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Collage of veterinary medicine

Radiographic Barium Contrast of the Gastrointestinal of The Dog

Techniques and diseases

إستخدام الأشعة الملونة فى تشخيص أمراض الجهاز الهضمي فى الكلاب

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Abstract

This work was performed to discuss and the importance of contrast radiographic techniques for diagnosis of diseases of the gastrointestinal tract of the dog. The application of the barium contrasts give useful results for detection of gastrointestinal diseases in dog such as dilation, tumor, inflammation, obstruction, torsion, ulcer ,intussusception, pneumo-colon and diverticulum.

The most common used contrast agent is the barium sulphate. Although the x-ray is a good diagnostic method for diseases, it has many radiation hazards for both animals and human beings.

Key words: Radiography, Contrast studies, Barium sulphate, Small animals

مستخلص الاطروحه

اجريت هذه الاطروحه لاظهار اهمية الاشعه كواحده من اهم طرق التشخيص في الممارسه البيطريه ,استخدام محاليل الباريوم تعطي نتيجه افضل في تشخيص امراض الجهاز الهضمي في الكلاب مثل التمدد, الالتهاب, الاورام الخبيثه , الانسداد ,القرحه والالتواء و الاكثر استخداما هو كبريتات الباريوم .

كما ان الاشعه السينيه جيده في تشخيض الامراض فهي ايضا لها اضرار علي صحه الانسان والحيوان , ومساوئها قد تسبب اخطاء تشخيصيه.

الكلمات الدليليه :علم الاشعه ، دراسات التباين ،كبريتات الباريوم ، الحيوانات الصغيره

Radiographic barium contrast study of the gastrointestinal tract of the dog

Techniques and abnormalities

Chapter one

Introduction

Radiology is becoming a routine procedure for confirming and diagnosing many diseases in small and large animals. Abdominal radiography is very important in veterinary practice due to the frequency of abdominal disorders (O'Brien, 1978).Abdominal radiography in the dog is frequently used as a survey study since it permits evaluation of a part of the gastrointestinal tract (Morgan, 1993). The indications for examinations are wide spread and related to the body system that can be evaluated. A painful abdomen may relate to peritoneal disease, trauma to the abdominal wall or spinal injury. The clinician shouldn't hesitate to use abdominal radiography as a routine in the establishment of a data base in many patients (Morgan, 1993). Any radiographic study that require some special positioning of the patient, x-ray beam or use of contrast agents can be considered as special procedures.

To use the method of x-ray for recognizing abnormal radiographic findings effectively, an understanding of normal radiographic anatomy for the specific area of interest is required (Smallwood and Spaulding 2007). Abdominal radiographs can help the clinician make a definitive diagnosis or decide between medical or surgical treatment (Riedesel, 2007).

In the photographic portfolio gathered by Joseph Maria Eder (1855–1945) and Eduard Valenta (1857–1937), from Vienna, one can find numerous

radiographs of animals. Despite the great interest of veterinarians in the new diagnostic possibilities of x-rays, their application only developed gradually.

Recently, Radiological examinations form a vital role in the investigation of gastrointestinal tract diseases such as determination of site of obstruction along GIT that caused by foreign bodies or neoplasm. It also detects the pathological condition such as ulceration or degenerative changes and allows evaluation of shape and position of gastrointestinal tract. The x-ray plays an important role in detection of alteration in position of parts in GIT (McConnell, 2014). Radiology became an integral part of veterinary medicine and surgery shortly after the exposure of the first radiographic films. This subsequently led to the publishing of the first English language text on the subject of radiology in canine practice.

Although many special radiographic procedures have been described since then, survey radiography remains the standard for the majority of ante mortem anatomical diagnoses. Diagnostic radiology and ultrasonography will play an important and expanding role in the practice of small animal medicine and will contribute to improved health for pets.

Chapter two

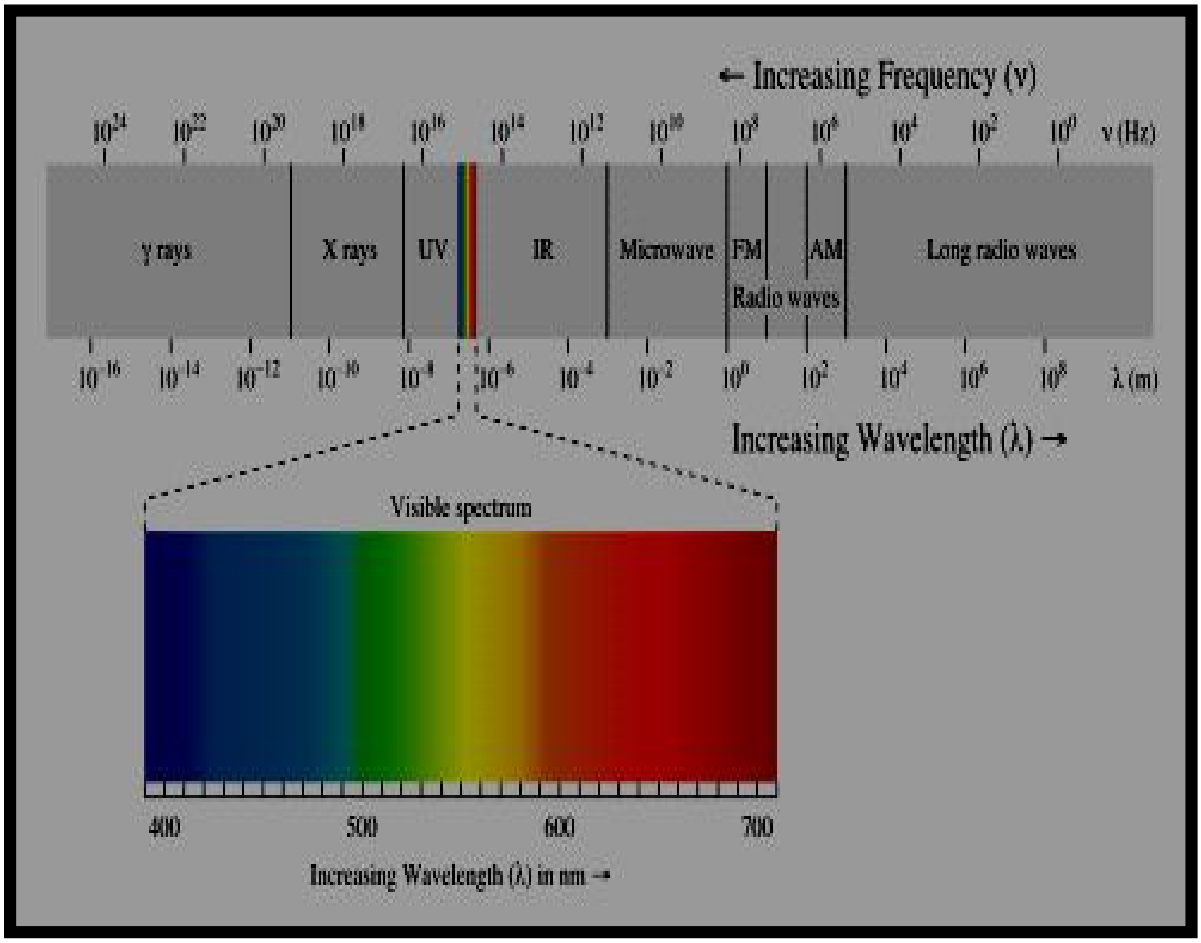
Diagnostic radiology and contrast media

2.1. Electromagnetic radiation

It is a method of transporting energy through space; it is distinguished by its wave length, energy and frequency (Thrall, 2007).

2. 2. Spectrum of electromagnetic radiation

Electromagnetic waves can be characterized by either



the frequency or wavelength of their oscillations to form the electromagnetic spectrum, which includes, in order of increasing frequency and decreasing wavelength: Radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays.

2.3. X-rays

It is a form of electromagnetic radiation, similar to visible light but of shorter wave length. Also it is defined as a branch of medicine that deals with radioactive substances used for diagnosis and treatment of diseases.

2.4. Discover of X-rays

On November 8, 1895, 36 Wilhelm Conrad Roentgen discovered X-rays at the University of Würzburg in Germany. He called them the X-rays after the algebraic symbol of the unknown, x. He noticed that the bones of his fingers were shadowed on the screen. On December 22, Roentgen decided to show his wife what had been occupying his time and took an X-ray image of her hand.

2.5 Properties of x-rays

Have no charge and no mass , x-rays travel at the speed of light in a straight line, they are invisible and cannot be felt, also it cannot deflected by magnetic field.

2.6. Anatomy of the x-ray machine

Tube head, arms and control panel. X-ray tube consists of a **cathode (-)** and an **anode (+)** encased in a glass envelope which is evacuated to form a vacuum. The x-ray tube is used to generate a controlled x-radiation.

2.7. Basic radiographic densities

2.7.1. Air

Appears the blackest on a radiograph

2.7.2. Fat

Is a lighter shade of gray than air?

2.7.3. Soft tissue and fluids

Because both soft tissue and fluid appear the same on conventional radiographs, you cannot differentiate between heart muscle and the blood inside of the heart on a chest radiograph

2.7.4. CALCIUM (bone)

Usually contained within bones

2.7.5. METAL

Appear the whitest on a radiograph

2.8. Radiation safety

All living cells are susceptible to ionizing radiation damage; cells may be damaged or killed. Rapidly dividing cells are most sensitive to radiation (neoplastic cells, metabolically active, hemopoietic cells and bone are also sensitive to radiation.

2.8.1. Somatic damage (in the patient himself)

It Describes damage to the body that becomes manifest within the lifetime of the recipient.

2.8.2. Genetic damage (off spring)

It occurs as a result of injury to the gene of reproduction cells.

2.9. Radiographic contrasts

Contrast medium: is a substance used to enhance the contrast of structures or fluids within the body in medical imaging (Dorland, 2011).

2.10. General classification of contrast

The two main categories of contrast agent are **positive and negative agents**. Positive contrast agents have a high atomic number, either **barium sulphate or iodine**, and appear more radiopaque than the surrounding tissue (bright). **Negative contrast** agents are gases of low density (air,

oxygen, carbon dioxide) which appear radiolucent (dark). The agents can also be combined to produce a **double-contrast** study which is often the best way to give optimal mucosal detail. It is administration of small volume of barium sulphate followed by distension of the stomach with air.

2.11. Types of positive contrasts

2.11.1. Barium sulphate

Barium sulfate is the most commonly used contrast medium for gastrointestinal tract (reference). Oral barium sulfate is commercially available in powder form, which has to be reconstituted with water, or in liquid form.

Advantages

Excellent mucosal coating with no absorption and no mucosal irritation and cheap.

Disadvantages:

Causes irritation if there is peritoneal leakage and aspiration pneumonia if inhaled

2.11.2. Iodine compounds

Iodinated contrast media are water-soluble and can be divided into two main groups: ionic and non-ionic.

Advantages

it is transmit rapidly, not irritant in case of peritoneal leakage and it quickly absorbed.

Disadvantages

It has poor mucosal coat which is slowly absorbed, Hyperosmolality (ionic) and Expensive.

2.12. Adverse effects of contrast media

Modern contrast media are generally safe to use, reactions can range from minor to severe sometimes resulting in death, strong allergies, bronchial asthma, cardiac disease and beta-Blocker use. In the past contrast media was sometimes highly dangerous but these dangers have been reduced during the development of the early types of contrast media.

2.13. Effects of Contrast on Patient

High osmolality contrast causes increasing in blood volume and it also reduces peripheral vascular resistance but contrast with low osmolality can cause discomfort of the patient

2.14. Double Contrast

Utilize both positive and negative contrast agents to image an organ, commonly the urinary bladder, stomach and colon. To avoid air bubbles, which can be misinterpreted as lesions, the negative-contrast medium is generally administered first, followed by the positive-contrast agent.

Chapter Three

Radiographic contrast study of the esophagus

3.1. Anatomy of the esophagus

Esophagus is small house like tube which connects the mouth to stomach path through the neck and chest passing near the heart through the diaphragm muscle and finally entering to the stomach (O'Brien 978). The esophagus is composed of four layers (1) the mucosa (2) the sub mucosa (3) the muscularis and (4) the adventitia (Watrous, 2007)

3.2. Esophagography (barium swallow)

Esophagography is the radiographic study that may permit evaluation of both esophageal function and morphology. The study is best performed under fluoroscopic examination which allows the dynamic process of swallowing to be studied. This study is termed a dynamic or real-time esophagogram. Conventional radiographic examination permits static short-lived picture of the function of the esophagus. Multiple serial static radiographs, or static esophagogram, may provide much information.

A properly performed conventional esophagogram (without the assistance of fluoroscopy) can provide all the information needed on location, luminal size, shape, content, and integrity of the esophagus (Thrall, 2007). It is best used to evaluate morphological and structural alterations of the esophagus. Non-static imaging such as fluoroscopy is recommended for specific evaluation of functional abnormalities (brown and brown 2014).

3.3. Indications of the study

Further evaluation and definition of survey radiographic findings (2) History of regurgitation, of undigested materials , dysphagia, excessive salivation,

acute gagging, painful swallowing To outline lesions of the esophagus (masses, esophagitis, diverticula, strictures, Perforations, foreign objects To evaluate location of esophagus relative to conditions in the immediate vicinity (cervical, mediastinal, pulmonary masses To study swallowing difficulties and motor dysfunctions (need fluoroscopy for dynamic studies).

3.4. Contra-indications

In cases of rupture or perforation; if an esophageal perforation is suspected, iodinated contrast material should be used. Barium sulfate can stimulate a severe granulomatous reaction in mediastinum,Presence of bronchoesophageal fistula ,inability to swallow, since the danger of aspiration is increased when a large amount of barium is present in the caudal pharynx.

3.5. Complications

Aspiration of contrast material , Leakage of barium into mediastinum or pleural Cavities , in bronchoesophageal fistula leakage of barium may develop a seriously diseased lung lobe (Root, 1975)

3.6. Contrast Media Used/Dose:

Barium sulphate cream or paste is used to enable good adherence to esophageal mucosa and valuable for extreme radiopacity. Suspected esophagus irregularities should be initially evaluated with barium paste or cream , Liquid barium suspension mixed with wet food and different sizes of dry kibble , approximately 5-20 ml of the selected contrast material is given to induce several complete swallows for coating the pharynx and esophagus.

3.7. Preparation

Fasting for at least 12 hours, a fractious animal should be given a low dose of phenothiazine tranquilizer. However the esophagus is affected by most CNS depressant drugs, hen motility is to be assessed it is disadvantageous to use these drugs (Watrous, 2007).

3.8. Technique:

Survey radiographs should always be obtained immediately prior to esophagography (lateral and VD view of thorax, lateral of neck.

1. Position the animal in lateral recumbency in the x-ray table

2. Place paper towels on tabletop or towels around the patient's mouth and neck 3. Slowly infuse the barium into the buccal pouch, close the mouth and wait for the animal to swallow.

4. Take serial radiographs of the animal in lateral recumbency- the right is usually easier for the positioner.

5. Administer additional barium or barium soaked kibble in the buccal pouch-close the mouth and wait for the animal to swallow.

6. Obtain further lateral radiographs if required or placed the patient in ventral recumbency to obtain ventrodorsal or oblique views which avoid super imposition of the esophagus over the spine.

7. If a lesion has been noted by esophagoscope or with the passage of the tube, a partial esophagogram can be made. Pass the tube till the point of the abnormality and administer barium sulphate in the site (Brown and Brown 2014).

3.9. Disorders of the esophagus

3.9.1. Gastro esophageal intussusceptions

It is a rare case and usually affecting puppies, the stomach invaginates into the caudal esophageal lumen. The intussuscepted portion of the stomach appears s as amass within the esophageal lumen.

3.9.2. Esophageal perforation and fistula

Cervical esophageal perforations result in leakage with sepsis and secondary inflammation. Gradually an abscess may form or cellulites may extend long facial planes through thoracic inlet to involve the mediastinum and pleural cavity.

Radiograph findings of esophageal perforation may include variable amount of intraluminal esophageal gas or fluid, cervical gas, cervical swelling (thrall, 2007).

3.9.3. Mega esophagus

Segmental mega esophagus may be congenital or acquired and either functional or mechanical. Segmental mega esophagus frequently is identified on survey radiographs by focal air accumulation. Abnormal regional air accumulation may occur anywhere along the esophagus just cranial to or at the site of location disease (Thrall, 2007).

3.9.4. Esophageal stricture

Inflammation lead to scarring of the wall depending on severity of scarring pre-stenotic dilation may not see in visible on survey radiographs (Thrall, 2007).

3.9.5. Foreign bodies

Entrapment of bodies with esophageal lumen is common cause of esophageal dysphagia. Typical feature of obstructing foreign object include afirm or rigid consistency, a Radiographs may be satisfactory for identification of radiopaque foreign body (Thrall, 2007).

3.9.6. Esophageal masses

They may be benign or malignant neoplasm or inflammatory masses. Mass lesion of the thoracic esophagus usually appears as an intrathoracic mass in position consistent with esophagus. Differentiation from a non-esophageal mediastinal mass or accessory lobe mass is difficult radiographically (Thrall, 2007).

3.9.7. Congenital esophageal hiatus hernia

A soft tissue mass effect is often present in thorax cavity include esophageal mass and pulmonary mass. To determine a mass lesion that is caused by a hiatal hernia; barium can be administration.

Barium will typically allow the misplaced fundus to be identified and the caudal esophageal sphincter recognized as a focal narrowing of barium contrast column is cranially displaced . A hiatal hernia is defined as any protrusion of abdominal contents through the esophageal hiatus of the diaphragm into the thoracic cavity in the presence of an intact, phrenico-esophageal ligament. Radiolucency of irregular shape was seen in the centre of the soft tissue mass, suggesting that the opacity was a partially herniated gastric fundus containing rugal folds (Thrall, 2007).

Normal location

1. On midline dorsal to the larynx

2. To the left of the trachea in the lower cervical region and thoracic inlet

3. Dorsal to the trachea and to the right of the ascending aorta in cranial thorax

4. Near midline in the caudal thorax (as it passes dorsal to tracheal bifurcation)

3.9.8. Dysphasia

Or difficulty with swallowing is a clinical symptom that may arise from a variety of diseases. Radiography depends on the suspected lesion type. Barium paste or cream is highly viscous and may adhere best to mucosal irregularities (Thrall, 2007).

3.9.9. Radiography of the pharynx and esophagus

Dosage is related to body weight such that small to medium sized dogs should receive 15mL boluses while larger dogs should receive 20–30mL boluses of liquid barium orally .When perforation of the pharynx, , or esophagus is suspected, non-ionic iodinated contrast agents are preferable to avoid the granulomatous reaction associated with leakage of barium into the cervical soft tissues or mediastinum .

Esophageal perforation should be suspected when survey radiographs identify gas in the cervical soft tissues or mediastinum but no external wounds are present (Thrall, 2007).

Chapter four

Radiographic contrast study of the stomach

4.1. Anatomy of the stomach.

The dog's stomach is a sac-like structure designed to store large volumes of food and continue the digestive process. It is subdivided into the cardia, fundus, body and pyloric portions (Frank and Mahaffey, 2007).

4.2. Gastrography

It is defined as the radiographic study of the stomach including the proximal portion of the duodenal loop. The examination can provide both morphologic and functional informations. A morphologic study examines the character and location of the gastric wall or contents looking for an extramural, mural and intraluminal lesions. A functional study examines gastric motility and pyloric function and it is evaluated by the time of onset of gastric emptying and the time of complete gastric emptying (Morgan, 1993).

4.3. Indications of gastrography

General indications include Vomition, hematemesis, anorexia, melena, cranial abdominal pain, suspicion of complete or partial obstruction and palpable mass in the stomach. The specific morphologic lesions include intraluminal foreign body, mural lesion, mucosal lesion, diaphragmatic hernia with gastric displacement. Specific functional lesions include determination of gastric emptying which may indicate a pyloric out flow dysfunction (Brien, 1978, Root, 1975).

4.4. Contra-indications

Gastrography is contraindicated in the presence of massive gastric fluid accumulation, i.e. if survey radiographs show obstruction, also in known or suspected perforation, prior use of motility altering drugs (antiemetic), food in stomach (Root, 1975).

4. 5. Complications

In a patient with severe, extended vomiting, the risk of aspiration of contrast is increased

4. 6. Patient preparation:

Under ideal conditions routine radiographic examination of the stomach should be performed on an animal that has been fasted for 12-24 hours (Root, 1974; Brawner and Bartels 1983; Arnbjerg, 1992). Fasting is not feasible in many situations and the inability to fast the animal is not a contraindication for abdominal radiography. Also fasting should be avoided in patients with acute abdominal disorder for which time delays are medically contraindicated. Plain radiographs must precede the contrast study.

A morphologic study can be done on a sedated or anesthetized animal; however the functional study is performed in a non-sedated animal because many drugs may cause gaseous distention of the stomach and decreased motility (Morgan, 1993; Scrivani, et al 1998).

4.7. Technique

The study can be done with negative, positive and double contrast. For complete evaluation of the stomach four views are necessary: Ventrodorsal (VD), Dorsoventral (DV), Right recumbent lateral (RL) and left recumbent

lateral views Survey radiography of the stomach should always precede the contrast study (Frank and Mahaffey, 2007).

4.7.1. Negative contrast

Negative contrast is recommended in suspected radiolucent foreign body, it has the advantage that it will not mask foreign bodies such as barium tends to do. Bicarbonate soft drinks such as seven-up are a good source of carbon dioxide, however air is the most frequently used for a nega4tive contrast studies (Brien, 1978). For morphologic study it permits evaluation of gastric location or the presence of extramural, mural and intraluminal lesions (Morgan, 1993).

Technique for administration of air

1. Determine the distance from the mouth to stomach with a stomach tube
2. Pass the lubricated stomach tube through a mouse speculum for the predetermined distance to the stomach
3. Quickly blow air into the stomach until it is visibly distended or the patient struggles due to increased pressure.
4. Rapidly remove the stomach tube, hold the mouth closed and position the patient for examination.
5. A left lateral recumbent and VD views are taken **(O' Brien, 1978)**

4.7.2. Positive contrast

A barium sulphate suspension is recommended for detailed evaluation of the gastric lumen, mucosal surface and functional activity when perforation is not suspected. If perforation is suspected iodinated compounds must be used. Leakage of barium into the peritoneal space can initiate severe granulomatous reaction, peritonitis or serosal adhesion (Fazio, 2006).

Barium sulfate suspension of a dose **2.3-3.6 ml/kg body weight is the** contrast medium generally used.

Administer the contrast medium via stomach tube or orally. The objective is to distend the stomach; you may need to use relatively more barium in small dogs and less in larger dogs. After administering contrast, obtain lateral and ventrodorsal views of the abdomen every 15 minutes for one hour and then every hour until the contrast is present in the colon.

The primary indication for a functional study is to determine gastric emptying time. For morphologic study it is good to evaluate gastric size, shape and location of extramural gastric lesions. However, it is not good for evaluating a mural or intraluminal gastric lesions.

4.7.3. Double contrast

Provides coating of the stomach wall and permits determination of gastric location and extramural lesions. Because we can see through the stomach it is possible to determine mural and intraluminal lesions. A double contrast study of canine stomach with oral barium sulphate 25% (3 mL/kg b.wt) followed by air (2 to 10 mL/kg b.wt, negative contrast) after sedation with triflupromazine (2 mg/kg b.wt, i.m.) was done in six clinical cases of dogs to study the affections of stomach. Double contrast radiography with barium sulphate and air was found effective for identifying various details of the gastric mucosa(Dlipeekumar, et al, 2012)

4.8. Diseases of the stomach diagnosed by contrast radiography

4.8.1. Gastric dilatation and volvolus

Gastric dilatation and volvolus syndrome (GDV) is an abnormal accumulation of gastric gas (dilatation) which may be complicated by

rotation of the stomach (volvolus) about its mesenteric axis that causes obstruction (Bhatia, et al 2010). Pathophysiological changes occur and they are responsible for the high mortality rate (Williams, 1991). It is a life threatening condition of large and giant breeds (Graham, et al 2007).

In dilatation the stomach is enlarged and filled primarily with gas, but it retains in its normal position and anatomic relations. Thus the pyloric still located on the right and the fundus on the left (Thrall, 2007). Gastric volvolus is differentiated from gastric dilatation by the present of gastric malposition. Different direction and degree of the rotation of the stomach are responsible of the radiographic appearance. As the stomach dilates the fundus and greater curvature rotate to lie along the ventral abdominal wall and the pylorus shifts dorsally, cranially and to the left. Lateral views are usually of most value in these conditions (Thrall, 2007). A severely dilated stomach may extend beyond the umbilicus. The stomach is usually filled with fluid and smaller quantity of gas.

Gastric volvolus is suspected if tissue density separate the gas filled gastric shadow into two chambers or the pylorus is dorsocranial to the fundus in the right lateral view (Bhatia, et al, 2010). The right lateral recumbent position is sufficient to establish the diagnosis and it is the most revealing **(Hothcock, 1984, Thrall 2007**). If the animal doesn't tolerate the lateral recumbent, the DV radiograph should be made.

Hartman (2012) reported that the classic radiographic appearance of GDV is represented here with gas dilatation of the stomach, dorsal positioning of the pylorus evidenced by compartmentalization at the

craniodorsal margin of the stomach. Notice the esophageal dilation which is often present with GDV.

4.8.2. Pyloric obstruction

It is defined as obstruction of gastric empty at the pylorus .It may be acute as in foreign body or gastric volvolus or chronic as in inflammation or fibrosis, hypertrophic pyloric stenosis, pylorospasm and neoplasia (due to their effects on pyloric wall or blocking the orifice). Chronic partial obstruction of the gastric outflow causes progressively slower gastric emptying and results in gastric dilatation.

In radiographic findings, the stomach appear enlarged and filled with fluid, also retention of barium within the stomach 3-4 hours after administration usually indicates pyloric obstruction (Thrall, 2007)

If radiography show thin line of minimal amounts of this contrast material getting through the pylorus into the intestines, thus strongly suggesting the diagnosis of pyloric stenosis.(khuly,2012)

4.8.3. Gastric ulcer

Difficult to detect by x-ray; appears as defect on the stomach wall and gastric fluid accumulation. Increased soft tissue density may indicate perforation and loss of serosal detail may indicate peritonitis secondary to perforation (Parrah, et al 2013). Dog ulcer always associated with malignant gastric neoplasia.

Gastric ulcers cannot be identified on survey radiographs; a double- contrast gastrogram must be performed to identify the characteristic features of gastric ulceration. These features include, a rigid appearance of the wall adjacent to the crater, a radiating mucosal

pattern, abnormal mucosal folds, prolonged gastric transit time (Pennin, et al 1997).

4.8.4. Gastric neoplasia

Adenocarcinoma is the most common malignant gastric tumor. This tumor mostly found in the pyloric region. Radiographic appearance depends on size, shape or location of the tumor. It appears as mass lesion that project into the gastric lumen creating filling defect within the contrast medium. The more nodular the lesion the easier to recognize it (Thrall, 2007).

4.8.5. Gastric foreign body

Radiopaque material within the stomach is easily visualized and is commonly present on survey radiographs. These opacities are most often the result of ingested bone fragments and usually have no clinical significance. A greater problem exists with radiographic diagnosis of non-opaque gastric foreign bodies. These objects are difficult to see on survey radiographs. Giving small amount of barium; make gastric foreign body easier to visualize than standard gastrogram using large volume of barium. Large volume of barium may completely obscure the foreign body give false negative result (Frank and Mahaffey, 2007).

Fazio (2006) reported that begin with a small volume of liquid contrast medium (usually 1-2 ml/kg of barium sulfate suspension) may outline a radiolucent foreign body where a normal volume positive contrast gastrogram could completely obscure visualization of a foreign body within the stomach. The appearance of foreign bodies on a gastrogram varies depending on the type of foreign body present (Frank and Mahaffey, 2007).

Chapter five

Radiographic contrast study of the small intestine

5.1. Anatomy and physiology of the stomach

The small intestine is a tube-like structure, which extends between the stomach and large intestine. It has three parts duodenum, jejunum and ileum (anatomy reference).The motion of the small bowel is described as segmentation, pendular movements and peristalsis (O'Brien, 1978).

The most important factor affecting this motion is gastric emptying time. Segmentation takes place in the dog at a frequency of 17-18 per minute in the duodenum, 15-16 in the jejunum and 12-14 in the ileum. Pendular movement may be an independent motion of the small intestine or modification of segmentation. Aboral propulsive movement of chyme or contrast material is chiefly a result of peristaltic waves, which appear as ring like strictures that travel rapidly over a long segment of a bowel. Motility is best evaluated using radiography (Hill, 1970).

5.2. Indication

Obstructions suspected from palpation, severe or protracted vomiting or diarrhea, hematemesis or melena, a palpable mass requiring further evaluation, abdominal pain of unknown cause, fever of unknown origin, and impaired growth in the young and uncertainty of organ location following survey radiographs of the organ.

5.3. Contraindications

Contrast evaluation is not warranted in the patient with survey radiographic evidence of bowel obstruction. If the clinical and survey radiographs are strongly suggestive of mechanical obstruction, surgery is

indicated. Patients with survey radiographic evidence of bowel perforation are not appropriate for contrast studies. Use of barium sulphate is not recommended because the combination of barium and ingesta within the peritoneal cavity may cause more severe peritonitis. Prior use of tranquilizer or other drug that affects bowel transit time and suspect paralytic ileus

5.4. Complications

1. Aspiration of contrast
2. Problematic with barium in diseased lung
3. Leakage of contrast into peritoneal cavity

5. 5. Contrast radiography

An axiom of radiography is that survey radiographs must precede a special examination. Most contrast examinations are performed to study both the stomach and the small intestine, since many diseases of these organs cannot be differentiated by clinical signs.

5.6. Animal preparation

Low dose of (0.05mg/kg bw) acepromazine malaete given intravenously has been recommended for tranquilization of fractious dogs. General anesthetics (isoflurane) and sedatives such as xylazne slow the passage of barium through the intestine and should be avoided. In patients with chronic signs, food should be withheld for 24 hours and a cleansing enema administered 2-4 hours prior the examination. In patient with acute abdomen or acute persistent vomiting no preparations are possible.

5.7. Sequence of radiographs

5.7.1. Survey radiographs of abdomen

A. Views: DV and RLR

B. Objectives include evaluation for preparation of patient, interpretation for disease and reference point for contrast study

5.7.2. Immediately following contrast administration

A. Views DV, RLR, LLR

B. Objective include evaluate distended stomach and initial gastric emptying

5.7.3. 20-30 minutes following contrast administration

A. Views DV, RLR

B. Objective: evaluate stomach and pyloric function and duodenum

5.7.4. 60 minutes following contrast administration

A. Views DV, RLR

B. Objective: evaluates small intestine

5.7.5. 3 hours following contrast administration

A. Views DV, RLR

B. Objective: evaluates passage of contrast material into colon and complete emptying of the stomach.

A contrast examination should allow for the following determinations: a more thorough evaluation of mucosal abnormalities, length of intestine affected, abnormalities in peristaltic activities and intestinal transit time, a more complete determination of luminal contents, size of lumen and thickness of bowl wall.

5.8. Disorders of the small bowel

5.8.1. Intestinal obstruction (ileus)

Failure of intestinal contents to pass through the tract is called ileus. Ileus can be mechanical caused by physical obstruction of the bowel (foreign object, intussusceptions, masses from wall of bowel), or functional (paralysis) in which peristaltic contractions of the bowel cease as result of vascular or neuromuscular abnormalities within the bowel wall. Mechanical obstruction differs from functional obstruction.

1. Mechanical obstruction is usually of larger diameter than functional obstruction.

2. Both gas and fluid typically are in the lumen mechanical obstruction, whereas functional obstruction contains gas.

3. Patients with mechanical obstruction usually have some bowel segments of normal size, whereas patients with function obstruction may have generalized involvement of the bowel. Radiographic sign of MO is dilatation of bowel loops oral to site of obstruction, the segments often assume a stacked appearance, but in FO uniformly distended bowel segments, delayed transit, and normal to nonspecific changes in the barium texture and mucosal border (Thrall, 2007).

5.8.2. Intussusceptions

Describes a condition in which one segment of the intestine telescopes or invaginates into the lumen of an adjacent segment of intestine. Radiographically the area of intussusception may appear as a “coiled spring”. Radiographs will show a typical pattern of intestinal obstruction

with gas and fluid-filled dilated loops of bowel if the obstruction caused by the intussusception is complete.

In cases of partial obstruction, there may not be significant signs on plain radiographs (Levine et al, 2015).

5.8.3. Jejenal Diverticulitis

Results from herniation of the mucosa at sites of weakening, predominantly on the mesenteric border of the jejunum or, less frequently, the ileum.The diverticula are characterized on barium studies by multiple rounded outpunching that have discrete necks

5.8.4. Infiltrative bowel disease (IBD)

It is infers generalized or segmental infiltration of the bowel wall as a result of infection or neoplasia. Infiltrative bowel diseases are lymphocytic and plasmocytic enteritis. On radiography an abnormal mucosal margin, intestinal wall thickness is complicated by silhouetting of intraluminal fluid within the wall (Thrall, 2007).

5.8.5. Linear foreign material

This causes an abnormal shape and contour of the loops. The intestine may have a bunched appearance and appear tightly stacked. Barium contrast studies improve detection of the abnormal shape and contour of the loop containing foreign body (Thrall, 2007).

5.8.6. Adenocarcinoma

Is type of cancer that forms in mucus –secreting glands of intestine. Radiography shows a soft-tissue mass with heterogeneous attenuation. May manifested as an annular with irregular a discrete tumor mass or an ulcerative.

Narrowing of the lumen leads to partial or complete small bowel obstruction (Bickle and Muzio, 2015).

5.8.7. Volvolus

It is defined as a twisting of a bowel loop about its mesenteric base, usually at either the sigmoid or the ileocecal junction. On radiograph it is identifiable as a collection of air conforming to the shape of the affected, dilated bowel.

Chapter six

Radiographic contrast study of the large bowel

Radiographic examination of the large intestine can be performed by positive, negative and double contrast studies. Oral administration of positive contrast does not fully distend the large intestine and for the visualization of the entire large intestine and small lesions such as mucosal irregularities, full distention with removal of feces is required and therefore oral positive contrast couldn't consider adequate for a large intestinal study (Brown and Brown, 2014). Survey and contrast radiographic procedures have been used to assess many colonic conditions (O'Brien, 1981, Farrow, et al 1995, kealy and McAllister, 2010). Feces and gas produce contrasting radiographic opacities and are usually present in the large bowel, a part or the entire large bowel is identifiable on survey radiographs (Schwarz and Biery, 2007). The different body positions used for survey radiographs distribute intraluminal gas to different parts of the large bowel, largely because of gravity. Normal large bowel content usually has a characteristic pattern of fine and evenly distributed gas bubbles which is helpful in differentiating the colon from the small intestine and abnormal conditions of large bowel ((Schwarz and Biery, 2007).

When the large bowel is evaluated radiographically, the entire abdomen and pelvic area must be included on two orthogonal views (Schwarz and Tobias, 2007). An understanding of the anatomic relation of the large bowel to other viscera is extremely important for the radiographic recognition of diseases of large bowel and adjacent organs (Schwarz and Biery 2007). The

radiographic examination of the cecum, colon and rectum through retrograde administration of contrast medium generally of morphological character and evaluates extramural masses, mural or larger mucosal lesions. Smaller mucosal lesions are better determined endoscopically (Morgan 1993, Brown and Brown, 2014).

6.1. Anatomy of the large bowel

The dog large bowel composed of caecum, colon, rectum and anal canal. The colon is divided into ascending, descending and transverse colon. The caecum is a diverticulum of the colon near the ileocecal junction. The canine caecum is semicircular and extends caudoventrally (O'Brien, 1978). The cecum has different anatomic and radiographic appearance, it is semi circular and compartmentalized and normally it contains intraluminal gas. The intraluminal gas and characteristic shape enable easy recognition of the cecum in the right mid abdomen on most survey radiographs. The colon is one of the abdominal structures that is easily displaced by abdominal masses (Graham et al 2007).

6.2. Indications of the study

Abnormal defecation characterized by excessive mucus or bright red blood coating the stool (2) penciling of stool due to a stricture (3) pain or difficulty during defecation (Tenesmus or dyschezia) (4) suspected caudal abdominal or pelvic mass and (5) preneal hernia

6.3. Clinical signs of large bowel diseases

Diseases of dog large bowel show several signs such as diarrhea, tenesmus, vomition, constipation, loss of body weight, intestinal distension with gas, severe colic and failure to pass feces.

6.4. Patient preparations

Patient should be held off food for 24 hrs until the study (2) Mild catharsis 12 hours prior the study (3) Cleansing enema with worm water until the returning fluid is clear (partially to stimulate defecation (4) Anesthetize the animal with general anesthesia because inflation of the catheter induces discomfort and stimulate tenesmus in the conscious animal.

6.5. Contraindication

They are (1) Suspected obstruction of the colon (2) rupture or perforation of the colon (3) lesions that are clinically limited to the rectum or terminal colon since they will be obscured by the inflated cuff of the catheter.

6.6. Technique for positive contrast enema

Have the chemically restrained patient on the table (2) insert the catheter rectally and inflate the cuff to prevent leakage (3) keep the reservoir slightly above the table top to maximize gravity or use minimum pressure on the syringe, stop the infusion if there is a resistance to the flow of contrast agent, close off the three way stopcock (4) take ventrodorsal and both right and left lateral radiographs (5) process the film and if no additional contrast agent or radiographs are required remove as much as of the contrast medium as possible prior to the removal of the catheter (6) further radiographs may be obtained if desired once the barium is removed (Brown and Brown 2014).

6.7. Complications

Retrograde filing of the jejunum and ilium, if this reflux is massive it can obscure visualization of portions of the colon (2) rupture of the colon due

to many reasons such as improper catheter care, overdistention or weakening of the wall of the colon.

6.8. Doses of contrast media

Barium sulphate suspension of 10% W/W or 20% w/w per body weight is generally used. Dilution of the concentration of the available barium sulphate suspension must be done. Iodide contrast should be used in case of suspected perforation. Contrast material should be wormed till body temperature. Dose for complete barium enema approximately 3-5 ml /bound BW must be injected rectally. Less contrast should be used if the position of the colon is the only information wanted.

6.9. Large bowel disorders

6.9.1. Obstruction

Obstruction of the colon may be partial or complete. Mechanical obstruction of the intestine occurs due to either intraluminal mass or external compression of the intestinal wall. Intraluminal obstruction can occur due to foreign bodies, fecolith, impacted ingesta and huge parasitic infestation (McColl, 2010). Khan, et al (2014) reported an obstruction in two dogs Labrador male and Doberman female. They were presented with cessation of feces for two weeks, depression, lethargy and anorexia. The radiological examination revealed radiopaque material in the colon by using right and lateral recumbent views. The condition is suggestive of fecolith. (Chen, et al ,2013) reported that a female beagle was presented to veterinary teaching hospital with cauliflower mass-like germinating from the rectal mucosa. The bitch was presented with clinical signs including severe emaciation; scratched anus, mucoid and blood flecked feces and

showed tenesmus and abdominal pain. Radiographic examination performed on the left-right lateral position and showed solid feces and gas in the descending colon. Enema was performed and on radiographic Strongyloid stercoralis was found in rectum and colon.

6.9.2. Intussusception

It is an imagination of a portion of the intestine into the distal segment adjacent to it. It is most commonly seen in the young dogs and is often associated with hypermotility of the intestine, enteritis and parasitism. The most common intussusception is Ileocolic; however cecocolic intussusception has also been described. A contrast study is usually necessary to outline intussusception. If possible, barium enemas should be observed fluoroscopically. Enema my reduce intussusception but there is a recurrence within hours. Intussusception may cause partial or complete obstruction (Kealy, et al 2010).

6.9.3. Colon foreign body

The diagnosis of colon foreign body in dogs is difficult for practitioners , not only do pets presents with a variety of clinical sings but client of ten can't any information about whether the pet ate for bidden object (Fazio, 2006). The most common of the intestinal foreign body are bone , rocks and plastic, not only can foreign body cause obstruction but sometimes such as object containing head can cause systemic toxicosis. Others can cause local damage of the intestine itself. some foreign body particularly pieces of string can perforate the intestine and lead to subsequent peritonitis (Fazio, 2006).

Radiographic features

Barium enema

Give the dog sedation or general anesthesia for control. Infuse the catheter rectally; put small volume of liquid contrast medium usually 1-2mg/kg/Bw of barium enema suspension. This small a normal volume positive contrast colon gram could become visualization of the foreign body within the colon. After administrating the contrast, obtain ventrodorsal view of the abdomen every 15 minutes until the present of contrast. Intestinal emptying depends on many factors like; low volume of contrast (Fazio 2006).

6.9.4. Perineal hernia

Perineal hernia characterized by rupture of one or more pelvic cavity muscles (Ferrein and Delgado, 2003). This rupture due to alteration of the pelvic diaphragm, caudal displacement of anatomical structure such as rectal, pelvic or abdominal contents. It is indicated by swelling of the preneal region (Welches et al , 2008) and lead to persistence rectal distension and impaired defecation (Fossum, et al 2008). The causes of muscle weakness are unknown but some factors have been proposed such as neurogenic senile muscle Atrophy, myopathy, prostate enlargement and hormonal disturbance (Hedland , 2002).

Radiographic features

Barium enema

Survey radiographs should be performed to evaluate the extension of the rectal dilation and determined the correct radiographic exposure technique and adequate patient preparation before contrast study.

Patient should be fasting for 24 hours and cleansing enema should be performed to empty the colon. Barium enema radiographic study achieved by administrating room temperature barium through the inflatable cuffed catheter placed distal and filled by gravity. Using volume varying from 7-15 ml/kg/Bw (Bojrab and Toomey, 1981). Radiographic findings of rectal dilation or sacculations are characterized by external and intact pouch on the rectum wall (Bojrab and Toomey, 1981). Positive contrast will show presence of rectal sacculation on the ventrodorsal aspect of the intestine. The Barium enema shows looseness of the caudal portion of the rectum (arrows)

6.9.5. Impacted cecum

Cessation of the feces in dogs is relatively common; it may be due to functional obstruction or cessation of the peristalsis movement of the gastrointestinal tract (Khan, et al 2014).). the feces may be partial or complete impacted due to intraluminal obstruction or external compression . The intraluminal obstruction occurs due to foreign body (Khan et al, 2014).the Fecolithiasis impacted due to parasitic infestation (Mccoll, 2012).

Radiographic feature

Barium enema

The contrast medium radiographic study has added a Considerable advances in diagnosting fecal impaction in dogs and cats compared to plain Radiography survey concerning partial obstruction and ileocecal intussusception. Positive contrast shows evacuation of the semi hard stool, disintegration of radiopaque material.

6.9.6. Mega colon

Mega colon refers to abnormal dilation of the colon. It can be acute, chronic or toxic (Ahmed 2003). The chronic mega colon is classified into congenital or acquired or may be primary or secondary. The cause of primary mega colon is unknown. The secondary mega colon will occur as the result of intestinal wall lesion or various condition that prevent defecation for prolonged period time. Hypertrophic mega colon refere to functional disorders; develops as a result of chronic obstructive lesion as stenosis, tumor and foreign body.(Tharal,2007)

Radiographic features

Barium enema

Animal off food at overnight and evacuation of the rectum after inserted catheter and cuffed enema. Give general anesthesia to the dog. The position is recumbent ventro-dorsally. Give 1-2mg/kg/Bw of Barium enema suspension. For positive contrast; appear distension of the colon and dilatation was evidence in all radiographic images, enlarged colon and extended from the epigastrium region to the pelvic canal.

6.9.7. Colonic torsion

Torsion is defined as twisting of the intestine causing obstruction; the torsion of the colon is rarely but fatal.(Jean 2013).

Radiographic features

Barium enema

Animal will be fasting and fully anesthetized. Position the animal on dorsoventral recumbency. Positive contrast shows; severe gas

distension on the colon with displacement of the right mid line, there is also fluid and gas distension in the small intestine. (Jean et al ,2013)

6.9.8. Colitis

It is an inflammation of the colon caused by bacteria, virus, parasite and trauma. The extra colonic manifestation includes erythema, nodule, cholangitis, arthritis and hepatitis (Gabriel et al, 2009). The more chronic complication includes stricture and chronic colonic carcinoma.

Radiographic features

Barium enema

Sedation or general anesthesia is recommended. Positive contrast shows narrowing, incomplete filling and sub mucosal ulceration mucosal edema. Loss of the structure and narrowing of the lumen (Gabriel et al, 2009).

6.9.9. Tumor

Carcinoma and adenocarcinomas are the most common neoplasia of the large bowel more than small bowel (Carlos, 2005). The clinical signs associated with the carcinoma as anorexia, diarrhea and vomition.

Radiographic features

Barium enema

Plain radiographs demonstrates the presence of palpated abdominal mass and obstruction of pattern of the intestine. Carcinoma due to concentric narrowing of the intestinal lumen. Contrast radiography can highlight area of the intestinal stenosis and for diagnosis (Carlos , 2005)

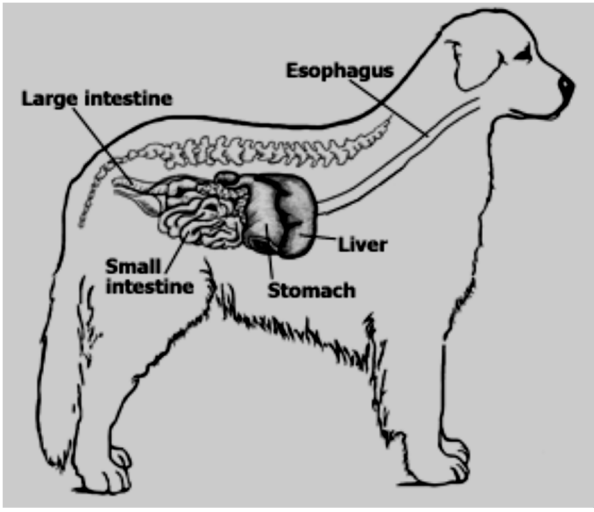


Figure 4: Anatomy of GIT

Figure 5: Esophageal perforation and fistula

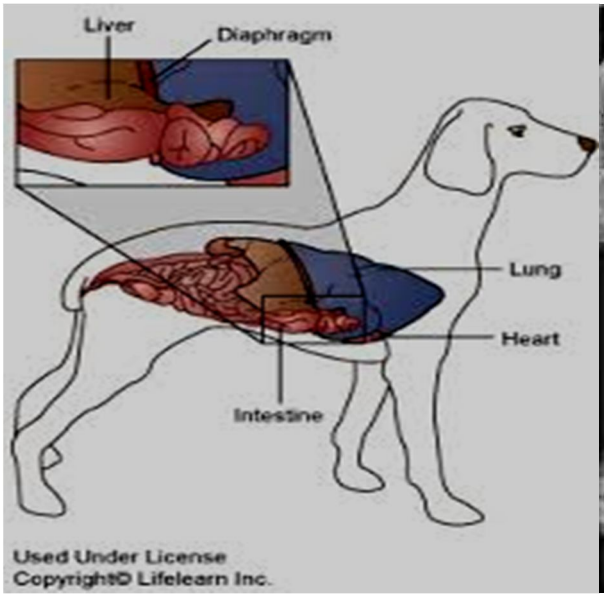


Figure 6: . congenital oesphageal hiatal hernia

Figure 7: Mega esopha

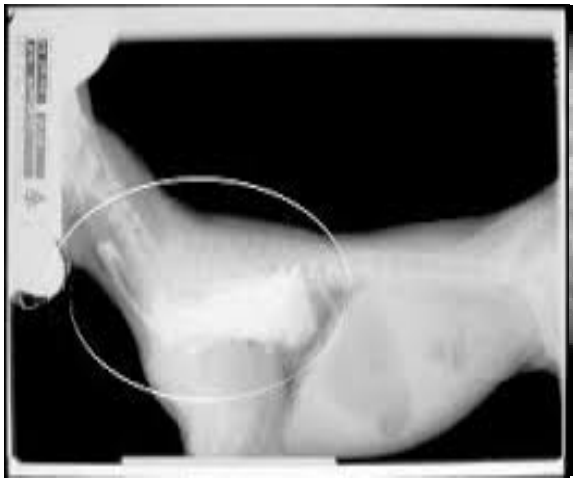


Figure 8: Mega esophagus

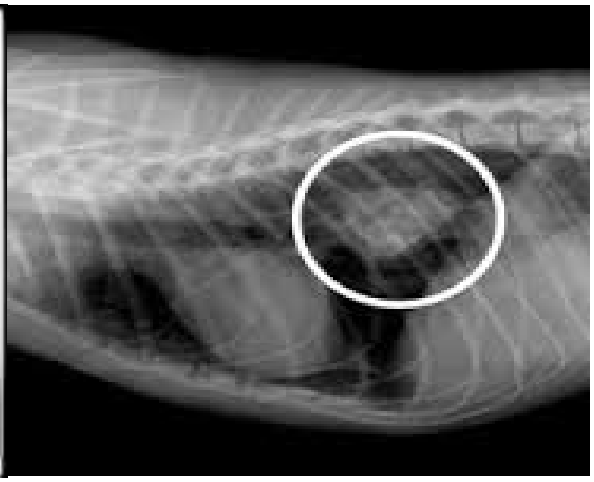


Figure 9: Foreign bodies

Figure 10: Gastro esophageal intussusceptions

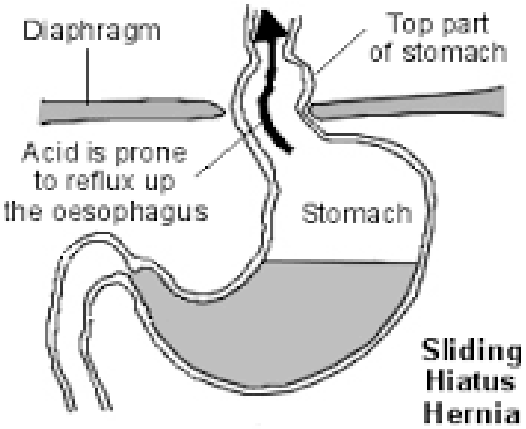


Figure 11: congenital oesphageal hiatal hernia

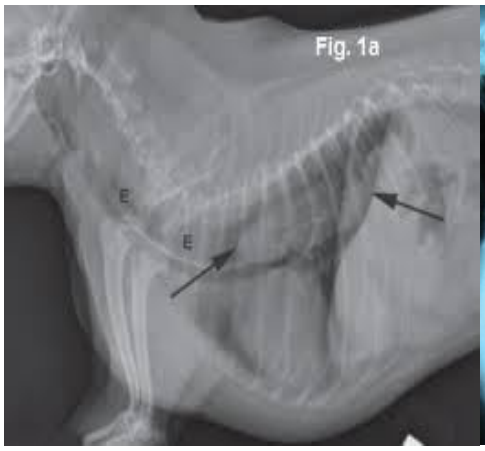


Figure 12: Foreign bodies

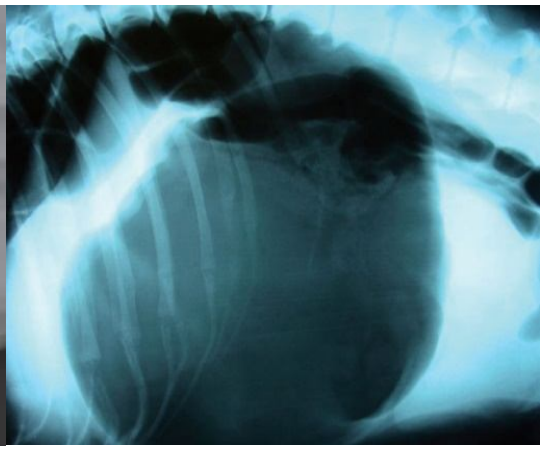


Figure 13: Gastric dilatation

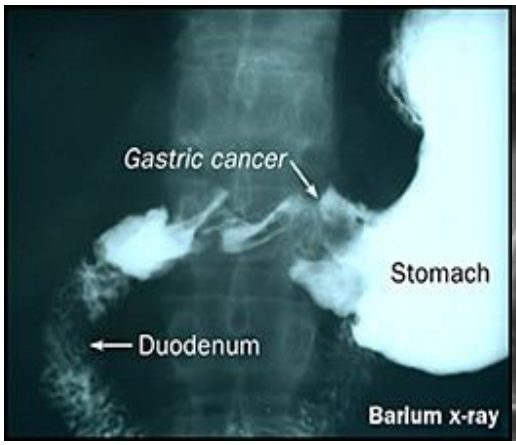


Figure 14: gastric neoplasm

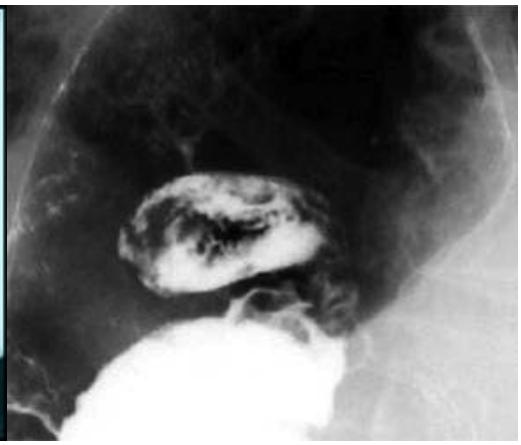


Figure 15: gastric ulcer

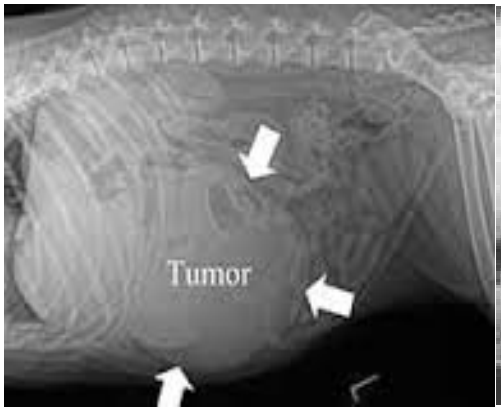


Figure 16: gastric neoplasm

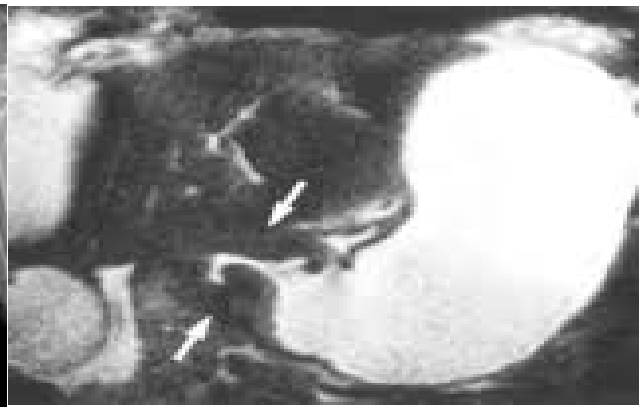


Figure 17: pylorus stenosis

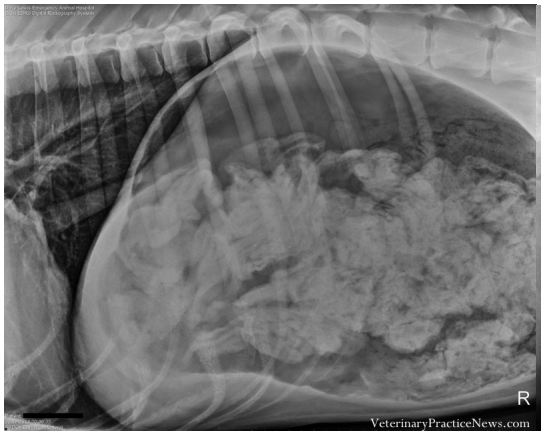


Figure 18: gastric foreign body

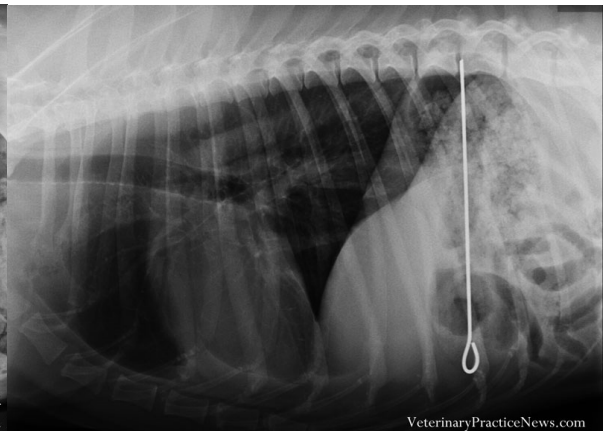


Figure 19: gastric foreign body

3

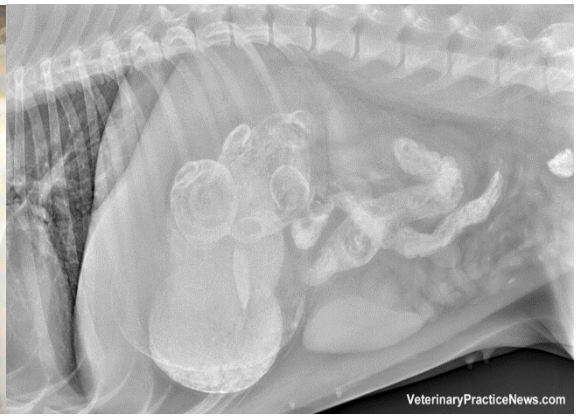


Figure 20: gastric foreign body

Figuer 21:gastric foreign

Figure 22: contrast in small bowel

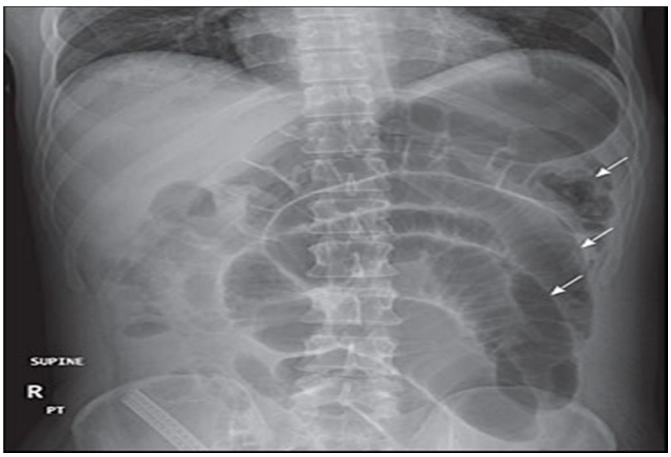


Figure 23: intestinal obstruction

Figure 24: Intestinal volvulus

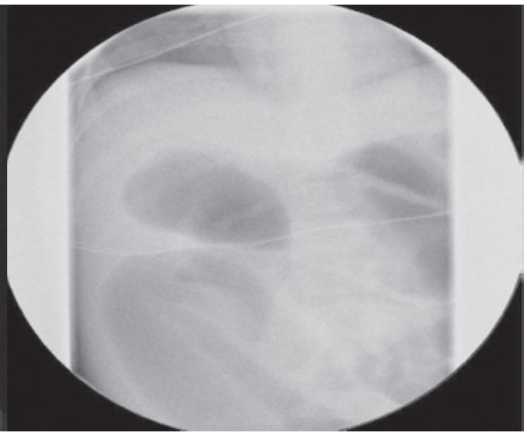


Figure 25: intestinal intussusception

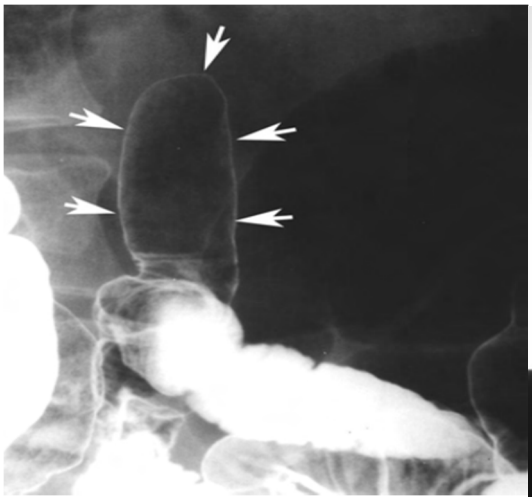


Figure26: Intestinal diverticulum

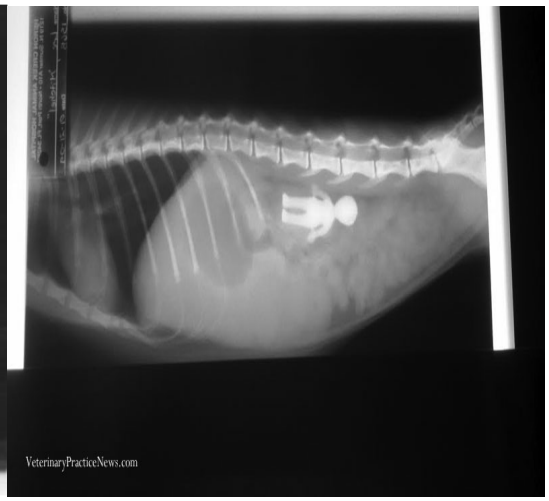


Figure 27: intestinal foreign body

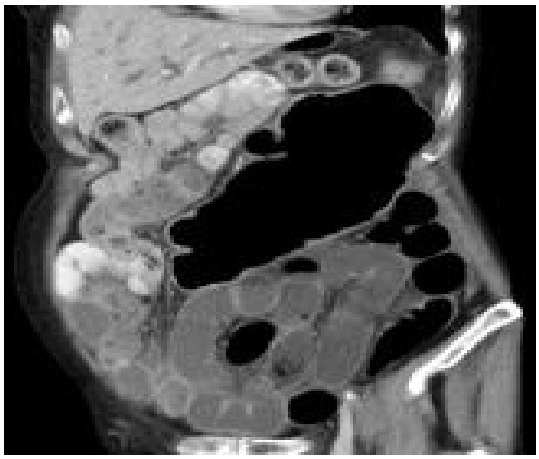


Figure28: large bowel foreign body

Figure29;normal colon

Figure 30: megacolon

Figure 31: large bowel foreign body

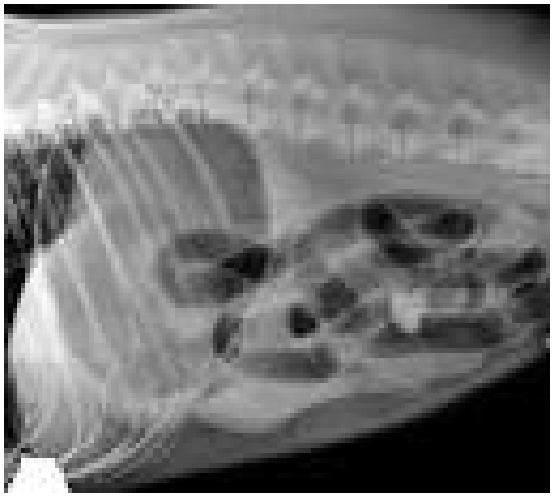


Figure 32: large bowel obstruction

Figure 33: large bowel torsion

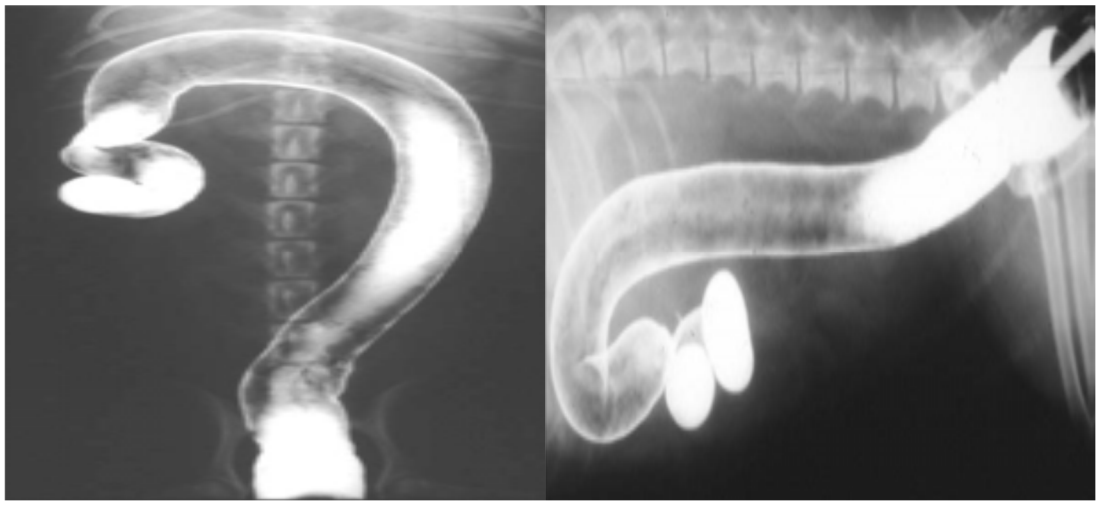


Figure 34: Normal double contrast barium enema

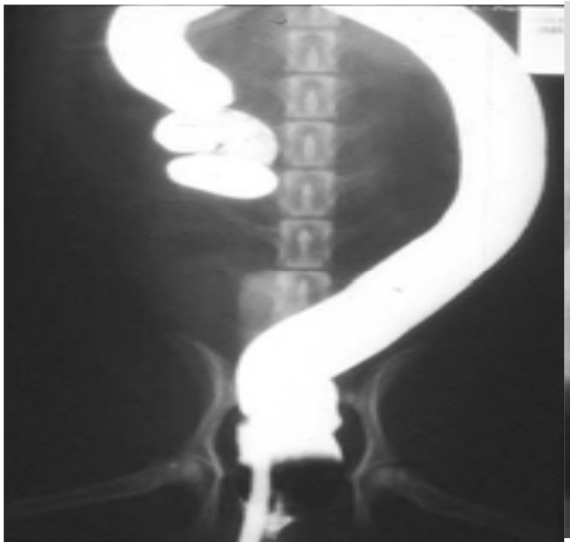


Figure 35: normal barium enema

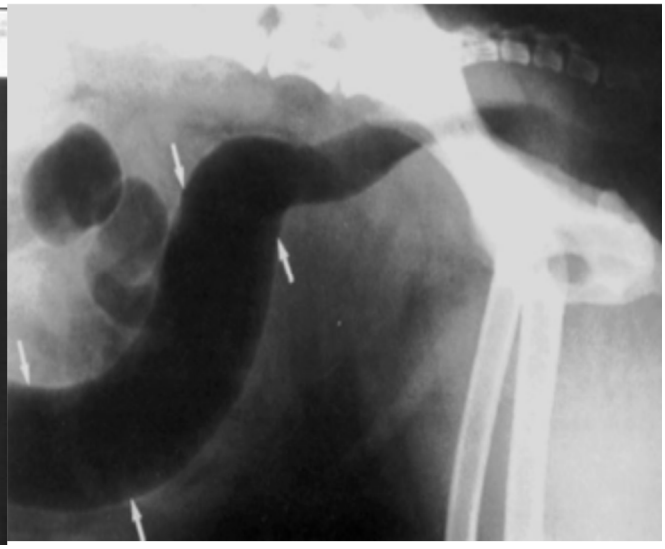


Figure 36: pneumocolon

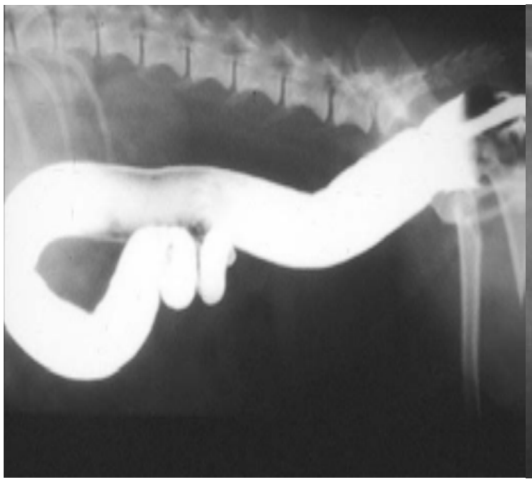


Figure 37: Colonic Intussusceptions (intraluminar)

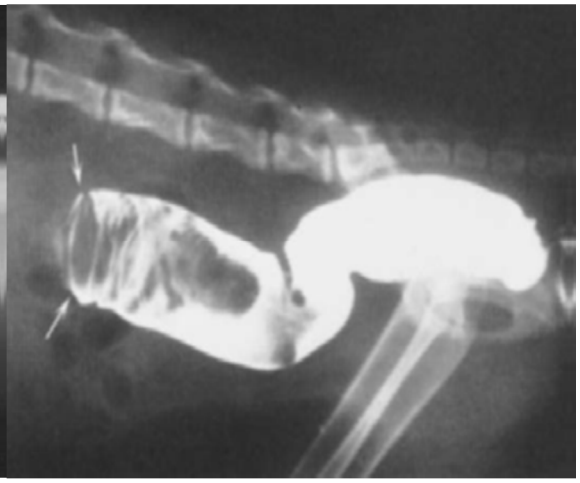


Figure38 : Normal barium enema

Discussion, conclusion and recommendation

The application of radiographic studies become very important for diagnosis of disease of the small animal (costaneto et al, 2006).

Important of the thesis derived from these applications aim to create diagnostic protocol based on complementary imaging methods for testing definitive diagnosis for GIT disorders. diagnosis of digestive disorders can be depend on the stage of development by using diagnostic imaging methods which have advantages and disadvantages.

Esophageal disease maybe characterized by focal or diffuse involvement. Diffuse disease usually result in megaesophagus characterized by generalized dysfunction but megaesophagus may also occur with obstruction of the terminal esophagus from a few focal causes.The absence of abnormal esophageal radiographic findings does not preclude the presence of esophageal disease, such findings are often encountered with acute esophageal disease.

Increase the size of the stomach and intestine achieved by evaluation of a partial thickness of the abdomen and easily to detected by using radiographic scanning.The presence of the foreign body and tumor observed by characteristic radiological appearance represented from the gas when using contrast agent .

The occurrence of the preneal hernia is frequent in the routine small animal. The patients that were subjected only to preneal herniorrhaphy

and exhibit rectal abnormality is also common. The clinical examination and radiographic studies is extremely important for precise diagnosis in case of large bowel diagnosis the use of the cuffed catheter is the most important to prevent straining (Bojrab and toomy, 1981). It could be concluded that

1_the radiographic is the most impotance tool for diagnosis of diseases of small animals

2_is the most information about specific causes of gastro intestinal diseases in dogs.

3_the barium contrast is wild use in veterinary practice than CT and MRI

A_ Owners and farmers must be going there animals when suspect disease to veterinary radiographic earlier

B_ Veterinarain don't hesitate for using x ray for diagnosis of abdominal disorders

c- Very important to conduct veterinary radiographic to student and veterinary collage

Chapter six

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