6 Group IV

Two dogs which had shown the symptoms of uremic gastropathy were included in this group.

5.6.1 History

Case no. 14 and 15 had a history of anorexia, polyuria and polydypsia for a week. Animals exhibit vomiting immediately after taking water. Later this was diagnosed as a case of chronic renal failure.

Vomiting is a common complication of uremia in dogs. These abnormalities may be due to direct physiologic effects of uremic toxins, alterations in gastrointestinal endocrine and secretory functions or structural changes in the gastrointestinal tract. (Thornhill, 1983; Grooters *et al.*, 1994)

Strombeck and Guilford, (1991); Twedt, (1992); Johnson *et al.*, (2000) also reported similar history/symptoms in uremic gastropathy.

5.6.2 Clinical examination

Temperature, rate of pulse and respiration of animals of the group were within normal range. In both cases mucous membranes were congested and animals showed anorexia, abdominal pain, vomiting, polyuria, polydypsia, hematochezia or melena and halitosis.

Grooters *et al.*, (1994) also reported similar clinical signs viz. one week history of vomiting, anorexia, polydypsia and abdominal pain in four dogs with uremia due to chronic renal disease.

5.6.3 Physical examination

In both cases physical examination revealed pain on epigastric area with distended intestinal loops.

Similar observations were made by Strombeck and Guilford, (1991); Sherding and Johnson, (2000).

5.6.4 Ultrasonography

In both cases ultrasonographic examination revealed marked thickening and nonhomogenous texture of mucosa of stomach wall and rugal folds. The normal layers of the gastric wall could not be identified separately. The gastric mucosal surface was lined by hyperechoic rim at its interface with the gastric lumen. This hyperechoic line did not produce any acoustic shadowing.

Intestinal loops were distended and fluid filled.

Ultrasonographic examination of kidney revealed increased echogenicity of cortex with corticomedullary indistinction. Later it was confirmed as renal failure on postmortem examination.

Ultrasonographic features in uremic gastropathy in dog included thickened gastric wall and thickened rugal folds and a hyperechoic line at the mucosal-luminal interface due to mineralization of the gastric mucosa. (Grooters *et al.*, 1994).

Mineralization is often associated with an acoustic shadow due to reflection at the soft tissue mineralization interface. But in this case acoustic shadowing was not observed with mucosal mineralization. This may be due to the fact that the mineralization was small and therefore the degree of sound attenuation and resultant shadow was minimal.

Hypergastrenemia due to decreased renal clearance of gastrin may cause gastric wall thickening and acid hypersecretion which could contribute to gastric lesions (Thornhill, 1983).

5.6.5 Clinical Pathology

5.6.5.1 Haematology

5.6.5.1.1 Haemoglobin

The haemoglobin concentration in both the animals were below normal range. This was agreeing with reports made by Benjamin, (1985). This may be due to chronic gastrointestinal blood loss and iron deficiency due to decreased absorption. A nonregenerative type of anemia could be observed in renal failure.

5.6.5.1.2 Volume of Packed Red Cells (VPRC)

The volume of packed red cells in both animals were below normal range. This may be due to chronic gastrointestinal blood loss, iron deficiency due to decreased absorption, decreased erythropoietin production and suppression of bone marrow by uremic toxins. A nonregenerative type of anemia could be observed in renal failure.

5.6.5.1.3 Total Leucocyte Count

Leucocytosis was evident in both cases.

These findings were agreeing with reports made by Benjamin, (1985). Leucocytosis in uremic gastropathy was due to pathological leucocytosis, metabolic disorders like uremia.

5.6.5.1.4 Differential Leucocyte Count (DLC)

Neutrophilia was recorded in both cases.

This may be due to stress, trauma, inflammatory process and dehydration (Benjamin, 1985).

Relative lymphopenia with normal monocytes and eosinophils were observed in both the cases.

5.6.5.2 Serum biochemistry

5.6.5.2.1 Serum Sodium

The serum sodium concentration in both cases were above the normal range.

This may be due to loss of water that exceeds the sodium loss. The most common route of water loss is *via.* the gastrointestinal tract such as vomiting, diarrhoea and polyuria may contribute high serum sodium concentration in uremic gastropathy. (Cornelius, 1992; Grooters *et al.*, 1994).

5.6.5.2.2 Serum Potassium

The serum potassium concentration both cases were within normal range.

5.6.5.2.3 Serum Chloride

The serum chloride concentration in both cases were within normal range.

Summary

6. SUMMARY

The study "Ultrasonographic studies on gastro intestinal disorders in canine" was conducted to evaluate ultrasonography as diagnostic tool in gastro intestinal disorders; to assess and to correlate serum biochemical values, clinico-pathologic findings with ultrasonographic changes. The study included 15 animals with gastro intestinal disorders in which the following parameters were studied.

History

Signalment

Clinical examination

Physical examination

Ultrasonography

Haematology

Serum biochemistry

Based on the ultrasonographic changes the cases were divided into four groups.

Group I: consisted of four dogs with gastritis

Group II: consisted of four dogs with enteritis

Group III: consisted of five dogs with gastrointestinal tract obstructions

Group IV: consisted of two dogs with uremic gastropathy

Physical examination findings in dogs with gastritis were non specific. Foreign bodies as the cause of obstruction were detected in dogs with gastrointestinal obstruction. Ultrasonography could identify lesions in dogs with gastritis, enteritis and gastrointestinal obstruction due to foreign bodies.

In the present study, ultrasonographic changes in animals with gastritis were thickening of stomach wall with loss of wall layers.

Dilated intestinal lumen with thickened wall layers was observed in animals with enteritis.

In case of gastrointestinal obstruction due to foreign body the sonographic features are dilated fluid filled stomach and intestine with hyperperistaltic movements proximal to the obstruction.

Ultrasonographic changes observed in uremic gastropathy were thickened stomach wall and rugal folds.

Stress leucogram were recorded in dogs with gastrointestinal obstructions and uremic gastropathy.

The value of serum sodium recorded in gastritis, enteritis and gastrointestinal obstruction were 131.0, 129.0 and 134.0 milliequivalents per litre respectively, suggesting hyponatremia as the electrolyte abnormalities recorded in these dogs.

The values of serum potassium in groups of dogs with gastritis, enteritis, gastrointestinal obstruction and uremic gastropathy were 3.35, 3.6, 3.1 and 4.6 milliequivalents per litre respectively, suggesting hypokalemia as the electrolyte abnormalities recorded in these dogs.

The value of serum chloride recorded in gastritis, enteritis, gastrointestinal obstruction and uremic gastropathy were 97.0, 88.75, 82.4 and 101.5 milliequivalents per litre respectively, suggesting hypocholremia as the electrolyte abnormalities recorded in these dogs.

From this study it was concluded that

1. Ultrasonography could detect gastritis, enteritis, gastro intestinal obstruction due to foreign bodies.

2. Ultrasonography together with clinico-pathologic findings provide accurate diagnosis.

3. Hypokalemia, hyponatremia and hypocholremia were the electrolyte abnormalities in dogs with gastro intestinal disorders.

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ULTRASONOGRAPHIC STUDIES ON GASTROINTESTINAL DISORDERS IN CANINE

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ABSTRACT

The study "Ultrasonographic studies on gastrointestinal disorders in canine" was conducted in 15 dogs to evaluate ultrasonography as diagnostic tool in gastro intestinal disorders. To assess and to correlate serum biochemical values, clinico-pathologic findings with ultrasonographic changes. The study included 15 animals with gastrointestinal disorders. Various parameters such as history, signalment, clinical, physical examination, ultrasonography, haematology, serum biochemistry were studied.

Physical examination findings in dogs with gastritis were non specific. Ultrasonography could identify lesions in dogs with gastritis, enteritis, uremic gastropathy and gastrointestinal obstruction due to foreign body.

In the present study, ultrasonographic changes in animals with gastritis were thickening of stomach wall with loss of wall layers.

Dilated intestinal lumen with thickened wall layers was observed in animals with enteritis.

In case of gastrointestinal obstruction due to foreign body the sonographic features are dilated fluid filled stomach and intestine with hyperperistaltic movements proximal to the obstruction.

Ultrasonographic changes observed in uremic gastropathy were thickened stomach wall and rugal folds.

Stress leucogram were recorded in dogs with gastrointestinal obstructions and uremic gastropathy.

Hyponatremia, hypokalemia and hypocholremia were the electrolyte abnormalities in dogs with gastritis, enteritis, uremic gastropathy and gastro intestinal disorders.

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