

**CONTRAST RADIOGRAPHY FOR THE
DIAGNOSIS OF GASTRIC DISORDERS
IN DOGS**

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**Thesis submitted in partial fulfilment of the
requirement for the degree of**

Master of Veterinary Science

**Faculty of Veterinary and Animal Sciences
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2005

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DECLARATION

I hereby declare that the thesis entitled "**CONTRAST RADIOGRAPHY FOR THE DIAGNOSIS OF GASTRIC DISORDERS IN DOGS**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Certified that the thesis entitled "**CONTRAST RADIOGRAPHY FOR THE DIAGNOSIS OF GASTRIC DISORDERS IN DOGS**" is a record of research work done independently by Mr. Dileepkumar. K. M. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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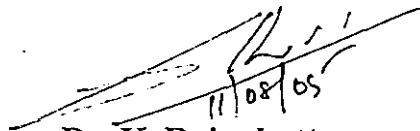
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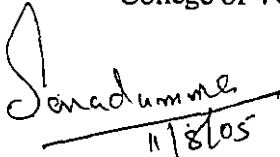
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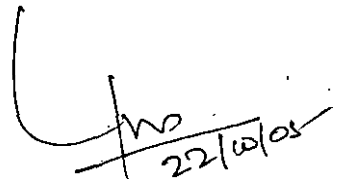
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Dedicated to My Beloved Parents

Smt. (late) Meenakshy Manikkan

and

Sri. (late) Manikkan. K.M.

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Introduction

1. INTRODUCTION

Radiography, as a diagnostic tool has sustained its role even with the emergence of latest imaging techniques like CT scan and MRI, because of its low cost, easy availability and easiness of reading. Though most of the lesions on hard tissues are positively available on a radiograph, radiography of soft tissues are often difficult or even impossible to define clearly, as a particular organ or structure, owing to its lack of contrast with the surrounding tissues. In such instances a deliberate attempt to alter the contrast of the tissues by using contrast materials was adopted so a radiograph with enhanced visualization and demarcation is obtained. Contrast radiography is used to supplement or confirm the information already obtained from plain radiographs (Herrtage,1978).When materials which increases the contrast is used ,it is called as a positive contrast radiography and when materials which decreases the contrast of the tissues is used it is called as a negative contrast radiography.

Apart from giving the structural details, contrast radiography often gives indication about the functional status of different organ system especially of the gastrointestinal and urinary systems .The movement of the contrast material through tracts of these systems observed through the series of radiographs taken will indicate the performance of different part of the system.

Dogs by their nature itself are prone to accidental ingestion of various foreign bodies like stones, bone pieces, part of plastic toys etc. Most of them being radiolucent identification of them by plain radiography is difficult. It may require a positive contrast radiography of stomach. Acquired lesions like gastric neoplasms, mucosal irregularities, gastric dilatation (Gibbs,1978)and gastric displacement (Frendin *et al.*,1988) may also require contrast radiography of the stomach for diagnosis. For positive contrast radiography of stomach barium sulphate suspension is preferred if there is no perforation of stomach wall.(Root,1975).Contrast radiography with barium sulphate suspension is

also helpful in determining the gastric emptying time and thereby diagnosis of pyloric obstruction (Gibbs and Pearson.,1973).

Even by making use of positive contrast radiograph, identification of mucosal lesions like gastric ulcers are often impossible. Similarly large volumes of barium sulphate administered may mask the appearance of small foreign bodies on the radiograph (Herrtage and Dennis, 1987).In such instances a double contrast radiography with barium sulphate as positive and air as negative contrast agent will help in better visualization of gastric mucosa and gastric lumen (Thilagar *et al.*,1994).

The present study was undertaken with an objective to evolve a contrast radiographic technique for the diagnosis of affections of stomach like mucosal lesions, space occupying intraluminal masses and causes for functional disorders like persistent vomiting and delayed gastric emptying.

Review of Literature

2. REVIEW OF LITERATURE

Butler (1969) diagnosed a case of acquired stenosis of the pylorus in an 8-year old female terrier-type dog with barium sulphate contrast radiography. The radiography revealed that little or no passage of radioopaque material from the stomach into the duodenum over a 4-hour period.

Pearson (1970) diagnosed the case of persistent vomiting, over a long period, in a young dog as pyloric stenosis or pyloric spasm. It was stated that following the administration of barium, normally barium empties from the stomach within 30 minutes, and if delayed for an hour or more the probable cause can be attributed to pyloric stenosis or pyloric spasm.

Singh *et al.* (1970) carried out barium meal studies in human beings for diagnosis of pyloric obstruction following ingestion of corrosives.

Gibbs and Pearson (1973) reported that in contrast radiography, dorsoventral and right lateral projections are best for outlining the pylorus, and ventrodorsal and left lateral positions produce filling of the gastric contents into the body and fundus. They stated that contrast radiography was helpful in determining gastric emptying time related to pyloric obstruction and displacement of the stomach in case of diaphragmatic hernia. It was also stated that contrast radiography had particular value in detecting the presence of radiolucent materials, which might either retain contrast medium or prevent its even dispersion throughout the organ. The ingestion of large quantities of fabric, string or hair might lead to filling of the gastric lumen and pylorus, and somewhat variable symptoms of vomiting or anorexia. Such materials cause filling defects on contrast radiography and then became readily visible. It was also stated that contrast radiography was helpful in determining gastric emptying time, which was markedly delayed in pyloric obstructions. In the normal conscious animal, contrast medium usually begins to enter the duodenum within few minutes and total retention within the stomach for 30 minutes, or longer, generally indicates some degree of pyloric occlusion.

Gaskell *et al.*, (1974) reported the diagnosis of sliding hiatal hernia in two dogs with the under fluoroscopy where intermittent herniation of a stomach occurred at hiatus and was frequently associated with gastric reflux.

Grandage (1974) reported that stomach gas serves as an excellent radiographic contrast agent for outlining the gastric mucosa. Selection of a suitable posture, based on the principle of rising of gas, coupled with an appropriate projection, enables demonstration of most of the lining of the stomach.

Bostock and Owen (1975) had recommended contrast radiography with barium meal for the diagnosis of adenomas and adenocarcinomas of stomach and intestine in dogs.

Root (1975) recommended contrast radiography of the stomach with the administration of carbonate beverage at the dose of 30 to 90 ml as the source of gas for distention of the stomach or room air at the dose of 3 to 5 cc / pound body weight introduced into the stomach via stomach tube. It was stated that if double contrast study is decided, a small amount of barium sulphate could be given prior to the administration of the gas or gas-producing agents. It was also stated that barium contrast radiography of the upper gastro intestinal tract should be avoided in patients suspected of having perforation or rupture of the stomach or gut, since leakage of barium sulphate in the peritoneal cavity may lead to the formation of granulomata. Contrast media, such as the oral diatrizoates, may be used without fear of producing granulomata when there is suspicion of rupture or perforation of the stomach or small bowel.

Sautter and Hanlon (1975) administered suspension of barium sulphate (30% w/v) at the rate of 4 to 8 ml/kg body weight in dogs with gastric neoplasm. The main radiographic features observed in dogs that led to an inferential diagnosis of gastric neoplasia were as follows: a thickening and rigidity of the gastric wall, distortion of the gastric lumen, derangement of the rugal folds, filling defects, and a marked delay in gastric emptying time.

Gibbs (1978) reported that contrast examination was useful in the diagnosis of the presence of gastric lesions, radiolucent foreign bodies in the stomach, gastric neoplasm, gastric dilatation and delayed emptying time due to pyloric obstruction.

Herrtage (1978) opined that contrast radiographic is not a suitable substitute for plain radiographic technique but it can be used to supplement or confirm information already obtained from plain radiograph.

O'Brien (1978) recommended the use of negative contrast agent in cases of suspected radiolucent gastric foreign bodies. Negative contrast agents like air or carbon dioxide has the advantage that it will not mask foreign bodies, as barium tends to do, so the foreign body becomes easier to detect.

Mitchell and Gompf (1981) reported vomiting along with chronic diarrhoea in a dog with chronic gastric ulcers and was further confirmed with endoscopy.

Miyabayashi and Morgan (1984) reported that normal gastric emptying time in a dog with full dose meal (8g/kg solid food and 5 to 7 ml/kg barium sulphate suspension) ranged from five to ten hours whereas with the feeding of half the dose (4g/kg solid food and 3.5 ml/kg barium sulphate suspension) it was four to six hours.

Kleine (1985) described the radiographic signs of abdominal disease in dogs and cats. It was opined that when radiography was properly performed and correlated with clinical findings, it is an accurate diagnostic technique for evaluating gastric and small intestinal morphology.

Burk and Ackerman (1986) stated that for taking double contrast gastrogram, the patient should be anaesthetized, narcotized, or heavily tranquilized. A 100 percent weight/ volume barium suspension was administered via a stomach tube at a dose 1.5 to 3.0 cc/kg. Following this the stomach was distended with air until it was tympanic

(approximately 20 ml/kg) upon percussion. Four radiographic views (ventrodorsal, dorsoventral, left lateral and right lateral) were taken to assure the evaluation of every gastric surfaces.

Burns and Fox (1986) studied the total gastric emptying time in mongrel dogs using barium meal contrast procedures and the total gastric emptying time were found ranged from seven to fifteen hours. It was also observed that extreme excitement would alter the gastric emptying time.

Allan (1987) recommended the administration of liquid barium (30% w/v) or barium impregnated food as positive contrast agent in stomach at a dose rate of 8-12 ml/kg for small to medium sized and 5-7 ml/kg for large sized dogs. For taking double contrast radiography of the stomach, the animal was administered micropulverised barium sulphate at the dose of 1 ml/kg body weight, then it was rolled to coat the stomach and the stomach was inflated with infusion of air. This technique was found useful for studies, which require good mucosal details. It was also recommended that for negative contrast studies of the stomach air could be used for identifying gastric foreign bodies.

Herrtage and Dennis (1987) reported that gases such as air, oxygen, carbon dioxide and nitrous oxide could be used as negative contrast agents. These gases can be used with positive contrast agents to provide double contrast, which often provides the mucosal detail, and avoid complete obliteration of small foreign bodies by large volumes of positive contrast agents.

Theilen and Madewell (1987) had reported thickening of stomach and abnormal filling defects as the radiographic features for the diagnosis of gastric neoplasm in dogs.

Frendin *et al.* (1988) diagnosed gastric displacement in a dog with barium sulphate contrast radiography that was unable to detect on plain radiography.

Fonda *et al.* (1989) reported thickening or roughening of the wall, loss of normal rugal fold pattern, delayed or incomplete emptying of contrast materials from the stomach as the radiographic features in stomach cancer.

Balasubramanian *et al.* (1990) reported a case of chronic hypertrophic pyloric gastropathy in a dog, which had a six-month-old history of over distention of the stomach and frequent vomiting though not at regular interval after feeding. Haematological observations revealed low erythrocyte count with normal haemoglobin concentration and leukocyte count.

Bellenger *et al.* (1990) reviewed fourteen cases of chronic hypertrophic pyloric gastropathy in dogs. The most commonly affected breeds were Shihtzu and Maltese. The mean age was 8.2 years and the mean body weight was 6.5 kg. The most common clinical signs were vomiting, weight loss, polydypsia and depression.

Mantri *et al.* (1992) described the incidence of foreign body syndrome in dogs. Incidence was more commonly encountered in Doberman and Pomeranian breeds and was most frequently seen in younger dogs of age group of one year and below. Vertebral bones and stones were the commonest foreign bodies ingested, although other objects like sewing needles, marbles, rubber balls, keys, mango kernel, audio tape etc. were also observed. The clinical signs in most of the cases were, constant vomiting or attempts at vomiting, discomfort, dehydration and pain, tenderness on palpation of the abdomen.

Simpson (1993) suggested contrast studies (\pm fluoroscopy) as a good way of examining functional or emptying disorders of the stomach.

Bright *et al.* (1994) opined that in most of the linear foreign obstruction in companion animals often associated with small bowel problems. But in some instances gastric dysfunction can occur.

Murdoch (1994) stated that delayed gastric emptying can be diagnosed by contrast radiography with the administration of barium sulphate. It was reported that in the normal dog, barium sulphate should enter the duodenum within 30 minutes of administration and stomach got emptied of barium sulphate by 90 minutes.

Thilagar *et al.* (1994) carried out double contrast radiography of the stomach in dogs after sedating them with triflupromazine hydrochloride. Barium sulphate (3 ml/kg) as positive and air (20 ml/kg) as negative contrast media were used. According to the observations, double contrast radiographic technique allowed direct visualization of all inner gastric surface, thus increasing the probability of identifying mucosal lesions.

Willard and Twedt (1994) reported that abdominal palpation and radiography were the best initial diagnostic tests in case of gastric or intestinal obstruction and stated that barium is preferred over iodine compounds unless intestinal rupture is strongly suspected.

McLaughlin and Ayer (1995) used barium contrast radiography in a case of gastrointestinal pythiosis in a dog as a diagnostic aid. Findings revealed no passage of barium through the pyloric sphincter. The exploratory laparotomy revealed that the pyloric region of the stomach, and approximately 12 cm of the proximal duodenum were severely thickened and distorted.

Guilford *et al.* (1997) reported that gastric emptying rate of food can be assessed by radioopaque markers fed with special canned food diet.

Leib (1997) carried out barium contrast radiographic studies in dogs with stomach tumours and observed ulcer, roughened irregular mucosal surfaces, intramural mass, luminal filling defects, thickened gastric wall, derangement of rugal folds, and delayed gastric emptying.

Shaiken (1997) opined that administration of 30 % w/v barium sulphate suspension at the rate of 3 to 6 ml/ pound body weight provided good distention of stomach for evaluating mucosal surfaces.

Amma (1998) in an experimental study reported dilatation of stomach and narrowing of the caudal oesophageal sphincter as a complication of myotomy and omental grafting at the gastroesophageal junction in dogs. Radiography revealed severely dilated stomach.

Jose (2001) studied barium contrast radiography in a dog with partial torsion of stomach and observed only partial gastric emptying even after 90 minutes of the administration of barium sulphate.

Chourasia *et al.* (2002) administered acetyl salicylic acid (Aspirin) orally to dogs and subjected to barium meal contrast examinations after signs of gastritis became apparent. The borders of the stomach appeared uneven at places suggestive of gastric erosion.

Normal Radiographic Anatomy of Stomach

According to Gibbs and Pearson (1973) the empty stomach is related cranially and laterally to the liver from which it cannot be distinguished, but it almost always contains some gas which outlines the mucosal folds. After feeding, the stomach was seen greatly increased in size and revealed mottled shadows of variable density on survey radiography.

In the dog the cranial wall of the stomach is in contact with the liver except for a portion of the cardia which touches the left diaphragmatic crus. The position of the caudal wall depends on the amount of material or gas within the stomach; normally this should not extend caudal to fourth lumbar vertebra. On the lateral view a line drawn between the cardia and pylorus should be parallel to or more upright (vertical) than the

12th intercostal space. If the stomach contains both fluid and air, as is usually the case, a right lateral recumbent radiograph will have the fluid in the pyloric portion of the stomach and the air in the fundus. The pylorus will appear radiographically as a round tissue density in the midventral portion of the abdomen just caudal to the liver and the cardia. The fundus will be seen as an air-containing structure dorsal to the pylorus and caudal to the liver. On the ventrodorsal view, the stomach extends from near the left lateral body wall across the midline to the area of the right lateral body wall (Burk and Ackerman,1986)

Materials and Methods

3. MATERIALS AND METHODS

The study was carried out in twelve dogs of different breeds, age and of either sex, with the history of gastric problems presented to the Veterinary Hospitals of the College of Veterinary and Animal Sciences at Mannuthy and Kokkalai.

These animals were randomly divided into two groups viz., Group I and Group II, each consisting of six animals. The animals in Group I were serially numbered viz., I₁, I₂, I₃, I₄, I₅ and I₆, and animals in Group II were serially numbered viz., II₁, II₂, II₃, II₄, II₅ and II₆.

The trials were carried out as follows:

All the animals were subjected to survey radiography on left lateral/ right lateral recumbent position. In Group I, 25 % of barium sulphate suspension at the rate of 5 ml per kg body weight was administered orally. In Group II, 25 % barium sulphate suspension at the rate of 3 ml/kg body weight followed by room air at the rate of 2 to 10 ml /kg body weight was administered to the stomach with a flexible polythene tube. The animals were then subjected to left lateral/ right lateral and/or ventral dorsal radiography.

History and clinical observations

The details regarding the breed, sex, age, the symptoms manifested, response to previous medications and the duration of illness were recorded. The animals were observed for its general condition as active, alert or weak. Physiological parameters viz., respiratory rate (per minute), pulse rate (per minute), rectal temperature (°C) and colour of conjunctival mucous membrane were recorded.

Blood samples were collected from the cephalic vein for haematological evaluation in EDTA (Benjamin, 2001).

All the animals were subjected to abdominal palpation on recumbent position to locate the presence of any palpable mass in the stomach, and to assess the pain response and the condition of the abdominal wall. The plain left/ right lateral radiographs of the stomach. of all the animals were taken.

RADIOGRAPHY

Control of animal

All the animals in Group I were controlled manually and barium sulphate suspension was administered orally.

The animals of Group II were sedated with intramuscular administration of triflupromazine hydrochloride at the rate of 2 mg/kg body weight and barium sulphate and air were administered through a flexible tube introduced into the stomach.

Contrast radiographic techniques

In Group I, animals were controlled manually in standing/ lateral recumbent position. 25 % barium sulphate suspension¹ at the rate of 5 ml/kg body weight was administered orally by pouring into the buccal pouch by a feeding cup, and the animals were rolled to 360° and were subjected to radiography.

In Group II, the animals were controlled on lateral recumbent position, 25 to 30 minutes after the administration of triflupromazine hydrochloride² and a flexible polythene tube lubricated with lignocaine jelly³ was introduced into the stomach. Then, 25 % barium sulphate suspension at the rate of 3 ml / kg body weight was administered

¹Bariumsulphate Oral Suspension, 95% w/v- National Drugs and Chemicals, VAPI, India .

²Siquil – Sarabhai Chemicals, Vadodara.

³Xylocaine (2%) Jelly- Astra Zeneca Pharma India Limited, Bangalore.

through the tube The animals were rolled to 360° and air at the rate of 2 to 10 ml/ kg body weight was administered through the tube without causing over distention of the abdomen and discomfort to the animals. The polythene tube was clamped to prevent the return of the contrast materials and the tube was gently withdrawn, keeping the head of the animals in a raised position.

Lateral radiographs of the animals of the both groups were taken in right lateral/left lateral recumbent position immediately (0 minute) and at 30 minutes after the administration of the contrast material(s). In selected cases, ventrodorsal radiographs were also taken concurrently and at later intervals for the confirmation of the diagnosis. The radiographs were studied to find out the lesions, technical feasibility in assessing the diagnosis and the comparative effectiveness of the techniques.

Main items of observation

1. History

Anamnesis regarding the duration of illness and other complaints by the owner were recorded.

2. Clinical signs exhibited by the animals

Clinical symptoms such as vomiting, defaecation, micturition, status of food intake, pain on abdominal palpation, gross appearance of abdomen were recorded.

3. Physiological observations

Physiological parameters viz., rectal temperature, pulse rate, respiratory rate and colour of conjunctival mucous membrane were recorded.

4. Haematological observations

Haematological parameters viz., total erythrocyte count, total leukocyte count, differential leucocyte count, haemoglobin concentration, packed cell volume and erythrocyte sedimentation rate were estimated.

5. Radiological observations

Lateral plain and contrast radiographs of the stomach were taken immediately after (0 minute) and after 30 minutes of the administration of contrast agent(s) and radiological observations were recorded on.

- a) Gross appearance of the stomach, cardia and pylorus
- b) Mucosal appearance
- c) Presence of foreign bodies and other space occupying masses, if any
- d) Alterations in the size and shape of gastric lumen, including cardia, stomach proper and pylorus, and
- e) Gastric emptying.

6. Other findings

Other findings relevant to confirm the diagnosis like observation during surgery/ therapy and/or postmortem were recorded.

7. Technical feasibility in assessing the diagnosis

The feasibility of administration of contrast materials, complications if any encountered was recorded.

8. Comparative evaluation of the techniques.

The advantage of one technique over the other was evaluated.

Results

4. RESULTS

The study was carried out in twelve dogs of either sex belonging to different breeds, age and of either sex with history of gastric problems presented to the Veterinary Hospitals of College of Veterinary & Animal Sciences at Mannuthy and Kokkalai. These animals were randomly divided into two groups viz., Group I and Group II, each consisting of six animals.

GROUP I

To the animals of this group, 25 % barium sulphate suspension at the rate of 5 ml/kg. body weight was administered orally and the animals were rolled to 360° and were subjected to radiography.

History and clinical observations (Table 1 & 2)

The breeds of animals utilised for the study included Dachshund (2), Doberman (1), Labrador (1), Cocker Spanial (1) and Non Descript (1). The age of the animals ranged from 6 months to 7 years. The animals were weighed between six to twenty one kilograms. Of these animals four were males and two were females.

General appearance of the animals of this group were weak in three (I₁, I₂, I₃), dull in two, (I₄, I₆) and was alert in one (I₅). All the animals, except one (I₃), were anorexic during the period of illness which varied from two days to twenty two days. Vomiting was present in all the animals. In one animal (I₃), vomiting persisted for four months. The vomitus was yellowish except in two animals (I₄, I₅) in which the vomitus was blood tinged. Diarrhoea was present in one animal (I₁) and constipation in one animal (I₆). In all other animals defaecation was normal. The appearance of abdomen was tucked up in four animals (I₁, I₂, I₃, I₆)

and tensed (I₄) and flaccid (I₅) in one animal each. Palpation of abdomen elicited pain in three animals (I₂, I₄, I₆) but no palpable mass could be felt.

Physiological observations (Table 3)

The rectal temperature (°C) ranged from 37.7 to 39.6, pulse rate (per minute) ranged from 80 to 120 and respiratory rate (per minute) ranged from 13 to 35. In two animals (I₄, I₆) panting type of respiration was observed. Conjunctival mucous membrane was congested in three animals (I₁, I₅, I₆) and was pale roseate in others (I₂, I₃, I₄)

Haematological observations (Table 4)

Packed cell volume (%) ranged from 20 to 34, haemoglobin concentration (g/dl) ranged from 6 to 12, erythrocyte sedimentation rate (mm/hr) ranged from 5 to 8, total erythrocyte count ($10^6/\text{mm}^3$) ranged from 3.5 to 6 and total leucocyte count ($10^3/\text{mm}^3$) ranged from 5.6 to 15.

Neutrophil count (%) ranged from 44 to 88, lymphocyte count (%) ranged from 12 to 52, monocyte count (%) ranged from 0 to 3 and eosinophil count (%) ranged from 0 to 4.

RADIOLOGICAL OBSERVATIONS (Table 5-10)

Animal No. I₁

Plain right lateral radiograph showed fluid collection in the stomach towards the pyloric end. A radioopaque thin and crescent shaped area was seen in the ventral border of the stomach wall (Fig.1).

Contrast radiograph (at 0 minute) revealed leakage of the barium into the wall and thickened gastric wall and filling defect in the stomach. A double

shadow of the stomach wall as that of fluid filled appearance was noticed at the greater curvature of the pylorus. On the ventral aspect of stomach at the level of pylorus infiltration of barium sulphate through the musculature and accumulation at the subserosal level was observed suggesting perforation at the area. (Fig.2).

Contrast radiograph (at 30 minutes) revealed thickened gastric wall at the pyloric part. Little or no barium sulphate was evacuated from the stomach indicating pyloric obstruction/ hypertrophy of the pylorus. Double shadow of the stomach wall with fluid density was observed, indicating subserosal fluid collection. Leakage of the barium sulphate through the gastric wall and its collection at the subserosal level of the pyloric region revealed thickening and irregularity of the pyloric musculature and perforation of the wall. (Fig.3).

Animal No. I₂

Plain right lateral radiograph revealed gas filled distended stomach extending upto the last rib. Presence of stomach contents could not be detected, except gas (Fig.4).

Right lateral contrast radiograph taken immediately after administration (at 0 minute) revealed a highly distended stomach and the barium sulphate was seen accumulated at the pyloric end (Fig.5).

Contrast radiograph (at 30 minutes) revealed highly distended gas filled stomach with no sign of evacuation of barium sulphate indicating obstruction at the pyloric region. Barium was accumulated at the pyloric region and mucosal folds were visible at pylorus, which showed slight twisting at the pyloric region (Fig.6).

Animal No. I₃

Plain radiograph revealed dilated thoracic and caudal oesophagus. No abnormality could be detected in stomach.

Contrast radiograph (at 0 minute) revealed no abnormality with stomach. The caudal thoracic oesophagus showed dilatation.

Contrast radiograph (at 30 minutes) revealed slight dilatation of stomach. Partial emptying into the intestine. Rugal folds of gastric mucosa are clearly seen with contrast radiography on right lateral recumbent position. Ventrodorsal view at 30 minutes also revealed slightly dilated stomach and partial emptying of stomach.

Animal No. I₄

Plain radiograph revealed gas filled stomach and was displaced cranially by the distended intestinal loops. The intestinal loops were highly distended cranially almost up to the 9th rib (Fig.7).

Contrast radiograph (at 0 minute) revealed displacement of stomach cranially by the distended intestinal loops and contained barium (Fig.8).

Contrast radiograph (at 30 minutes) revealed emptying of barium meal from the stomach and it was reached into the intestinal loops which contained radioopaque materials inside (Fig.9).

Contrast radiograph (at 1 hour 30 minutes) revealed that greatly distended intestinal loops .Barium sulphate was seen evacuated from the stomach.

Animal No. I₅

Plain radiograph revealed distended stomach upto the last rib. Two distinctly separated gas columns were seen between fundus and pylorus, which indicated gastric torsion (Fig.10).

Contrast radiograph (at 0 minute) revealed highly distended stomach. Barium sulphate was seen accumulated more towards the fundic part. Fundus of the stomach as well as pylorus was seen highly distended with a constriction in between (Fig.11).

Contrast radiograph (at 30 minutes) revealed no sign of gastric emptying suggestive of pyloric obstruction (Fig.12).

Contrast radiograph (at 1 hour 30 minutes) revealed distention of caudal border of the stomach up to the last rib. There was accumulation of the barium sulphate in the pylorus as well as the pyloric canal. There was no sign of gastric emptying.

Animal No. I₆

Plain radiograph revealed no abnormality with the stomach.

Contrast radiograph at immediately after barium administration (0 minute) no abnormality could be detected with stomach.

Contrast radiograph (at 30 minutes) revealed normal emptying of barium from the stomach.

Other findings (Table 5-10)

Animal No. I₁

During surgery, stomach wall showed slight thinning caudal to pylorus. The pylorus was almost blocked with irregular edged tumour like mass. An ulcerating area on the ventral side of pyloric wall with perforation of pylorus through which fluid infiltration and collection of fluid at subserosal level were also observed. The barium sulphate seen as a crescent at ventral aspect of the stomach pouch. Histopathology of the mass removed during surgery, was diagnosed as adenocarcinoma (Fig.13 & 14).

Animal No. I₂

The animal died on the same day. Post mortem findings revealed acute dilatation and volvulus of the stomach (GDV).

Animal No. I₃

The oesophagus was dilated along with slight dilatation of stomach. Both revealed atony, but after 30 minutes of barium administration, barium has evacuated into the intestine suggestive of normal gastric emptying.

Animal No. I₄

Enterotomy was done after two days and it was revealed that small intestine was found engorged with ingesta subsequent to block at ileo-caeco-colic junction by faecal balls and it was removed during surgery.

Animal No. I₅

The animal died after two days. The result of the postmortem indicated that the animal had been suffering from severe degree of gastric torsion.

Animal No. I₆

The filling defects with the pyloric canal was due to the localized reaction from gastric ulcer resulting in hypertrophy of stomach wall.

Table 1. Patient data of animals in Group I

Animal. No	Breed	Sex	Age	Body wt. (kg)	Quantity of barium administered (ml)
I ₁	Dachshund	male	7 years	9.5	47.5
I ₂	Non Descript	male	1 year 6 months	6	30
I ₃	Dobermann	female	1 year 6 months	15	25
I ₄	Labrador	male	3 years	21	105
I ₅	Dachshund	female	1 year 6 months	7.8	39
I ₆	Cocker spanial	female	6 month	7	35

Table 2. History and clinical observations of animals in Group I

Animal No	Duration of clinical illness (in days)	General appearance	Anorexia (in days)	Vomiting (in days)	Type of vomitus	Water intake	Micturition	Appearance of abdomen	Pain on palpation of the abdomen	Palpable mass if any
I ₁	7	Weak	7	7	Yellowish	Reduced	Normal	Tucked up	+	-
I ₂	2	Weak	2	2	Yellowish	No	No	Tucked up	-	-
I ₃	4 months	Weak	-	120	Yellowish	Reduced	Normal	Tucked up	-	-
I ₄	22	Dull	22	22	Blood tinged	Reduced	Normal	Tensed	+	-
I ₅	2	Alert	2	2	Blood tinged	No	Normal	Flaccid	-	-
I ₆	5	Dull	5	5	Yellowish	Reduced	Normal	Tucked up	+	-

+ Present
- Absent

Table3. Physiological observations of animals in Group I

Animal No.	I₁	I₂	I₃	I₄	I₅	I₆
Rectal temperature (°C)	38.4	37.7	39.6	39.6	37.7	39.4
Pulse rate (per minute)	116	120	120	80	120	90
Respiratory rate (per minute)	30	13	35	Panting	21	Panting
Colour of conjunctival mucous membrane	Congested	Pale roseate	Pale roseate	Pale roseate	Congested	Congested

Table 4. Haematological observations of animals in Group I

Animal Number	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆
Packed cell volume(%)	32	20	34	30	34	29
Haemoglobin concentration (g/dl)	10.8	6	11.9	10.4	12	10
Erythrocyte sedimentation rate (mm/hr)	5	6	5	5	5	8
Total erythrocyte count (10 ⁶ /mm ³)	5.5	3.5	5.6	6	5.7	5.2
Total Leucocyte count (10 ³ /mm ³)	6.8	8.5	8.2	5.6	15	8
Neutrophils(%)	59	82	88	44	82	80
Lymphocyte(%)	39	18	12	52	15	15
Monocyte(%)	-	-	-	-	3	2
Eosinophils(%)	2	-	-	4	-	3
Basophils(%)	-	-	-	-	-	-

Table 5. Radiographic observations and other findings of animals in Group I

Animal No. I₁	
Plain Radiograph (right lateral)	Stomach contained fluid density at pyloric antrum. A radioopaque crescent shaped area in the ventral border of stomach wall
Contrast Radiographic Observations	
0 Minute (right lateral)	Gastric wall thickened and sacculations of wall with barium showed a double shadow of fluid filled appearance. At pyloric region infiltration of barium flesh the musculature and accumulated at the subserosal level noticed suggestive of perforation of wall upto subserosa.
30 Minutes (ventrodorsal)	No gastric emptying of barium noticed suggestive of pyloric obstruction, and thickening of pyloric antrum at the pylorus, a double shadow of wall as that of fluid collection between layers.
30 Minutes lateral	Gastric emptying of barium was absent. Barium accumulated in the sacculated stomach wall. Thickened pylorus and irregular pyloric mucosa, narrowed lumen. Double shadow of the stomach wall. Seepage of barium from the pylorus into the subserosal levels of pyloric musculature.
Other suggestive observations following surgery/medical treatment/postmortem findings	During surgery stomach wall showed thinning towards pylorus and sacculations towards the outer wall of pylorus at the ventral side. The pyloric opening was almost obstructed with irregular mass. At the floor a deep ulcerated area was observed through which barium was escaped into the subserosal level. The pylorus was thickened and hence the pylorus was resected and gastrojejunostomy was performed. Longitudinal incision of the pylorus revealed an irregular growth inside blocking the lumen. Histopathology revealed adenocarcinoma at the pylorus.
Diagnosis arrived and Treatment given	Pyloric obstruction – due to pyloric adenocarcinoma. Resection of the tumor mass and performed gastrojejunostomy

Table 6. Radiographic observations and other findings of animal in Group I

Animal No. I₂	
Plain Radiograph (right lateral)	Stomach was gas filled and distended and distention extended beyond the last rib. No radioopaque foreign body could be detected.
Contrast Radiographic Observations	
0 Minute (ventrodorsal)	The whole stomach was distended with gas. Position of the stomach was more towards the left side of the abdomen. Barium was seen lodged in the pyloric orifice.
0 Minute (right lateral)	Stomach was highly distended with gas. No emptying of barium meal was seen, but was accumulated at the pyloric end.
30 Minutes (right lateral)	Highly distended stomach with gas could be seen. No sign of evacuation after 30 minutes of barium administration indicating obstruction to gastric emptying. Barium accumulation at the pylorus.
Other suggestive observations following surgery/medical treatment/postmortem findings	The animal died on the same day. Post mortem findings revealed acute dilatation and volvulus of the stomach (GDV).
Diagnosis arrived and Treatment given	Acute gastric dilatation and volvulus (GDV).

Table 7. Radiographic observations and other findings of animals in Group I

Animal No. I₃	
Plain Radiograph (left lateral)	Dilated thoracic oesophagus. No abnormality could be detected with stomach. Dilated oesophageal wall evident.
Contrast Radiographic Observations	
0 Minute (left lateral)	No abnormality could be detected with stomach. Dilatation of caudal thoracic oesophagus with accumulation of barium.
30 Minutes (ventrodorsal)	Stomach slightly dilated. Partial emptying into the intestine noticed.
30 Minutes (right lateral)	Rugal folds of stomach were clearly seen. Slight dilatation of stomach and normal gastric emptying
Other suggestive observations following surgery/medical treatment/postmortem findings	The owner was advised to adopt managemental practices with feeding the animal with small quantities of liquid/ semi solid food at different intervals by keeping the pot in an elevated area.
Diagnosis arrived and Treatment given	Slight gastric distention-stomach slightly distended with normal gastric emptying.

Table 8. Radiographic observations and other findings of animals in Group I

Animal No. I₄	
Plain Radiograph (left lateral)	Stomach overlapped with distended intestinal loops. Highly distended intestinal loops with gas and presence of many radioopaque materials inside the intestine. The intestine has displaced cranially almost up to the 9 th rib.
Contrast Radiographic Observations	
0 Minute (left lateral)	Stomach was pushed cranially by the distended intestinal loops and contained barium.
30 Minutes (right lateral)	Barium meal evacuated from the stomach and it has reached into the intestinal loops contained radioopaque materials inside.
Other suggestive observations following surgery/medical treatment/postmortem findings	Enterotomy was done after two days and it was revealed that small intestine was found engorged with ingesta subsequent to a block to the ileo-caeco-colic junction by faecal balls and it was removed during surgery.
Diagnosis arrived and Treatment given	Gastric displacement-stomach was empty and with slight distention and displaced cranially by the distended intestinal loops .Animal was given antibiotic treatment for two days.

Table 9. Radiographic observations and other findings of animals in Group I

Animal No. I₅	
Plain Radiograph (left lateral)	Gas filled and distended stomach, reached upto the last rib. The dilated stomach has two distinctly separated gas bubbles between fundus and pylorus indicating gastric torsion.
Contrast Radiographic Observations	
0 Minute (left lateral)	Highly distended stomach. Barium was seen more accumulated towards the fundus part. Body of the stomach as well as pyloric part was highly distended with a constriction in between.
30 Minutes (right lateral)	The stomach was reduced in size. Since the animal vomited immediately before radiography the volume of the barium in the stomach was reduced. Barium has accumulated in the pylorus. No sign of gastric emptying even after 30 minutes indicating absence of gastric emptying.
Other suggestive observations following surgery/medical treatment/postmortem findings	The animal was died after two days. The postmortem findings were indicated that the animal was seen suffering from severe gastric torsion.
Diagnosis arrived and Treatment given	Gastric torsion.

Table 10. Radiographic observations and other findings of animals in Group I

Animal No. I₆	
Plain Radiograph (left lateral)	Stomach contained little gas at the fundus. There was no sign of distention of the stomach and no abnormalities could be detected with the stomach.
Contrast Radiographic Observations	
0 Minute (Left Lateral)	Stomach contained barium meal administered. No abnormalities could be detected.
30 Minutes (right lateral)	Emptying of barium noticed and has been reached the intestine. The area of decreased density could be seen in the pyloric canal.
Other suggestive observations following surgery/medical treatment/postmortem findings	The filling defects with the pyloric canal may be due to the localized reaction on the mucosa.
Diagnosis arrived and Treatment given	Mucosal erosions at the pylorus.

Fig.1 Skiagram before the administration of the contrast material (I₁)

Fluid collection in the stomach towards the pyloric end.
A radioopaque thin and crescent shaped area in the ventral border of the stomach wall.

Fig.2 Skiagram after the administration of the contrast material (at 0 minute) (I₁)

Barium accumulation at the pyloric antrum.
Infiltration of barium sulphate through the musculature and accumulation at the subserosal level.

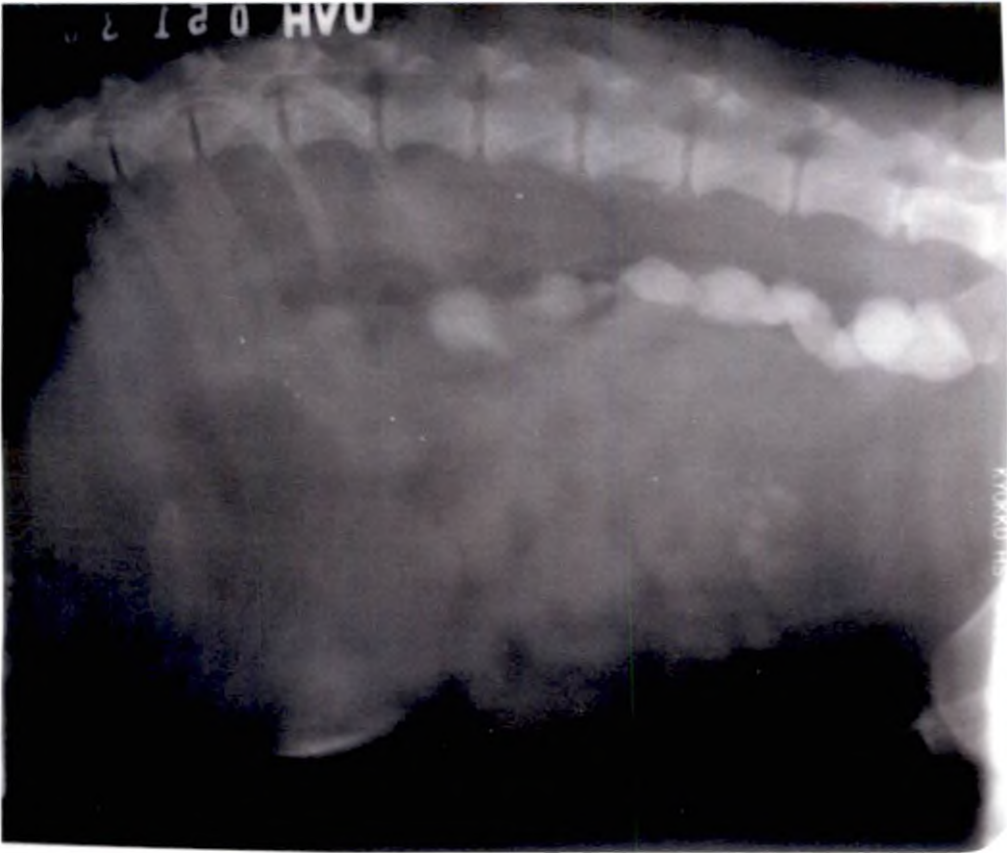


Fig.1

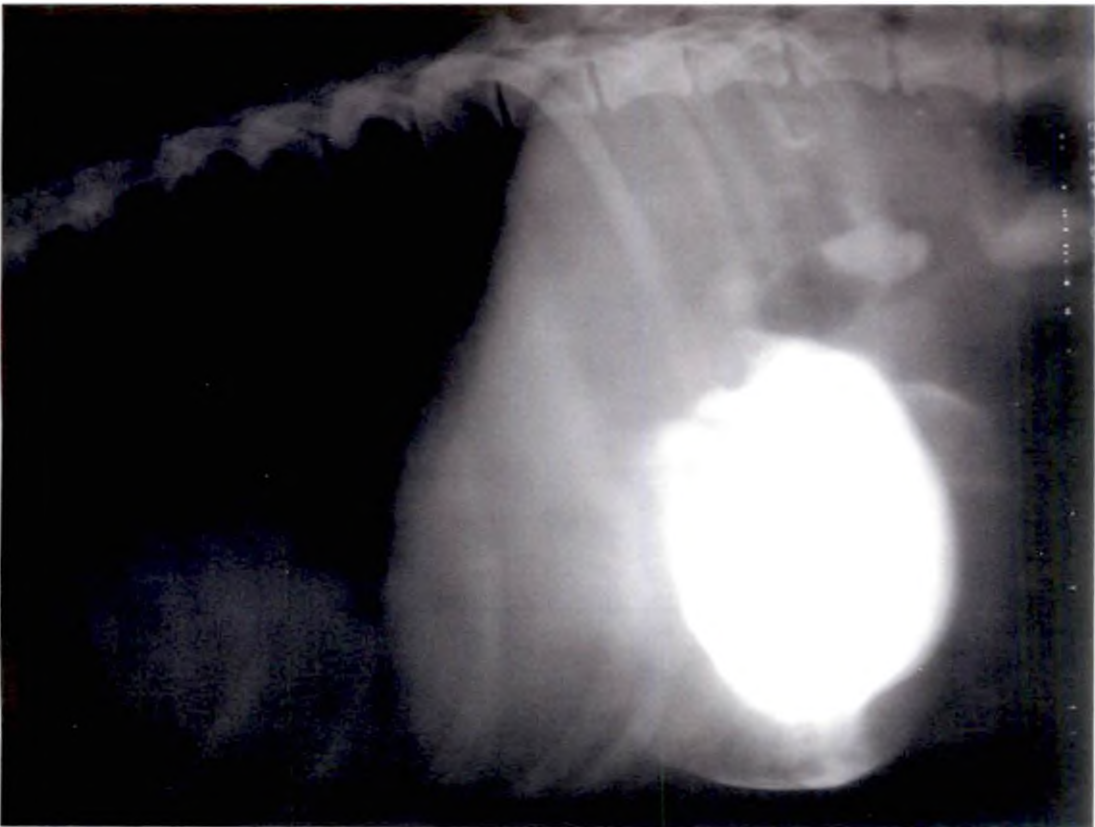


Fig.2



Fig.3



Fig.4

**Fig.5 Skiagram after the administration of the contrast material
(at 0 minute) (I₂)**

Stomach highly distended with gas.
Accumulation of barium sulphate at the pylorus with no emptying.

**Fig.6 Skiagram after the administration of the contrast material
(at 3 0 minute) (I₂)**

Accumulation of barium sulphate at the pylorus.
Mucosal folds visible at the pylorus, with slight twisting.



Fig.5

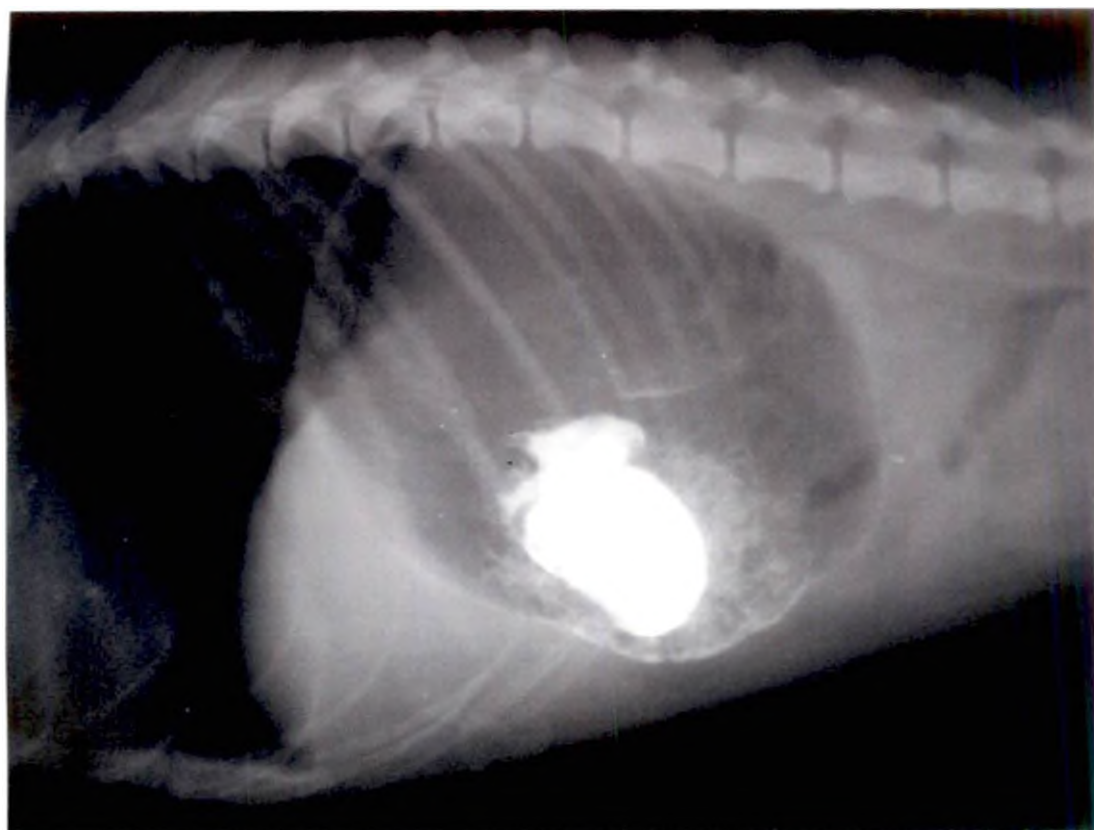


Fig.6

Fig.7 Skiagram before the administration of the contrast material (I₄)

Cranially displaced stomach.
Intestinal loops highly distended.

**Fig.8 Skiagram after the administration of the contrast material
(at 0 minute) (I₄)**

Cranially displaced stomach with barium sulphate.
Intestinal loops highly distended.

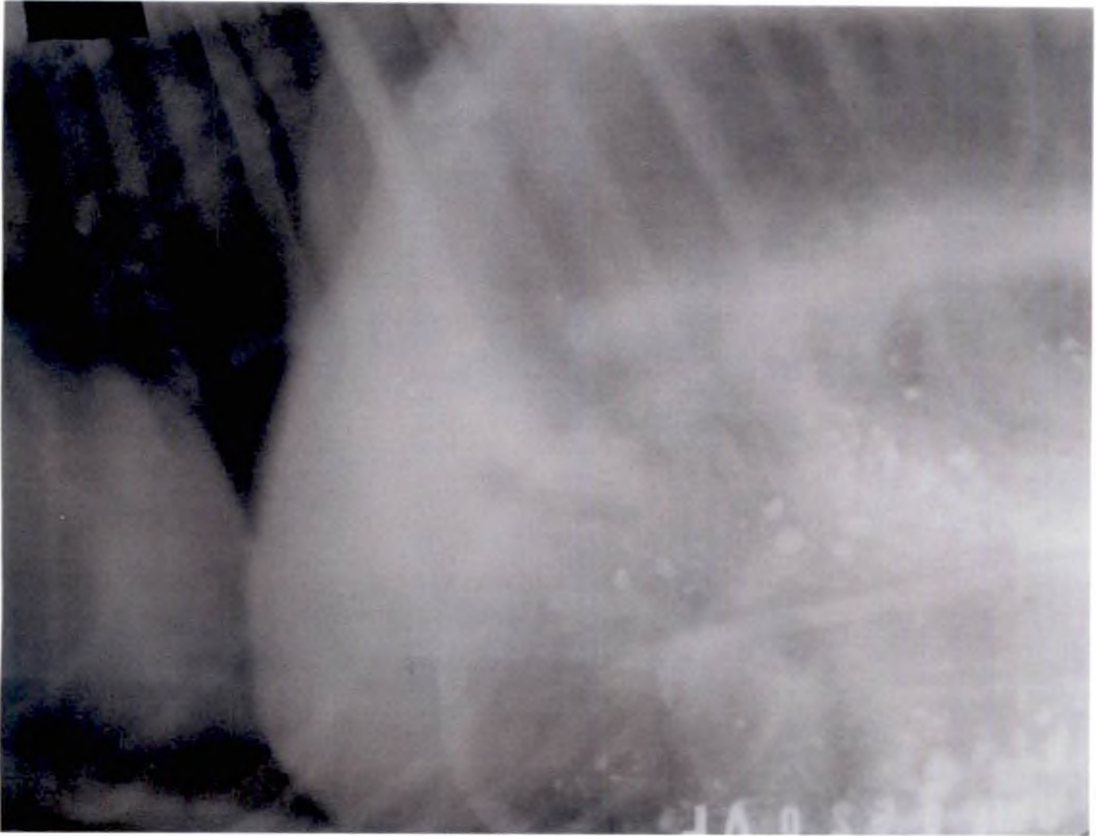


Fig.7

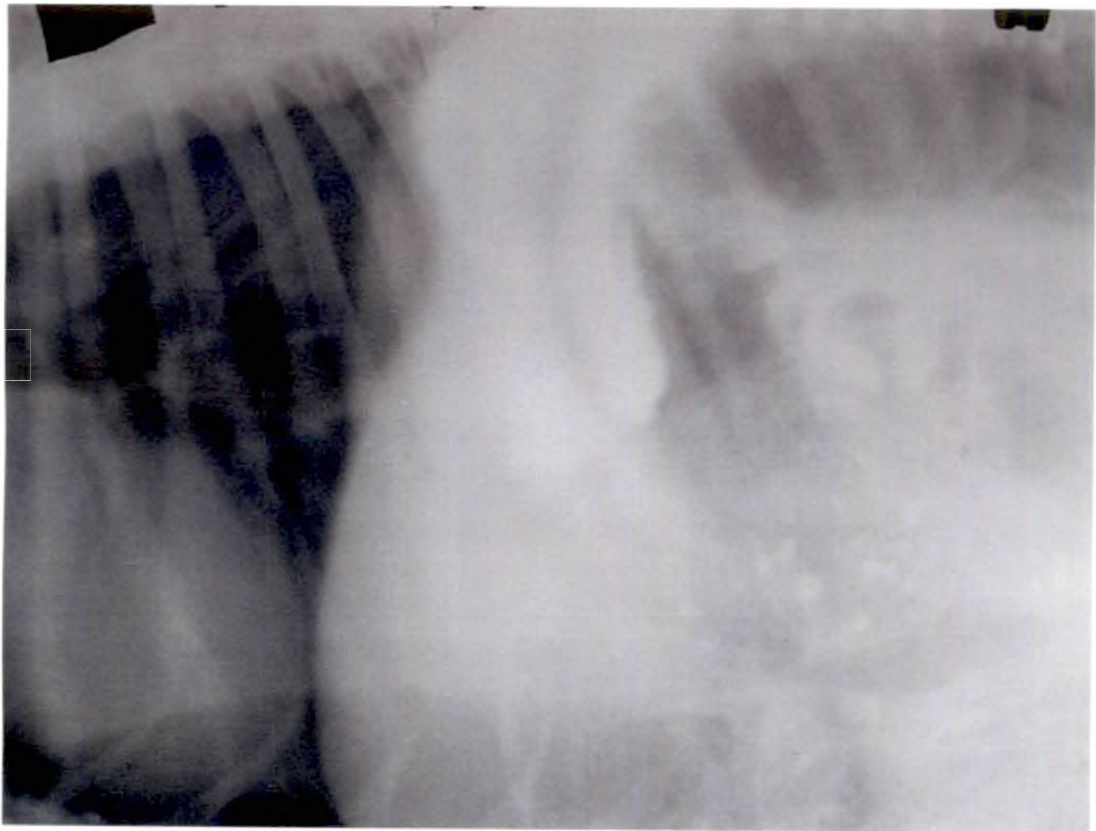


Fig.8

**Fig.9 Skiagram after the administration of the contrast material
(at 30 minute) (I₄)**

Gastric emptying with distention of intestinal loops.

Fig.10 Skiagram before the administration of the contrast material (I₅)

Distended stomach upto the last rib.

Two distinctly separated gas columns between fundus and pylorus
indicating gastric torsion.

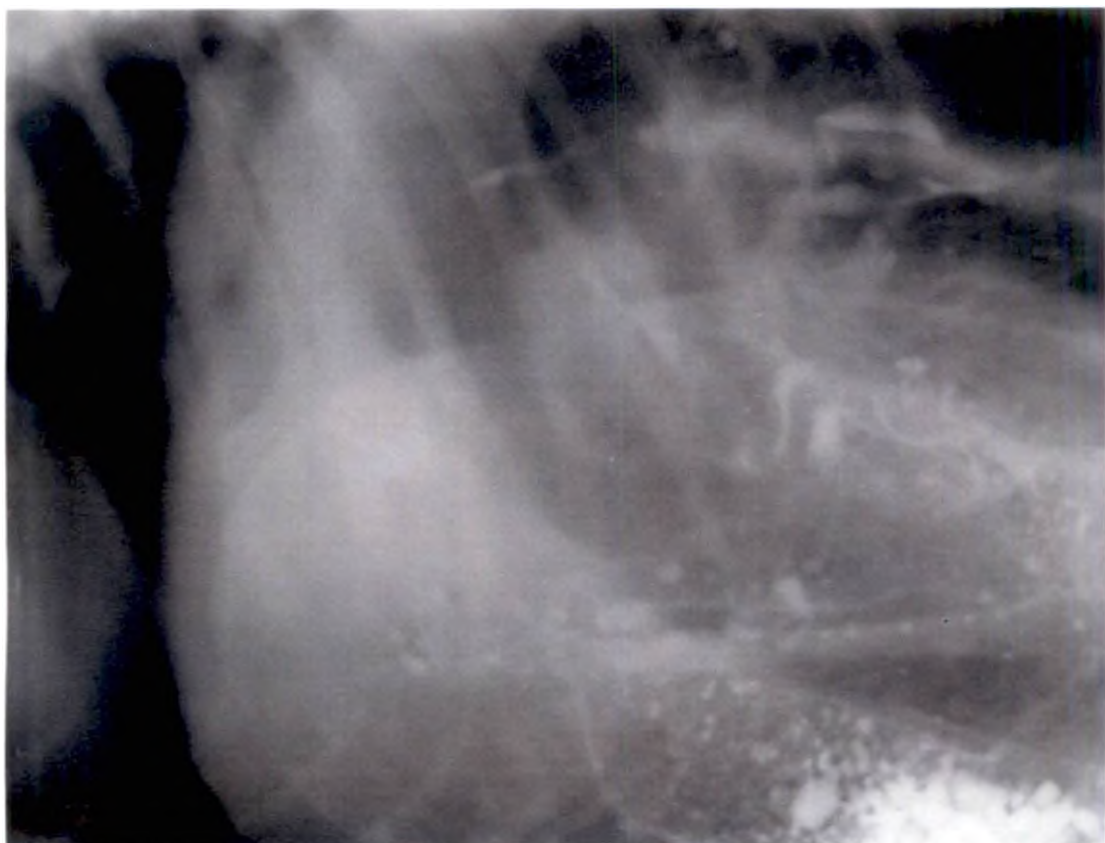


Fig.9



Fig.10

**Fig.11 Skiagram after the administration of the contrast material
(at 0 minute) (I₅)**

Highly distended stomach with a constriction in between fundus and pylorus.

**Fig.12 Skiagram after the administration of the contrast material
(at 30 minute) (I₅)**

Absence of gastric emptying suggestive of pyloric obstruction.



Fig.11



Fig.12

Fig. 13

Photograph showing the presence of tumour like mass at the pyloric part of stomach. (I₁)

Fig. 14

Photograph showing the tumour like mass, surgically removed from the pyloric part of stomach. (I₁)

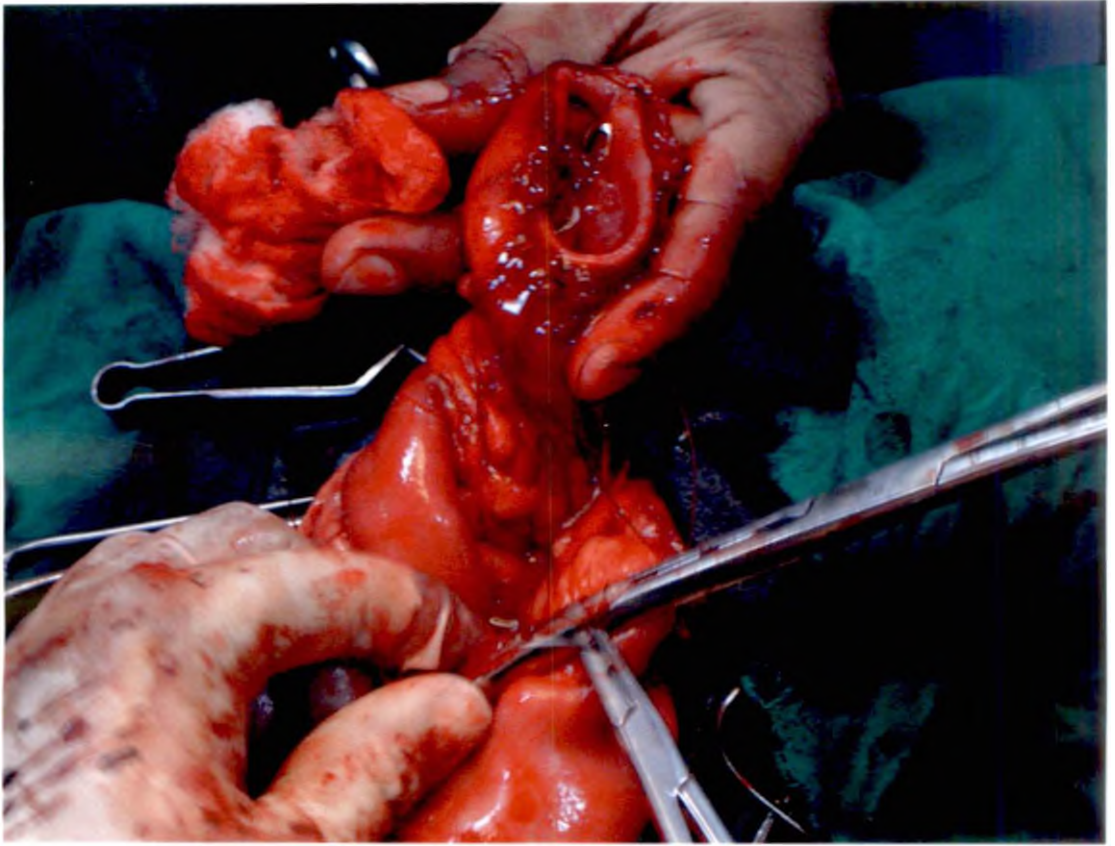


Fig.13

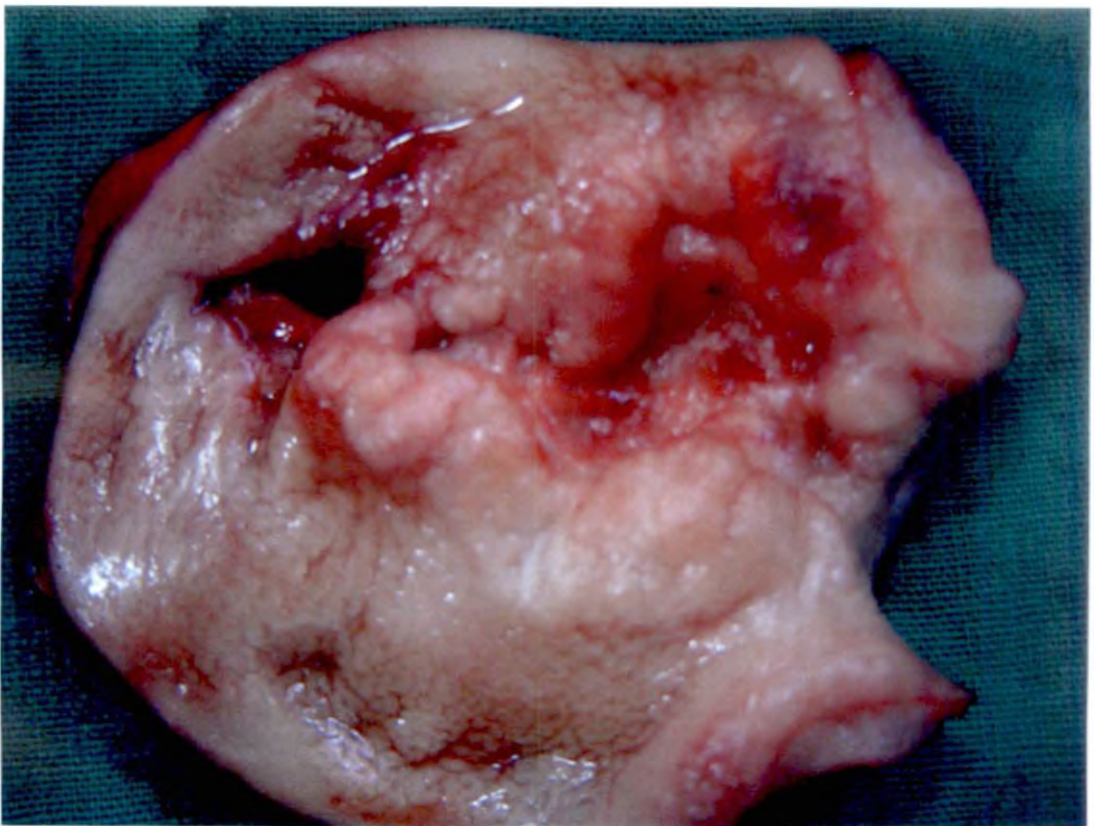


Fig.14

GROUP II

To the animals of this group, 25 % barium sulphate suspension at the rate of 3 ml / kg. body weight was administered through a stomach tube. The animals were rolled to 360° and room air at the rate of 2 to 10 ml/ kg. body weight was administered through the tube without causing over distention of the abdomen and discomfort to the animals and subjected to radiography.

History and clinical observations (Table No. 11 & 12)

The breeds of animals selected for the study included Non Descript (2), Spitz (1), Rottweiler (1), Dalmatian (1) and Dachshund (1). The age group of the animals ranged from 6 months to 2 years 5 months. The animals were weighed between seven and a half to twenty four kilograms. All the animals were females.

General appearance of the animals of this group were weak in two (II₃ II₄), dull in two (II₁, II₂) and alert in two (II₅, II₆). All the animals were anorectic during the period of illness, which varied from two days to fourteen days. Vomiting was present in all the animals, except in one (II₃) in which frequent attempt for vomiting was seen. The vomitus was blood tinged in two animals (II₄, II₆). Diarrhoea was present in two animals (II₄, II₆) and the faeces was blood tinged and constipation in one animal (II₃). In one animal (II₅) defaecation was normal but the faeces was blood tinged. There was shooting type of diarrhoea in one animal (II₄) and the faeces was scanty in one animal (II₂). The appearance of abdomen was tucked up in four animals (II₁, II₂, II₃, II₄) and tensed in one animal (II₅). Palpation of abdomen elicited pain in three animals (II₁, II₂, II₅) and palpable mass could be felt in one animal (II₁).

Physiological observations (Table 13)

Rectal temperature (°C) ranged from 38.3 to 40, pulse rate (per minute) ranged from 70 to 132 and respiratory rate (per minute) ranged from 30 to 40. In one animal (II₂) panting type of respiration was noticed. Conjunctival mucous membrane was congested in four animals (II₁, II₄, II₅, II₆) and it was pale in others (II₂, II₃)

Haematological observations (Table 14)

Packed cell volume (%) ranged from 30.3 to 44, haemoglobin concentration (g/dl) ranged from 9.8 to 16, erythrocyte sedimentation rate (mm/hr) ranged from 5 to 18, total erythrocyte count ($10^6/\text{mm}^3$) ranged from 3.2 to 7.3, and total leucocyte count ($10^3/\text{mm}^3$) ranged from 6 to 20.

Neutrophil count (%) ranged from 65 to 88, lymphocyte count (%) ranged from 12 to 30, monocyte count (%) ranged from 0 to 5, eosinophil count (%) ranged from 0 to 2. Basophils were absent.

RADIOLOGICAL OBSERVATIONS (Table 15-20)**Animal No. II₁**

Plain radiograph revealed the presence of some amount of gas in the stomach and intestine.

Contrast radiograph (at 0 minute) revealed rugal folds of the stomach with coating of barium sulphate against the negative contrast. No abnormality in the stomach was noticed.

Contrast radiograph (at 30 minutes) revealed that stomach was under evacuation process and barium sulphate had reached the intestine. There was plication of the intestine.

Animal No. II₂

Plain radiograph revealed some amount of gas in the stomach. But no other abnormality could be detected with the stomach.

In contrast radiography (at 15 minutes) rugal folds of the stomach was more visible with barium sulphate and air contrast. Some barium sulphate was found in intestinal loops indicating gastric emptying.

Contrast radiograph (at 30 minutes) showed that rugal folds were more visible with barium and air and stomach was under emptying process. Barium sulphate emptied from the fundus and accumulated at pylorus.

Animal No. II₃

Plain radiograph revealed no abnormality with the stomach wall. Stomach was distended. Streaks of radiodense and radiolucent area was seen in the stomach. No specific image was present. Intestinal loops were distended with air. Small areas of radiodense material in the stomach (Fig.15).

Contrast radiograph (at 0 minute) revealed that only part of the stomach was visible. No specific lesion could be identified in the stomach. No abnormality could be detected with the stomach wall. Contents appeared similar to that of plain radiograph. Increased density in the stomach contents, but not clear. Faecal stasis could be observed in intestine (Fig.16).

Contrast radiograph (at 30 minutes) revealed no abnormality with the stomach wall. Slight radioopacity at the body of stomach. Slight aspiration of

barium sulphate into the lungs. Blockage to barium sulphate flow seen at the middle of thoracic oesophagus at the level of base of heart indicating obstruction due to radiolucent material in the caudal oesophagus (Fig.17).

Animal No. II₄

Plain radiograph revealed a linear column of air within the stomach, at the pylorus (Fig.18).

Contrast radiograph (at 0 minute) revealed that rugal folds were more evident with barium and air. Defective filling is seen with stomach.

Contrast radiograph (at 30 minutes) revealed that within the negative contrast a positive contrast defective coating on the stomach wall at the fundus suggestive of some inflammatory lesion. Irregularity in the mucosal lining of the intestine were noticed (Fig.19).

Contrast radiograph (at 24 hours) revealed the presence of a streak of barium sulphate at the pyloric region. Colon contained contrast material mixed with gas (Fig.20).

Animal No. II₅

Plain radiograph revealed no abnormality with stomach.

Contrast radiograph (at 0 minute) revealed evacuation has started from the stomach and barium meal has reached the intestine. Barium coated materials seen in the stomach.

Contrast radiograph (at 30 minutes) revealed that evacuation has started from the stomach and barium meal has reached the intestine. Barium coated materials seen in the stomach.

Contrast radiograph (at 1 hour) revealed that barium meal has found to evacuating from the stomach. Plication of the duodenum indicating that linear foreign body in the large intestine.

Contrast radiograph (at 24 hours) revealed the presence of some radioopaque contrast coated material in the stomach (Fig.21).

Animal No. II₆

Plain radiograph revealed presence of accumulation of a little amount of air in the stomach (Fig.22).

Contrast radiograph (at 0 minute) revealed that shape of the stomach could be clearly seen with barium and air contrast accumulation. Barium accumulated in the fundus and body and air towards pylorus. Borders of the stomach could be clearly seen with barium and air contrast. Barium was seen accumulated at the pyloric region.

Contrast radiograph (at 30 minutes) revealed that rugal folds were clearly visible in the double contrast radiography with barium and air. Cardia and fundus rugal folds were more visible. Contrast material was seen accumulated more towards the pyloric part of the stomach. Borders of the stomach were clearly visible. Evacuation of barium had started from the pylorus (Fig.23).

Other findings (Table 15-20)

Animal No. II₁

Plication of the intestine was suggestive for linear foreign body with the intestine. Oral administration of liquid paraffin helped to evacuate the stomach and intestinal contents and the animal got recovered.

Animal No. II₂

No lesions could be detected with the stomach and the animal was successfully treated with antiemetics, antibiotics and parenteral fluid therapy.

Animal No. II₃

On the next day the animal vomited large quantity of plastic threads and electrical wires, and after the vomiting, the symptoms disappeared (Fig.24).

Animal No. II₄

Defective filling was seen with stomach due to increased thickening of the stomach wall.

Animal No. II₅

After 24 hour of contrast administration some radioopaque coated foreign body was indicative of presence of radiolucent foreign body in the stomach.

Animal No. II₆

Smearing of barium meal at the mucosa even after 24 hours of administration indicating that some ulceration with the stomach.

Table 11. Patient data of animals in Group II

Animal. No	Breed	Sex	Age	Body wt. (kg)	Quantity of barium administered (ml)	Quantity of air administered (ml)
II ₁	Spitz	Female	8 months	7.5	22.5	75
II ₂	Rottweiler	Female	8 months	24	72	240
II ₃	Dalmatian	Female	2 years 5 months	20	60	200
II ₄	Non Descript	Female	6 months	9	27	90
II ₅	Non Descript	Female	7 months	11	33	110
II ₆	Dachshund	Female	3 years	11	33	110

Table 12. History and clinical observations of animals in Group II

Animal. No	Duration of clinical illness (in days)	General appearance	Anorexia (in days)	Vomiting (in days)	Type of vomitus	Water intake	Micturition	Appearance of abdomen	Pain on palpation of the abdomen	Palpable mass if any
II ₁	7	Dull	7	7	Yellowish	Reduced	Normal	Tucked up	+	+
II ₂	14	Dull	14	4	Yellowish	Reduced	Normal	Tucked up	+	-
II ₃	2	Weak	2	-	-	Reduced	Normal	Tucked up	-	-
II ₄	4	Weak	4	4	Blood tinged	Reduced	Normal	Tucked up	-	-
II ₅	2	Alert	2	2	Yellowish	Reduced	Normal	Tensed	+	-
II ₆	2	Alert	2	2	Blood tinged	Reduced	Normal	Tensed	-	-

+ Present
- Absent

Table 13. Physiological observations of animals in Group II

Animal No.	II₁	II₂	II₃	II₄	II₅	II₆
Rectal temperature (°C)	40	39.8	38.8	39.1	39.4	38.3
Pulse rate (per minute)	90	112	72	70	72	132
Respiratory rate (per minute)	40	Panting	30	35	30	30
Colour of conjunctival mucous membrane	Congested	Pale roseate	Pale roseate	Congested	Congested	Congested

Table 14. Haematological observations of animals in Group II

Animal No.	II ₁	II ₂	II ₃	II ₄	II ₅	II ₆
Packed cell volume (%)	34	31.9	30.3	44	40	43
Haemoglobin concentration (g/dl)	10.5	10.3	9.8	16	12	14
Erythrocyte sedimentation rate (mm/hr)	4	5	5	18	10	5
Total erythrocyte count (10 ⁶ /mm ³)	6	3.5	3.2	7.3	6.8	6.9
Total Leucocyte count (10 ³ /mm ³)	9	18.8	14.5	9	6	20
Neutrophils(%)	70	88	88	70	65	82
Lymphocyte(%)	28	12	12	23	30	18
Monocyte(%)	1	-	-	5	4	-
Eosinophils(%)	1	-	-	2	1	-
Basophils(%)	-	-	-	-	-	-

Table 15. Radiographic observations and other findings of animals in Group II

Animal No. II₁	
Plain Radiograph (left lateral)	Some amount of gas noticed in the stomach and intestine.
Contrast Radiographic Observations	
0 Minute (left lateral)	Rugal folds of the stomach were more evident with the barium coating against the negative contrast. No abnormality could be detected.
30 Minutes (right lateral)	Stomach showed evacuation and barium meal entered the intestine. Plication of the intestine could be seen.
Other suggestive observations following surgery/medical treatment/postmortem findings	Plication of the intestine was suggestive for linear foreign body with the intestine. Animal was under treatment to evacuate the stomach and intestinal contents. Improvement was noticed with the animal.
Diagnosis arrived and Treatment given	No lesions could be detected with stomach.

Table 16. Radiographic observations and other findings of animals in Group II

Animal No. II₂	
Plain Radiograph (left lateral)	Some gas could be seen in the stomach. No abnormality could be detected with the stomach.
Contrast Radiographic Observations	
0 Minute (left lateral)	Stomach distended with barium and gas and barium seen accumulated at the fundus and the air in the distal half of the stomach and pylorus.
15 Minutes (left lateral)	Rugal folds were more visible with barium and air. Some amount of barium was seen in the intestine. More accumulation towards fundus.
30 Minutes (right lateral)	Rugal folds were clearly visible. Stomach showed emptying. Barium emptied from the fundus and body part and accumulated at pylorus.
Other suggestive observations following surgery/medical treatment/postmortem findings	Animal was treated with antibiotics, fluids and anti emetics.
Diagnosis arrived and Treatment given	No lesions could be detected with stomach.

Table 17. Radiographic observations and other findings of animals in Group II

Animal No. II₃	
Plain Radiograph (left lateral)	No abnormality could be detected with the stomach wall. Stomach was distended. Streaks of radiodense and radiolucent area were seen in the stomach. No specific image was present. Intestinal loops were distended with air. Small areas of radiodense material in the stomach.
Contrast Radiographic Observations	
0 Minute (left lateral)	No abnormality could be detected with the stomach. Intestinal loops were distended with air. Only part of the stomach was visible which contained radioopaque materials. No specific lesion could be identified.
30 Minutes (right lateral)	No abnormality could be detected with the stomach wall. Slight radio opacity at the body of stomach. Slight aspiration of barium into the lungs. Blockage of barium meal flow seen at the middle of thoracic oesophagus at the level of base of heart indicating obstruction due to radiolucent material in the caudal oesophagus.
Other suggestive observations following surgery/medical treatment/postmortem findings	Animal was treated with fluids antibiotics. On the next day the animal vomited bulk quantity of plastic threads and electric wires. The treatment was continued for 5 days and the animal recovered completely.
Diagnosis arrived and Treatment given	Gastric foreign body obstruction- due to radiolucent material in the caudal oesophagus.

Table 18. Radiographic observations and other findings of animals in Group II

Animal No. II₄	
Plain Radiograph (left lateral)	A linear column of air could be seen with the stomach at the pylorus.
Contrast Radiographic Observations	
0 Minute (right lateral)	Rugal folds were more evident. Barium accumulated towards the pylorus and rest of stomach filled with air.
15 Minutes (left lateral)	Some barium has been seen in the intestine. Stomach wall were more visible because of sticking of barium on the mucosa. Gastric emptying was notices.
30 Minutes (right lateral)	Accumulation of the barium in the pyloric antrum, and pylorus and emptying into intestine could be detected. Air collected at the fundus and the body of the stomach. Within the negative contrast a positive contrast coating seen at the stomach wall at the fundus indicating some inflammatory lesion. Irregularity in the mucosal lining of the intestine was also noticed.
Other suggestive observations following surgery/medical treatment/postmortem findings	Animal was treated with fluids, antibiotics and gastric protectives and improvement was noticed after therapy.
Diagnosis arrived and Treatment given	Gastric ulcer/ inflammation.

Table 19. Radiographic observations and other findings of animals in Group II

Animal No. II₅	
Plain Radiograph (left lateral)	No abnormality could be detected.
Contrast Radiographic Observations	
0 Minute (left lateral)	No abnormality with shape of the stomach. Gas filled distention along with barium meal noticed.
30 Minutes (right lateral)	Evacuation has started from the stomach and barium meal has reached the intestine. Barium deposited materials seen in the stomach.
Other suggestive observations following surgery/medical treatment/postmortem findings	Presence of radiolucent foreign body in the stomach. Animal was treated with fluids and gastric stimulants and improvement was noticed after therapy.
Diagnosis arrived and Treatment given	Gastric foreign body – radiolucent foreign body in the stomach.

Table 20. Radiographic observations and other findings of animals in Group II

Animal No. II₆	
Plain Radiograph (left lateral)	Some air was found accumulated in the stomach.
Contrast Radiographic Observations	
0 Minute (left lateral)	Shape of the stomach could be clearly seen with barium and air contrast accumulation. Barium accumulated in the fundus and body and air towards pylorus.
30 Minutes (right lateral)	Cardia and fundus rugal folds were more visible. Contrast material was more accumulated towards the pyloric part of the stomach. Borders of the stomach were clearly visible.
2 hours (right lateral)	Some contrast material was still present with the pylorus, rest of the barium was found to be evacuated into the intestine.
Other suggestive observations following surgery/medical treatment/postmortem findings	Animal was treated with fluids antibiotics and gastric protectives and improvement was noticed after therapy. Sticking of barium meal even after 24 hours of contrast administration indicating that some ulceration with the stomach. Out pouching of the barium into the colon is suggestive for intestinal ulceration.
Diagnosis arrived and Treatment given	Pyloric stenosis.

Fig.15 Skiagram before the administration of the contrast materials (II₃)
Small areas of radiodense material in the stomach.

Fig.16 Skiagram after the administration of the contrast materials
(at 0 minute) (II₃)

Stomach contents with increased density.



Fig.15



Fig.16

Fig.17 Skiagram after the administration of the contrast materials
(at 3 0 minute) (I I₃)

Blockage of barium sulphate flow at the middle of the thoracic oesophagus.

Fig.18 Skiagram after the administration of the contrast materials
(at 0 minute) (I I₄)

Accumulation of air at the top and barium sulphate at the bottom of the stomach.

Gastric emptying present.



Fig.17

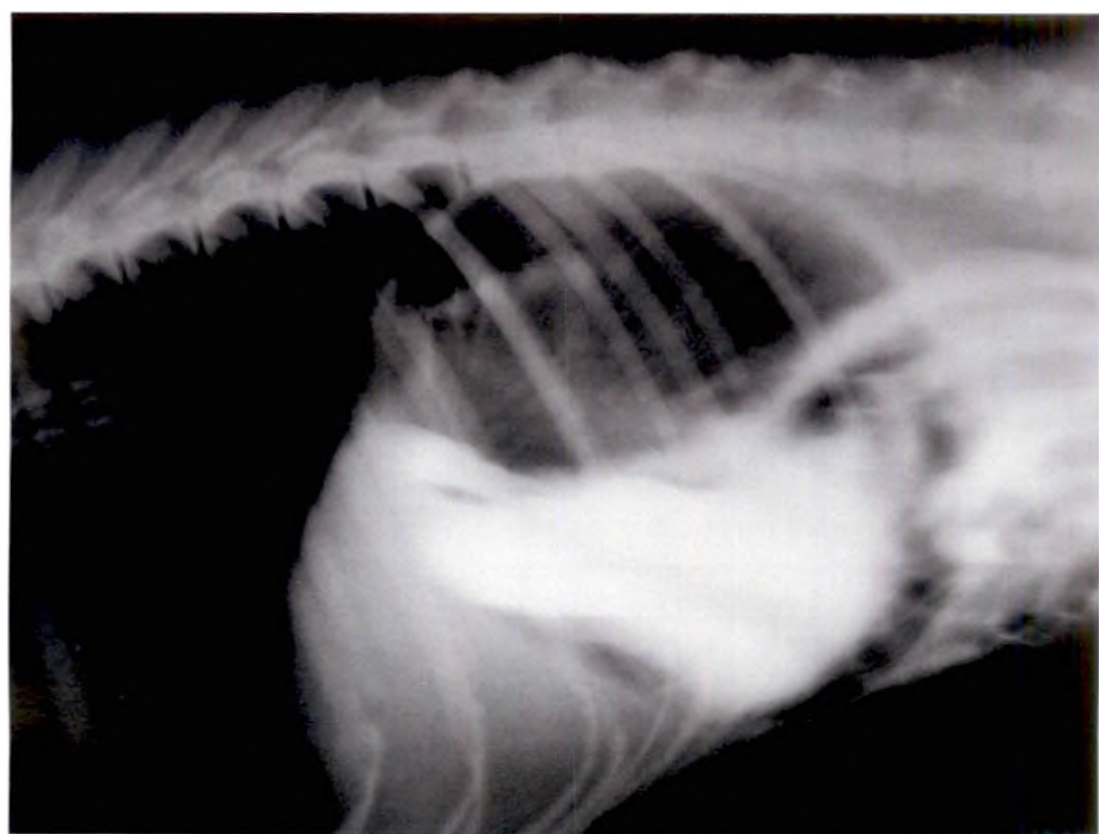


Fig.18

Fig.19 **Skiagram after the administration of the contrast materials (at 30 minute) (II₄)**
Gastric emptying almost complete.
Mucosa folds at the fundus of the wall coated with barium sulphate.

Fig.20 **Skiagram after the administration of the contrast materials (at 24 hours) (I I₄)**
Presence of a streak of barium sulphate at the pyloric region.



Fig.19

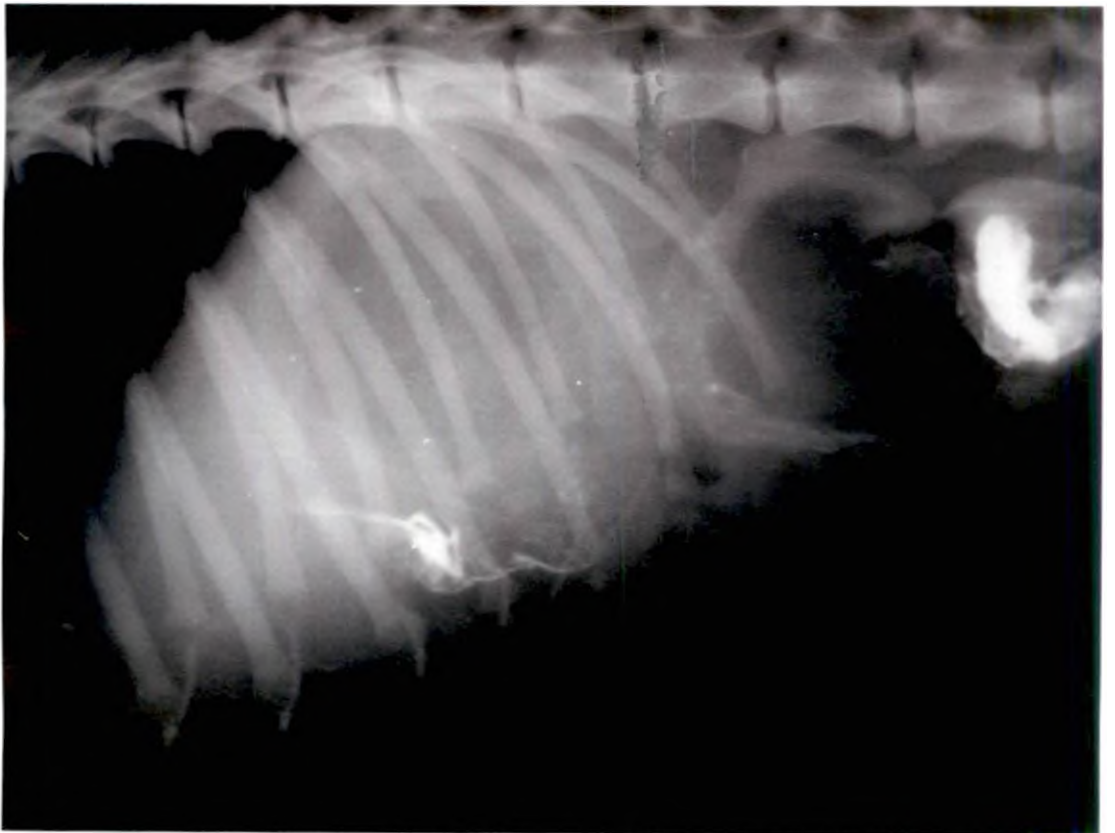


Fig.20

Fig.21 Skiagram after the administration of the contrast materials
(at 24 hours) (I I₅)
Presence of radioopaque barium sulphate coated material in the
stomach.

Fig.22 Skiagram before the administration of the contrast materials
(II₆)

Presence of a little amount of air in the stomach.



Fig.21



Fig.22

Fig.23 Skiagram after the administration of the contrast materials (at 30 minute) (II₆).

Accumulation of barium sulphate more towards the pylorus with gastric emptying.
Borders of the stomach are clearly visible.

Fig. 24 Photograph showing the materials vomited, containing plastic threads and electrical wires(II₃).



Fig.23



Fig.24

Discussion

5. DISCUSSION

The study was carried out in twelve dogs of different breeds, age and either sex, with the history of gastric problems presented to the Veterinary Hospitals of the College of Veterinary and Animal Sciences at Mannuthy and Kokkalai. These animals were randomly divided into two groups viz., Group I and Group II, each consisting of six animals.

The trials were carried out as follows:

In Group 1, 25 % of barium sulphate suspension at the rate of 5 ml per kg. body weight was administered orally. In Group II, 25 % barium sulphate suspension at the rate of 3 ml/kg. body weight followed by air at the rate of 2 to 10 ml /kg. body weight was administered into the stomach with a flexible polythene tube, after a survey radiography of the anterior abdomen.

Control of animals for the administration of contrast agent(s)

Manual control of the animals were sufficient for oral administration of barium sulphate suspension when it was used alone. But sedation with intramuscular administration of triflupromazine at the rate of 2 mg/kg. body weight was found satisfactory for easy administration of barium sulphate suspension followed by air into the stomach, through the flexible polythene tube. Sedation with the administration of triflupromazine hydrochloride had also been found satisfactory by Thilagar *et al.* (1994) to control the animals for double contrast radiography of the stomach in dogs.

History and clinical observations (Table 23 & 24)

General appearance of the animals were weak; dull or alert according to the severity of the problem. The prominent clinical symptoms noticed in the animals were anorexia, vomiting, reduced water intake, occasional diarrhoea and pain on palpation of

the abdomen. In most of the cases, the vomitus was yellowish. In three cases, which were diagnosed as gastric ulcers and gastric torsion, the vomitus was blood tinged. Diarrhoea was noticed in three cases in which diarrhoea was manifested, two cases were diagnosed as gastric ulcers and one was adenocarcinoma of the pylorus. Leib (1997) reported chronic vomiting, anorexia and weight loss as most commonly seen clinical signs of gastric neoplasms in dogs. Variable symptoms of vomiting or anorexia in dogs had been reported by Gibbs and Pearson (1973) by the ingestion of large quantities of fabric, string or hair due to the filling of the gastric lumen and pylorus. On reviewing fourteen cases of chronic hypertrophic pyloric gastropathy in dogs, Bellenger *et al.* (1990) reported vomiting as one of the common clinical symptoms. Mitchell and Gompf (1981) also reported vomiting along with chronic diarrhoea in dogs with gastric ulcers.

The appearance of the abdomen was tucked up, tensed or flaccid depending on the type of the gastric problems. Palpation of the abdomen elicited pain in six animals and the presence of a palpable mass in one animal, which was later diagnosed as a case of radiolucent foreign body in the intestine. According to Bright *et al.* (1994) gastric dysfunction can also occur along with small bowel problems.

Physiological observations

The variations observed in rectal temperature, pulse rate and respiratory rate, and colour of conjunctival mucous membrane were suggestive of the severity of gastric problems.

Haematological observations

Packed cell volume was below normal in eight animals. Haemoglobin concentration was below the normal limit in one animal, which was suffering from gastric dilatation and volvulus. The erythrocyte sedimentation rate was within the normal range. Total leukocyte count was below normal in two animals and above normal in two animals. Total erythrocyte count was below normal in three animals. Balasubramanian *et al.* (1990) also reported a decrease in erythrocyte count in a case of chronic hypertrophic

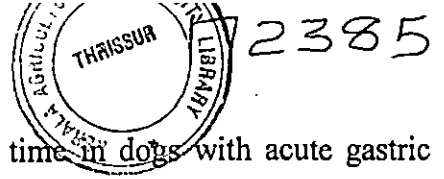
gastropathy in a dog. Reduction in packed cell volume and decreased total erythrocyte count with neutrophilia in cases of gastric impaction, gastric dilatation, gastric dilatation and volvulus (GDV) indicating anaemia and stress to the animal.

Differential leukocytic count revealed leukocytosis with neutrophilia in gastric ulcers and reduction in packed cell volume and decrease in leukocytes with lymphocytosis in pyloric adenoma and gastric displacement. The severity and chronicity of the localized/ generalised inflammatory reaction were evident from these observations.

Radiographic observations (Table 21 and 22)

Animal in which the condition was diagnosed as pyloric adenocarcinoma, the radiographic observations were delayed gastric emptying, sacculations at pyloric antrum, thickening and irregularities of the pyloric musculature with subserosal fluid collection at stomach wall. Contrast radiography with barium meal had been recommended by Bostock and Owen (1975) for the diagnosis of adenomas and adenocarcinomas of stomach and intestine. Fonda *et al.* (1989) reported thickening or roughening of the wall, loss of normal rugal fold pattern, delayed or incomplete emptying of contrast materials from the stomach as the radiographic features in stomach cancer. Thickening and rigidity of the gastric wall, distortion of gastric lumen, and derangement of rugal folds, incomplete filling defects and marked delay in gastric emptying had been reported by Sautter and Hanlon (1975) as the main contrast radiographic features in dog with gastric neoplasm. Theilen and Madewell (1987) had reported thickening of the stomach and abnormal filling defects as the radiographic features for the diagnosis of gastric neoplasms in dogs.

In the case which was diagnosed as gastric dilatation and volvulus, the radiographic features noticed were highly distended stomach with gas and delayed gastric emptying with the accumulation of contrast material at the pylorus. Funkquist and



Garner (1967) also reported delayed gastric emptying time in dogs with acute gastric dilatation.

The case, which was, diagnosed as gastric displacement it was seen that the stomach was pushed cranially by the distended intestinal loops. Frendin *et al.* (1988) were also successful in diagnosing the displacement of stomach in a dog with barium sulphate radiography. Importance of contrast radiography for the diagnosis of gastric displacement had also been reported by Gibbs and Pearson (1973).

In the case of gastric torsion, radiographic lesions observed was accumulation of barium meal in the pylorus as well as in the pyloric canal without any sign of gastric emptying. According to Pearson (1970) normally barium empties from the stomach within 30 minutes and if delayed for an hour or more there is probable cause of pyloric stenosis or pylorus spasm. Gibbs and Pearson (1973) reported that contrast radiography was helpful in determining gastric emptying time which was markedly delayed in pyloric obstruction. In the normal conscious animal, contrast medium usually reaches the duodenum within few minutes and total retention within the stomach for 30 minutes, or longer, generally indicates some degree of pyloric occlusion. McLaughlin and Ayer (1995) observed no passage of barium meal from the stomach in a case of gastrointestinal pythiosis where the pyloric region was severely thickened and distorted. Jose (2001) observed partial emptying in the case of partial torsion of stomach. Butler (1969) observed little or no passage of radioopaque material from the stomach into the duodenum over a four-hour period in a case of acquired stenosis of pylorus in a dog.

In the case of gastric ulcer, gastric emptying was normal and the area of decreased density in the stomach towards the pylorus may be due to the localized reaction. In gastric erosions the borders of the stomach were appeared uneven at the region. The uneven appearance of the borders of the stomach had also been observed by Chourasia *et al.* (2002) as the barium meal contrast radiographic feature in gastric erosion.

In the case of impaction of the stomach and oesophagus due to plastic threads and electric wires, the barium meal flow was seen blocked by the middle of thoracic oesophagus and hence there was only slight radioopacity in the body of the stomach.

Technical feasibility in assessing the diagnosis

From the study it could be seen that both contrast radiography with barium sulphate and combination of barium sulphate suspension and room air were useful for identifying radiolucent foreign bodies in the stomach, gastric tumours, gastric ulcers, pyloric obstruction, gastric dilatation and volvulus, displacement of the stomach, gastric torsion and impaction of the stomach. Kleine (1985) described the radiographic signs of abdominal disease in dogs and cats. It was opined that when radiography was properly performed and correlated with clinical findings, it is an accurate diagnostic technique for evaluating gastric and small intestinal morphology

Comparative evaluation of the techniques

Though both the techniques were useful for studies related to gastric emptying, barium meal alone was advised. Since the technique was simple and accurate, require no need of anaesthesia and not associated with complications like aspiration. For gastric impaction studies, combination of barium sulphate suspension and air was not found feasible. For studying architecture of gastric mucous membrane use of both the contrast materials were found to be useful.

Conclusion

From the present study, the contrast radiographic features of the following gastric disorders were identified as follows:

1. Pyloric tumour and ulcerations:
 - a. Absence of gastric emptying after 30 minutes of barium administration.

- b. Thickening and irregularity of the stomach wall.
 - c. Double shadow of the stomach wall indicating oedema at the subserosal level. Irregularity in the pyloric lumen and escape of barium through the defect and collection of the material at the subserosal level indicating ulceration and perforation.
2. Gastric volvulus and torsion:
 - a. Stomach was highly distended even by 30 minutes.
 - b. No sign of evacuation of barium sulphate.
 - c. Accumulation of barium sulphate at the pyloric end.
 - d. Twisted appearance of mucosal fold at the pyloric region
3. Gastric displacement:
 - a. Cranial displacement of stomach by distended intestinal loops.
 - b. Normal gastric emptying.
4. Gastric torsion
 - a. No sign of gastric emptying even after 30 minutes of administration of barium sulphate.
 - b. Distension of the body and the pyloric part of stomach. Double shadow of air column at the pyloric antrum and fundus of the stomach.
5. Gastric ulcer:
 - a. Defective coating of gastric mucosa with contrast material .
 - b. Irregularity in the mucosal lining-filling defects.
 - c. Accumulation of contrast material in the pyloric part with delay in emptying.
6. Radiolucent foreign bodies:
 - a. Presence of barium meal coated material even after 24 hours of administration could be seen in the stomach.

From the present study the technical feasibility and the comparative evaluation of the technique can be concluded as follows:

1. Contrast radiography using barium sulphate at the rate of 5 ml/kg body weight was found satisfactory for identifying of most of the lesions of the stomach.
2. Double contrast radiography using barium sulphate and air, anaesthesia was required to control the animals and for proper administration.
3. For diagnosis of the mucosal lesions, double contrast radiography with barium sulphate and air was better than barium meal alone.

Table. 21 A comparative evaluation of radiographic observations in animals of Group I

Animal No.		I ₁	I ₂	I ₃	I ₄	I ₅	I ₆
Plain radiograph	Visible foreign body	A	A	A	A	A	A
	Appearance of stomach	N	N	N	Not visible due to overlapping of intestinal loops.	Distended with gas	N
Contrast radiograph (0 Min.)	Appearance of stomach	N	N	N	Pushed cranially by distended intestinal loops.	Moderately distended	Smaller in size
	Appearance of mucous membrane	NAD	NAD	NAD	NAD	NAD	NAD
	Gastric filling defects	NAD	NAD	NAD	NAD	NAD	NAD
Contrast radiograph (30 Min.)	Appearance of stomach	N	Distended	Slightly distended	Smaller in size	Distended	Smaller in size
	Appearance of mucous membrane	NAD	NAD	NAD	Not visible	NAD	NAD
	Gastric filling defects	NAD	NAD	NAD	Not visible	NAD	NAD
	Gastric emptying	A	A	N	N	A	N
Foreign body, if any		A	A	A	A	A	A
Radiographic interpretation		Pyloric obstruction	Acute gastric dilatation and volvulus	Slight gastric distention	Gastric displacement	Gastric torsion	Mucosal erosions at the pylorus

A – Absent, N – Normal, NAD – No abnormality detected.

Table. 22 A comparative evaluation of radiographic observations in animals of Group II

Animal No.		II ₁	II ₂	II ₃	II ₄	II ₅	II ₆
Plain radiograph	Visible foreign body	A	A	A	A	A	A
	Appearance of stomach	N	N	N	N	N	N
Contrast radiograph (0 Min.)	Appearance of stomach	N	Distended	N	N	N	N
	Appearance of mucous membrane	NAD	NAD	NAD	NAD	NAD	NAD
	Gastric filling defects	NAD	NAD	P	P	NAD	NAD
Contrast radiograph (30 Min.)	Appearance of stomach	N	Distended	N	N	N	N
	Appearance of mucous membrane	NAD	NAD	NAD	AD	NAD	NAD
	Gastric filling defects	NAD	NAD	P	NAD	NAD	NAD
	Gastric emptying	N	N	A	Delayed	N	Delayed
Foreign body, if any		A	A	A	A	P	A
Radiographic interpretation		NAD	NAD	Foreign body obstruction	Gastric ulcer/ inflammation	Gastric foreign body	Pyloric stenosis

A – Absent ,P – Present, N – Normal, NAD – No abnormality detected, AD- Abnormality detected.

Table 23. Details of clinical signs, radiological observations, other findings if any and confirmatory diagnosis in Group I

Animal No.	Clinical signs	Radiographic observations	Other findings, if any	Confirmatory diagnosis
I ₁	Frequent vomiting and diarrhoea for seven days	Gastric emptying absent.	During surgery stomach wall showed slight thinning caudal to pylorus. The pylorus was almost blocked with irregular edged tumour like mass. Histopathology of the removed mass diagnosed as adenocarcinoma.	Pyloric obstruction-pyloric adenocarcinoma.
I ₂	Inappetance and vomiting for two days.	Highly distended stomach, gastric emptying absent.	The animal died on the same day. Post mortem findings revealed acute dilatation and volvulus of the stomach (GDV).	Acute gastric dilatation and volvulus.
I ₃	Frequent vomiting of undigested food for four months. Animal takes little food.	Slightly distended stomach, normal gastric emptying.	The oesophagus was dilated along with slight dilatation of stomach. Both revealed atony, but after 30 minutes of barium administration, barium got evacuated into the intestine suggestive of normal gastric emptying.	Slight gastric distention
I ₄	Anorexia for 22 days. Blood tinged vomitus some times after food intake	Stomach pushed cranially by the distended intestinal loops. Normal gastric emptying.	Enterotomy was done after two days and it was revealed that small intestine was found engorged with ingesta subsequent to block at ileo-caeco-colic junction by faecal balls and it was removed during surgery.	Gastric displacement.
I ₅	Inappetance for two days. Blood tinged vomitus for 2 days. History of consuming a mango seed 3 days back.	Distended stomach, gastric emptying absent.	The animal died after two days. The result of the postmortem indicated that the animal had been suffering from severe degree of gastric torsion	Gastric torsion.
I ₆	Inappetance for five days. Takes little water. History of falling of a coconut seed on the head.	Stomach smaller in size, mucosal erosion at the pylorus, normal gastric emptying.	The filling defects with the pyloric canal was due to the localized reaction from gastric ulcer resulting in hypertrophy of stomach wall.	Mucosal erosions at the pylorus.

Table 24. Details of clinical signs, radiological observations, other findings if any and confirmatory diagnosis in Group II

Animal No.	Clinical signs	Radiographic observations	Other findings, if any	Confirmatory diagnosis
II ₁	Anorexia for seven days. History of taken some rubber latex two weeks back.	No lesions detected with stomach.	Plication of the intestine was suggestive for linear foreign body with the intestine. Oral administration of liquid paraffin helped to evacuate the stomach and intestinal contents and the animal got recovered.	No abnormality with the stomach.
II ₂	Anorexia for 14 days. Vomiting about 30 minutes of food intake.	No lesions detected with stomach.	No lesions could be detected with the stomach and the animal was successfully treated with antiemetics, antibiotics and parenteral fluid therapy.	No abnormality with the stomach.
II ₃	Attempt for vomiting since two days. History of taking some plastic threads occasionally.	Obstruction due to radiolucent material in the caudal oesophagus.	On the next day the animal vomited large quantity of plastic threads and electrical wires, and after the vomiting, the symptoms disappeared.	Gastric foreign body.
II ₄	Frequent vomiting since four days, some times after food intake. The vomitus was blood tinged and bloodish diarrhoea was present.	Within the negative contrast, positive contrast coating seen at the stomach wall at the fundus indicating some inflammatory lesions.	Defective filling was seen with stomach due to increased thickening of the stomach wall.	Gastric ulcer / inflammation.
II ₅	Vomiting some time after food intake, history of consumption of some rubber material two days back.	Presence of radiolucent foreign body in the stomach.	After 24 hour of contrast media administration some radioopaque coated foreign body was indicative of presence of radiolucent foreign body in the stomach.	Gastric foreign body.
II ₆	Bloodish vomiting for two days. Abdomen was tensed.	Gastro intestinal ulceration and delayed gastric emptying.	Smearing of barium meal at the mucosa even after 24 hours of contrast administration indicating that ulceration with the stomach.	Pyloric stenosis.

Summary

6. SUMMARY

The study was carried out in twelve dogs of different breeds, age and either sex, with the history of gastric problems presented to the Veterinary Hospitals of the College of Veterinary and Animal Sciences at Mannuthy and Kokkalai. These animals were randomly divided into two groups viz., Group I and Group II, each consisting of six animals.

The trials were carried out as follows:

In group I, 25 % of barium sulphate suspension at the rate of 5 ml per kg. body weight was administered orally. In group II, 25 % barium sulphate suspension at the rate of 3 ml/kg. body weight followed by air at the rate of 2 to 10 ml /kg. body weight was administered into the stomach with a flexible polythene tube, after a survey radiography of the anterior abdomen.

Manual control of the animals were sufficient for oral administration of barium sulphate suspension when it was used alone. But sedation with intramuscular administration of trifluorpromazine at the rate of 2 mg/kg. body weight was found satisfactory for easy administration of barium sulphate suspension followed by air into the stomach, through the flexible polythene tube.

General appearance of the animals were weak, dull or alert according to the severity of the problem. The prominent clinical symptoms noticed in the animals were anorexia, vomiting, reduced water intake, occasional diarrhoea and pain on palpation of the abdomen. In most of the cases, the vomitus was yellowish. In three cases, which were diagnosed as gastric ulcers and gastric torsion, the vomitus was blood tinged. Diarrhoea was noticed in three cases in which diarrhoea was manifested, two cases were diagnosed

as gastric ulcers and one was adenocarcinoma of the pylorus. The appearance of the abdomen was tucked up, tensed or flaccid depending on the type of the gastric problems. Palpation of the abdomen elicited pain in six animals and the presence of a palpable mass in one animal, which was later diagnosed as a case of radiolucent foreign body in the intestine.

The variations observed in rectal temperature, pulse rate and respiratory rate, and colour of conjunctival mucous membrane were suggestive of the severity of gastric problems.

Packed cell volume was below normal in eight animals. Haemoglobin concentration was below the normal limit in one animal, which was suffering from gastric dilatation and volvulus. The erythrocyte sedimentation rate was within the normal range. Total leukocyte count was below normal in two animals and above normal in two animals. Total erythrocyte count was below normal in three animals. Reduction in packed cell volume and decreased total erythrocyte count with neutrophilia in cases of gastric impaction, gastric dilatation, gastric dilatation and volvulus (GDV) indicating anaemia and stress to the animal.

Differential leukocytic count revealed leukocytosis with neutrophilia in gastric ulcers and reduction in packed cell volume and decrease in leukocytes with lymphocytosis in pyloric adenoma and gastric displacement. The severity and chronicity of the localized/ generalised inflammatory reaction were evident from these observations.

Animal in which the condition was diagnosed as pyloric adenocarcinoma, the radiographic observations were delayed gastric emptying, sacculations at pyloric antrum, thickening and irregularities of the pyloric musculature with subserosal fluid collection of stomach wall.

In the case which was diagnosed as gastric dilatation and volvulus, the radiographic features noticed were highly distended stomach with gas and delayed gastric emptying with the accumulation of contrast material at the pylorus.

The case, which was, diagnosed as gastric displacement it was seen that the stomach was pushed cranially by the distended intestinal loops.

In the case of gastric torsion, radiographic lesions observed was accumulation of barium meal in the pylorus as well as in the pyloric canal without any sign of gastric emptying.

In the case of gastric ulcer, gastric emptying was normal and the area of decreased density in the stomach towards the pylorus, may be due to the localized reaction. In gastric erosions the borders of the stomach were appeared uneven at the region.

In the case of impaction of the stomach and oesophagus due to plastic threads and electric wires, the barium meal flow was seen blocked by the middle of thoracic oesophagus and hence there was only slight radioopacity in the body of the stomach.

From the study it could be seen that both contrast radiography with barium sulphate and combination of barium sulphate suspension and room air were useful for identifying radiolucent foreign bodies in the stomach, gastric tumours, gastric ulcers, pyloric obstruction, gastric dilatation and volvulus, displacement of the stomach, gastric torsion and impaction of the stomach.

Though both the techniques were useful for studies related to gastric emptying, barium meal alone was advised. Since the technique was simple and accurate, require no need of anaesthesia and not associated with complications like aspiration. For gastric impaction studies, combination of barium sulphate suspension and air was not found

feasible. For studying architecture of gastric mucous membrane combined use of both contrast materials were found to be useful.

From the present study, the contrast radiographic features of the following gastric disorders were identified as follows:

1. Pyloric tumour and ulcerations:
 - b. Absence of gastric emptying after 30 minutes of barium administration.
 - c. Thickening and irregularity of the stomach wall.
 - d. Double shadow of the stomach wall indicating oedema at the subserosal level. Irregularity in the pyloric lumen and escape of barium through the defect and collection of the material at the subserosal level indicating ulceration and perforation.
2. Gastric volvulus and torsion:
 - a. Stomach was highly distended even by 30 minutes.
 - b. No sign of evacuation of barium sulphate.
 - c. Accumulation of barium sulphate at the pyloric end.
 - d. Twisted appearance of mucosal fold at the pyloric region
3. Gastric displacement:
 - a. Cranial displacement of stomach by distended intestinal loops.
 - b. Normal gastric emptying.
4. Gastric torsion
 - a. No sign of gastric emptying even after 30 minutes of administration of barium sulphate.
 - b. Distension of the body and the pyloric part of stomach. Double shadow of air column at the pyloric antrum and fundus of the stomach.
5. Gastric ulcer:
 - a. Defective coating of gastric mucosa with contrast material .
 - b. Irregularity in the mucosal lining-filling defects.

- c. Accumulation of contrast material in the pyloric part with delay in emptying.
6. Radiolucent foreign bodies:
 - a. Presence of barium meal coated material even after 24 hours of administration could be seen in the stomach.

From the present study the technical feasibility and the comparative evaluation of the technique can be concluded as follows:

1. Contrast radiography using barium sulphate at the rate of 5 ml/kg body weight was found satisfactory for identifying of most of the lesions of the stomach.
2. Double contrast radiography using barium sulphate and air, anaesthesia was required to control the animals and for proper administration.
3. For diagnosis of the mucosal lesions, double contrast radiography with barium sulphate and air was better than barium meal alone.

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**CONTRAST RADIOGRAPHY FOR THE
DIAGNOSIS OF GASTRIC DISORDERS
IN DOGS**

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ABSTRACT

The study was carried out in twelve dogs of different breeds, age and either sex, with the history of gastric problems presented to the Veterinary Hospitals of the College of Veterinary and Animal Sciences at Mannuthy and Kokkalai. These animals were randomly divided into two groups viz., Group I and Group II, each consisting of six animals.

The trials were carried out as follows:

In group I, 25 % of barium sulphate suspension at the rate of 5 ml per kg. body weight was administered orally. In group II, 25 % barium sulphate suspension at the rate of 3 ml/kg. body weight followed by air at the rate of 2 to 10 ml /kg. body weight was administered into the stomach with a flexible polythene tube, after a survey radiography of the anterior abdomen.

Manual control of the animals were sufficient for oral administration of barium sulphate suspension when it was used alone. But sedation with intramuscular administration of triflupromazine at the rate of 2 mg/kg. body weight was found satisfactory for easy administration of barium sulphate suspension followed by air into the stomach, through the flexible polythene tube.

General appearances of the animals were weak, dull or alert according to the severity of the problem. The prominent clinical symptoms noticed in the animals were anorexia, vomiting, reduced water intake, occasional diarrhoea and pain on palpation of the abdomen. In most of the cases, the vomitus was yellowish. In three cases, which were diagnosed as gastric ulcers and gastric torsion, the vomitus was blood tinged. Diarrhoea was noticed in three cases in which diarrhoea was manifested, two cases were diagnosed as gastric ulcers and one was adenocarcinoma of the pylorus. The appearance of the abdomen was tucked up, tensed or flaccid depending on the type of the gastric problems. Palpation of the

abdomen elicited pain in six animals and the presence of a palpable mass in one animal, which was later diagnosed as a case of radiolucent foreign body in the intestine.

The variations observed in rectal temperature, pulse rate and respiratory rate, and colour of conjunctival mucous membrane were suggestive of the severity of gastric problems.

Packed cell volume was below normal in eight animals. Haemoglobin concentration was below the normal limit in one animal, which was suffering from gastric dilatation and volvulus. The erythrocyte sedimentation rate was within the normal range. Total leukocyte count was below normal in two animals and above normal in two animals. Total erythrocyte count was below normal in three animals. Reduction in packed cell volume and decreased total erythrocyte count with neutrophilia in cases of gastric impaction, gastric dilatation, gastric dilatation and volvulus (GDV) indicating anaemia and stress to the animal.

Differential leukocytic count revealed leukocytosis with neutrophilia in gastric ulcers and reduction in packed cell volume and decrease in leukocytes with lymphocytosis in pyloric adenoma and gastric displacement. The severity and chronicity of the localized/ generalised inflammatory reaction were evident from these observations.

Animal in which the condition was diagnosed as pyloric adenocarcinoma, the radiographic observations were delayed gastric emptying, sacculation at pyloric antrum, thickening and irregularities of the pyloric musculature with subserosal fluid collection of stomach wall.

In the case which was diagnosed as gastric dilatation and volvulus, the radiographic features noticed were highly distended stomach with gas and delayed gastric emptying with the accumulation of contrast material at the pylorus.

The case, which was, diagnosed as gastric displacement it was seen that the stomach was pushed cranially by the distended intestinal loops.

In the case of gastric torsion, radiographic lesions observed was accumulation of barium meal in the pylorus as well as in the pyloric canal without any sign of gastric emptying.

In the case of gastric ulcer, gastric emptying was normal and the area of decreased density in the stomach towards the pylorus, may be due to the localized reaction. In gastric erosions the borders of the stomach were appeared uneven at the region.

In the case of impaction of the stomach and oesophagus due to plastic threads and electric wires, the barium meal flow was seen blocked by the middle of thoracic oesophagus and hence there was only slight radioopacity in the body of the stomach.

From the study it could be seen that both contrast radiography with barium sulphate and combination of barium sulphate suspension and room air were useful for identifying radiolucent foreign bodies in the stomach, gastric tumours, gastric ulcers, pyloric obstruction, gastric dilatation and volvulus, displacement of the stomach, gastric torsion and impaction of the stomach.

Though both the techniques were useful for studies related to gastric emptying, barium meal alone was advised. Since the technique was simple and accurate, require no need of anaesthesia and not associated with complications like aspiration. For gastric impaction studies, combination of barium sulphate suspension and air was not found feasible. For studying architecture of gastric mucous membrane combined use of both contrast materials were found to be useful.