

## **An introduction to the Gastro Intestinal Tract for Student Radiographers**

Details of the projections mentioned can be found in a selection of text including the latest edition of Clark's Positioning in Radiography that should be the standard for techniques.

Further information can be obtained in the following texts:

A guide to Radiological Procedures by Chapman & Nakielny.

Introduction to Pathology by Prime.

Radiographic Positioning and Related Anatomy. by Bontrager

Contrast Media literature from suppliers.

Hospital Drug Administration Policy Document

***These notes are to serve only as an introductory guide,***

***Departmental and even Radiologists preferences must be understood and adhered to at all times.***

### ***An A-Z of the gastrointestinal tract:***

ANAEMIA caused by bone-marrow failure include aplastic anaemia, in which the bone marrow lacks adequate numbers of some or all types of blood cells. Another classical anaemia caused by failure of production is pernicious anaemia. In this disease, the person's stomach fails to produce "intrinsic factor," which is necessary for the normal absorption of vitamin B-12 from the intestines. Because vitamin B-12 is essential for normal bone marrow function, red cells are not formed normally.

ANTACIDS are substances that reduce the degree of acidity in the stomach and upper digestive tract. They are among the most commonly used non prescription drugs and are taken by persons feeling the distress of acid indigestion, sour stomach, and the oesophageal pain known as heartburn. In strong doses, many of the same chemicals are used by physicians in the treatment of peptic ULCER.

CIMETIDINE (trade name Tagamet) is a drug used primarily to treat gastrointestinal disorders, as well as peptic ulcers. Gastric acid secretion in the stomach is regulated by the chemical histamine, which stimulates the histamine receptor. Excess secretion of acid is caused by over stimulation of the receptor sites and leads to ulcers in the stomach and small intestines. Cimetidine blocks the receptors, reducing the histamine effects, and allows peptic ulcers to heal

COLIC {kah'-lik} Colic is an acute pain resulting from an irritation in organs such as the stomach, intestines, gallbladder, and the ureter duct. It commonly strikes infants who eat too rapidly and swallow air. It also results from emotional stress and overeating and can be a symptom of appendicitis, passage of a gallstone or kidney stone, bowel or ureter obstruction, or lead or zinc poisoning. Treatment, directed at the cause of the irritation, may include pain relievers

DIETARY FIBRE Dietary fibre, also known as bulk and roughage, is also an essential element in the diet even though it provides no nutrients. It consists of plant CELLULOSE and other indigestible materials in foods, along with PECTINS and gums. The chewing it requires stimulates saliva flow, and the bulk it adds in the stomach and intestines during digestion provides more time for absorption of nutrients. Diets with sufficient fibre produce softer, bulkier stools and help to promote bowel regularity and avoid constipation and other disorders, such as DIVERTICULOSIS. Fruits, vegetables, whole-grain breads, and products made from nuts and legumes are all sources of dietary fibre (see BRAN). A diet overly abundant in dietary fibre, however, can cut down on the absorption of important trace minerals during digestion.

DISEASES of the gastrointestinal tract Discomfort and other symptoms related to the gastrointestinal tract are among the most common of patient complaints. Often they are of no serious medical significance. Sometimes, however, they may be the first signs of

serious illness. The gastrointestinal tract is a long tube surrounded by smooth muscle extending from the mouth to the anus. Its main function is the digestion and absorption of nutrients, water, and electrolytes, as well as the elimination of waste. Gastrointestinal diseases may occur at any point (see DIGESTION, HUMAN), and may be caused by infections, immunological diseases, cancer, or disturbances in motility (the regular muscle contractions of the small intestine), and may include symptoms such as CONSTIPATION or DIARRHOEA.

**Oesophagus** The oesophagus is a straight tube approximately 20 cm (7.9 in) long in humans, that propels food from the mouth to the stomach by means of muscular contractions. The lower oesophageal sphincter (LES) at the level of the diaphragm causes muscular contraction of the oesophagus to prevent reflux, or back movement, of stomach contents. Heartburn often occurs when the LES relaxes or is weak, allowing acid reflux back into the oesophagus. This may occur in association with a HERNIA above the stomach, which is caused by a widening of the hole in the diaphragm. Chest pain may be caused by acid reflux or oesophageal spasm and may sometimes be difficult to distinguish from the pain of a HEART ATTACK. Dysphagia (difficulty in swallowing) or odynophagia (painful swallowing) may be due to the narrowing of the oesophagus by tumours or scars caused by acid reflux. **Stomach** The stomach is a storage and digestive organ, secreting hydrochloric acid and pepsin to begin the process of digestion. It is lined by a natural barrier that protects it from damage by the acid. Disruption of this protective barrier may cause inflammation (GASTRITIS) or ulcers. Symptoms of gastric diseases include upper mid abdominal pain, bloating, nausea, or vomiting. These are also symptoms of stomach cancer, one of the leading killers world-wide, although less common in the United States. If caught early, treatment involves removing the cancerous portion of the stomach. Motility disorders of the stomach have recently been recognised as a common cause of INDIGESTION, known as dyspepsia. The stomach also produces intrinsic factor, a protein necessary for the absorption of vitamin B12. In pernicious ANAEMIA, degeneration of the gastric lining causes the loss of intrinsic factor, resulting in vitamin B12 deficiency. **Small Intestine** The small intestine is about 3.6 m (12 ft) long, divided into the duodenum, jejunum, and ileum. It is the primary site of food digestion and absorption. The entire length of the intestine is lined by finger like microscopic projections called villi, which combine with the many intestinal folds and its great length to provide a large surface area for food absorption. Malabsorption results from loss of absorptive surface area due to surgical removal of the bowel (resection), creating short bowel syndrome, or damage to the villi, from such procedures as chemotherapy or radiation therapy. The duodenum comprises the first 26.4 cm (10.4 in) of the small intestine.

Pancreatic juice and bile, secreted by the liver, enter the small intestine and begin the many enzymic digestive reactions that will allow absorption of food nutrients. The duodenal mucosa, or inner lining, is sensitive to damage from gastric acid, which may cause ulcers,

especially if there is acid overproduction due to stress, smoking, or an inherited predisposition. Aspirin and alcohol may also contribute to duodenal ulceration; other dietary factors seem to be of minimal importance. A duodenal ulcer may be asymptomatic or may cause minor symptoms such as belching, dyspepsia, or mild epigastric discomfort. These symptoms occur most commonly at night and are relieved by food or antacids. Ulcers (see ULCER) may also cause life-threatening complications, such as bleeding and severe pain,

**DUODENUM** In mammals, the duodenum is the portion of the small **INTESTINE** between the stomach and the jejunum, or middle portion of the small intestine. It serves to digest further the food passed from the stomach; it also, like the rest of the small intestine, absorbs food through its lining into the bloodstream and lymphatic system (see **DIGESTION, HUMAN**). Passage of food into the duodenum is regulated by the pyloric sphincter, a ring of muscle. The bile duct carries bile from the liver and gall bladder to aid in fat emulsification and nutrient absorption. The pancreatic duct carries enzymes from the pancreas for protein, starch, and fat digestion. The wall of the duodenum consists of four layers. The innermost, the mucosa, is an absorptive surface lined with finger like projections (villi). The other layers are those of connective tissue (submucosa), muscle, and thin membrane (serosa).

**EMETIC** {uh-met'-ik} Emetics are substances administered to induce **VOMITING** and are most commonly used in cases of poisoning by some orally ingested compounds. Emetics that produce their effect by acting upon the medulla, such as apomorphine, tartar emetic, ipecacuanha, senega, and squill, are called central emetics. Tartar emetic (antimony potassium tartrate) and ipecacuanha can be called gastric emetics, that is, emetics that act upon the stomach itself. Other gastric emetics are alum (aluminium potassium sulphate), ammonium carbonate, common salt, and warm water

The **OESOPHAGUS** is part of the alimentary canal. It is a muscular tube that begins at the inferior end of the laryngopharynx and passes between the trachea and the vertebral column until it penetrates the diaphragm, at which point it joins the cardiac portion of the stomach. The oesophagus is about 23-25 cm (9-10 in) long and 25-30 mm (0.98-1.2 in) wide. The primary function of the oesophagus is to transport food from the pharynx to the stomach (see **DIGESTION, HUMAN**). The movement of food through the oesophagus is aided by rhythmic and co-ordinated contractions of its muscular walls. This process is known as peristalsis. At the terminal end of the oesophagus, a sphincter allows the swallowed material to enter the stomach. After the food passes into the stomach, the sphincter closes. Failure of the sphincter to close results in gastric reflux and the symptoms of heartburn.

**GASTRITIS** is an inflammation of the stomach lining that can be caused by many factors, including irritation by agents such as drugs, alcohol, and corrosive chemicals; bacterial and viral infections; and allergies. The symptoms of acute gastritis include discomfort after

eating, nausea, vomiting, and loss of appetite; they usually subside after identifying and dealing with the causative agent. Chronic gastritis, however, is more commonly the sign of some underlying disorder such as gastric or duodenal ULCERS, iron deficiency ANAEMIA, or other diseases that involve the stomach. Atrophic gastritis, which involves the degeneration of the stomach lining, is most often observed in older persons, including those with pernicious anaemia.

HEARTBURN is a mild to severe burning pain in the upper abdomen or beneath the breastbone. It usually results from spasms of the oesophagus or the regurgitation into the oesophagus of the stomach contents, the gastric-acid levels of which cause irritation. Heartburn typically occurs after meals, often after those containing fatty foods, or when a person is lying down. Occasional heartburn may be treated with antacids. Persistent or severe heartburn may be associated with a disorder of the lower oesophageal sphincter, which normally prevents stomach contents from entering the oesophagus, or with hiatus hernia, a protrusion of part of the stomach through a weak spot in the diaphragm. Spasms of the heart may cause pain sometimes mistaken for simple heartburn.

HERNIA {hur'-nee-uh} A protrusion of all or part of an organ or tissue through an abnormal opening is termed a hernia. It can be present at birth or it can occur when heavy strain is placed on a structurally weak point, for example, where blood vessels or ducts connect with a body cavity, as in the lower abdomen. Hernias occur in the groin (inguinal region) more frequently than in any other region. Congenital, or indirect, hernias occur due to incomplete closure of the inguinal canal following the descent of the testicle through the abdominal wall (in utero) into the scrotum. Other hernias occur in the upper midline of the abdomen and through operative incisions that were poorly done or not completely healed. The stomach commonly herniates through the diaphragm adjacent to the point at which the oesophagus passes through it. This condition is called a hiatus hernia. A hernia is said to be reducible if it can be returned to its normal position, incarcerated if it cannot, and strangulated if it has lost its blood supply.

Medical attention must be given to strangulated hernias, or gangrene could result. Often a small hernia will only protrude under strain, and a pad can be worn to control it. Mild hernias may enlarge; thus surgery is recommended.

INDIGESTION, or dyspepsia, commonly refers to general abdominal discomfort during and after meals and may be the result of specific diseases of the stomach or the intestines. The most frequently occurring symptoms are diarrhoea, heartburn, abdominal cramps and pain, gas distress, and nausea. Some common causes of indigestion in the stomach include swallowing air in large amounts and ulcers. In the intestine, indigestion can arise from colitis, viral or bacterial infections, and chronic inflammation. Other causes include gallstones, malignant growths, and emotional tension. A physician should be consulted when the indigestion is persistent.

The INTESTINE is the part of the DIGESTIVE SYSTEM in vertebrates that extends from the stomach to the anus and is divided into distinctive sections for handling the processes of digestion and absorption of food and the elimination of waste. In the adult human the intestine is divided into the small and large intestines. The small intestine is a tightly coiled, hollow tube about 5 m (16.4 ft) in length and made up of the DUODENUM, the JEJUNUM and the ILEUM, in that order. The large intestine, which is also a coiled tube, is joined to the ileum at a region called the CECUM, is about 1.5 m (5 ft) in length, and consists of the COLON and RECTUM. The length and internal features of intestines are adaptations that provide extensive surface areas for efficiently digesting foods and absorbing the products. Some organisms, notably teleost (bony) fish, have numerous supplementary sacs known as ceca, and sharks and a few other fish possess a so-called spiral valve, which is a membranous sheet traversing the intestine. In most land vertebrates, however, the surface of the small intestine is supplemented by elevations of its lining, or mucous membrane, to form finger like folds called VILLI. Small Intestine The duodenum in mammals is notable for its role in the ENDOCRINE SYSTEM because it produces such HORMONES as the following: cholecystokinin, which causes the GALLBLADDER to release bile, a substance that aids in the digestion of fat; secretin, which stimulates the PANCREAS to release digestive enzymes; and enterogastrone, which inhibits the secretion of hydrochloric acid by the STOMACH after the stomach contents have passed into the duodenum. At the end of the cecum is a small dead-end structure called the APPENDIX. In such animals as the horse and cow, which subsist solely on grasses and other plants, the cecum is large and an important site for the digestion of tough plant fibres by its specialised bacterial population. In humans the cecum and appendix have no important function. The intestine is surrounded by layers of smooth muscle, a circular layer on the inside and a longitudinal layer on the outside. The contractions of the various muscles propel the contents of the intestine from one segment to the next, sometimes delaying movement to enhance the digestive or absorptive processes. The small intestine is the site of digestion and absorption of nutrients and retention of waste materials. Very few digestible substances reach the large intestine. Large Intestine The COLON performs the vital function of absorbing water and salts from the undigested residues and passing them into the bloodstream so that they are not lost through the anus. A too rapid passage of material through the colon does not permit adequate absorption of water and results in DIARRHOEA. If unchecked, diarrhoea leads to dehydration and loss of salts that can be fatal, especially in infants. An unusually slow passage through the large intestine, on the other hand, may lead to excessive removal of water and cause CONSTIPATION, which is characterised by a hard mass of undigested residues. The normal bowel movement, or defecation, begins with the stimulation by faeces of sensory nerve receptors in the rectum. The nerve receptors trigger a complex reflex action, which results in relaxation of the sphincter muscles at the junction of the rectum and anus, allowing defecation unless a conscious effort is made to override the reflex.

**POLYP** (medicine) {pah'-lip} In medicine, a polyp is a tumour that usually occurs on mucous membranes and is characteristically attached to underlying tissues by means of a stalk. It thus resembles somewhat the animal known as a polyp. Medical polyps typically occur in the nose, the stomach, large intestine, bladder, and uterus. They can be malignant or benign.

**PANCREATITIS** {pan-kree-uh-ty'-tis} Pancreatitis is an acute or chronic inflammation of the pancreas. It is associated with alcoholism, such biliary-tract disorders as gallstones, such infections as the mumps, certain drugs, and such traumas as surgery. The underlying problem usually concerns the digestive enzymes that, instead of being secreted into the stomach, seep into pancreatic tissue and cause irritation, subsequent swelling, and eventual pancreatic-cell death. Symptoms of the acute form of pancreatitis include severe abdominal pain, fever, and shock; those of the chronic form include occasional or persistent pain and eventual diabetes mellitus. In either form, the victim experiences nausea and vomiting. Treatment includes alleviating the symptoms, especially pain and shock, and preventing possible infection through the use of antibiotics.

**PERISTALSIS** {per-i-stal'-sis} Peristalsis is one of several types of patterns of movement associated with the gastrointestinal tract. It can be described as a moving, co-ordinated wave of muscular contraction that is propulsive in nature, forcing the contents of the digestive tract ahead of it. Peristalsis occurs most frequently in the oesophagus, where it is stimulated by a swallow (primary peristalsis) and moves the entire length of the oesophagus to the stomach. A peristaltic wave may also occur in the absence of a swallow (secondary peristalsis). A secondary peristalsis is elicited when the oesophagus is distended—if the primary wave fails to clear the oesophagus of food, or if gastric contents reflux into the oesophagus. Peristaltic waves also occur in the small intestine but rarely travel more than 4 cm (1.6 in). In the large intestine peristalsis is responsible for the two or three mass movements that occur daily. Peristalsis is controlled largely by central and local nerves.

**PNEUMONIA** {noo-mohn'-yuh} Pneumonia is an inflammation of the LUNGS caused by a wide variety of agents, including viruses, bacteria, micro-organisms known as Mycoplasma and Rickettsia, and fungi. Inflammation also occurs with the inhalation of various dusts or gases and with the aspiration of food or stomach acid as a result of vomiting during an unconscious state. The pathological process consists of irritation of lung tissue. The walls of air sacs (alveoli) swell or are destroyed, and plasma, red blood cells, and white blood cells from lung capillaries fill the alveolar spaces. The portion of the lung involved becomes relatively solid and basically is rendered temporarily non-functional. Typical symptoms include fever, chills, cough, chest pain (pleurisy), increased production of sputum, sweating, aching, expectoration of blood, and difficulty in breathing.

The **SPLEEN**, the largest organ of the **LYMPHATIC SYSTEM**, is closely associated with the circulatory system. It is located below the diaphragm, behind and to the left of the stomach. The spleen is a richly vascular organ and has a great number of lymphocytes and

reticuloendothelial cells, necessary for filtration of cell waste products and worn-out red BLOOD cells as well as for the manufacture of antibodies and certain blood cells. It varies in size and weight according to the amount of blood it contains in storage and its immune functions.

TRICHINOSIS (or trichiniasis), a parasitic disease caused by the roundworm *Trichinella Spiralis*, usually results from eating infected pork products that are raw or undercooked. World-wide in occurrence, it is most prevalent in much of Europe and throughout the United States. Adult worms live in the lining of the small intestines of pigs, leaving encysted larvae (trichinae) in the intestinal wall. When ingested by humans, the larvae encyst in the stomach, burrow into the intestinal wall, and mature and mate within 3 or 4 days. One adult female worm can produce 1,000 living larvae in 6 weeks. Larvae are carried by the bloodstream to all parts of the body, but the only survivors are those reaching skeletal muscle, particularly the tongue, diaphragm, and pectoral and eye muscles. They invade individual fibres, coil up, and encyst. Encysted larvae may survive for up to 30 years. Gastrointestinal symptoms develop within 1 or 2 days after pork ingestion; fever, nausea, muscular soreness, oedema, and eosinophilia occur in 1 to 2 weeks. Symptoms subside in 3 months, after encystment. Trichinosis is prevented through proper cooking and by not feeding hogs infected pork wastes.

An ULCER is a pitting of a mucous or skin surface, that results from an erosion or disintegration of the tissues. Ulcers of the gastrointestinal tract, called PEPTIC ULCERS, are relatively common and are thought to occur in 1 to 20 percent of the population in developed countries. Peptic Ulcers. Peptic ulcers occur most commonly in the duodenum near the junction with the stomach and in the stomach wall. They usually occur singly as round or oval lesions. The erosions are usually shallow but can penetrate the entire wall, leading to haemorrhage and possibly death. Pain, the predominant symptom, occurs one to three hours after a meal and is usually relieved with alkalis. Although the cause of such ulcers is not established, researchers have found a link between infection of the stomach lining by *Helicobacter pylori* bacteria and ulcers. Some ulcers have also been linked with the use of the anti arthritis drugs called N.S.A.I.D.S. At any rate, when gastric juices (consisting of hydrochloric acid, mucus, and a digestive enzyme called pepsin) act upon the walls of the digestive tract, a peptic ulcer results. The fact that ulcers of the duodenum are frequently associated with excess secretion of gastric acid and that ulcers of the stomach are not suggests that the two lesions may be separate disease entities. Entry of acid-peptic contents from the stomach into the lower oesophagus can also cause ulcers in this area. Peptic ulcers tend to become chronic. Stress Ulcers. The so-called stress ulcer differs from peptic ulcers in their cause and characteristics. They usually occur in the stomach and are seen as multiple, shallow, bleeding erosions. Although stress ulcers tend to heal rapidly because of their shallowness, they can perforate and cause severe bleeding. They tend to cause less pain than the peptic ulcer. The term stress has led to

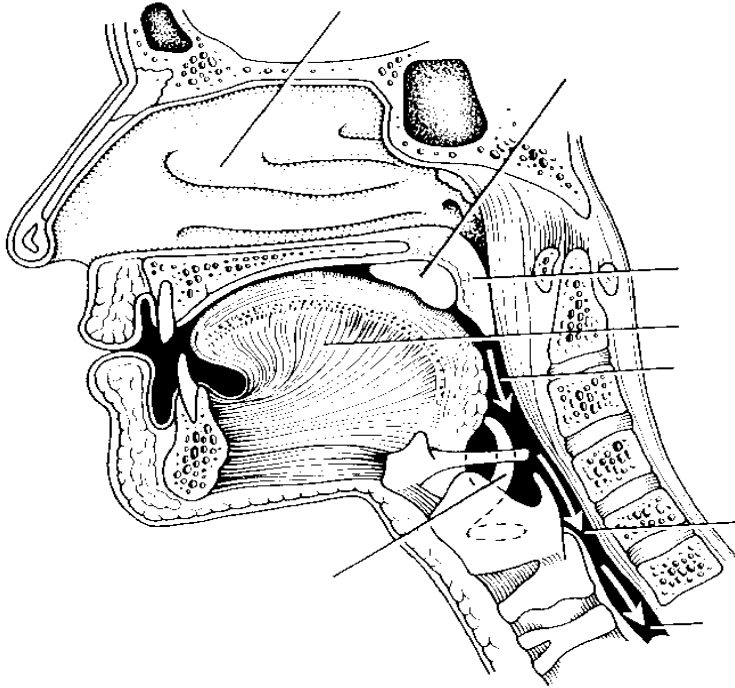
misconceptions about the role of psychological factors in the development of ulcers. These stress ulcers occur most often in patients who have been subjected to marked physical injury such as severe trauma, burns (resulting in Curling's ulcer), or major surgery, and are more common in elderly or debilitated patients. Stress ulcers that occur because of central nervous system disease are called Cushing's ulcers. The "chronic peptic ulcer" seems to be more related to psychological factors than are "stress ulcers," discussed below, but no identifiable psychological injuries have been reported, and they are not more common in "executive types." The chronic peptic ulcer develops when there is imbalance between the normal "aggressive" factors, the acid-peptic secretions, and the normal "resistance" factors such as mucous secretions and rapid cellular replacement. Psychological influences may alter these factors through cerebral reactions altering lower brainstem function, with the resultant vagal nervous stimulation directly affecting the stomach and duodenum. Treatment Ulcers, whether chronic or stress, are usually treated by medical therapy alone. The drugs most commonly used are alkaline buffering agents and a special class of antihistamine called cimetidine, which blocks the histamine-2 receptors in the stomach that regulate gastric secretion.

Newer drugs and drugs under development include sucrasulfate, prostaglandin compounds, and anticholinergic agents that inhibit acid secretion. The latter include omeprazol, ranitidine, and pirenzepine, which exerts antipepsin and antigastrin activity as well. Carbenoxolone, which increases mucus secretion, and colloidal bismuth, an antipeptic, have also been used. To eradicate *H. pylori*, a three-drug regime is used, including colloidal bismuth, antibiotics, and metronidazole.

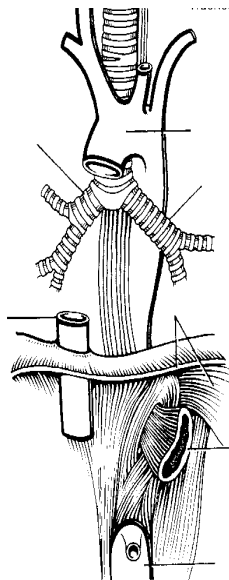
VITAMIN B-12 is present mainly in the liver, the kidneys, and the heart. In nature the source is believed to be solely that synthesised by micro-organisms. The ability to absorb this vitamin depends on the production by the stomach of an intrinsic factor, a glycoprotein; cases of B-12 deficiency often involve patients with defective production of an intrinsic factor. The symptoms of deficiency are identical to the classical syndrome of pernicious anaemia: ineffective manufacture of red blood cells; faulty myelin synthesis, leading to a paralysing neuritis; and a failure to maintain the epithelium of the intestinal tract. Marked anaemia and generalised debility eventually develop, which are always fatal unless treated. Cyanocobalamin has only one established use, the treatment of this deficiency disease, but it is included nevertheless in many multivitamin preparations.

**Basic Anatomy:**

**Saggital section Oral Cavity (For You to Label)**

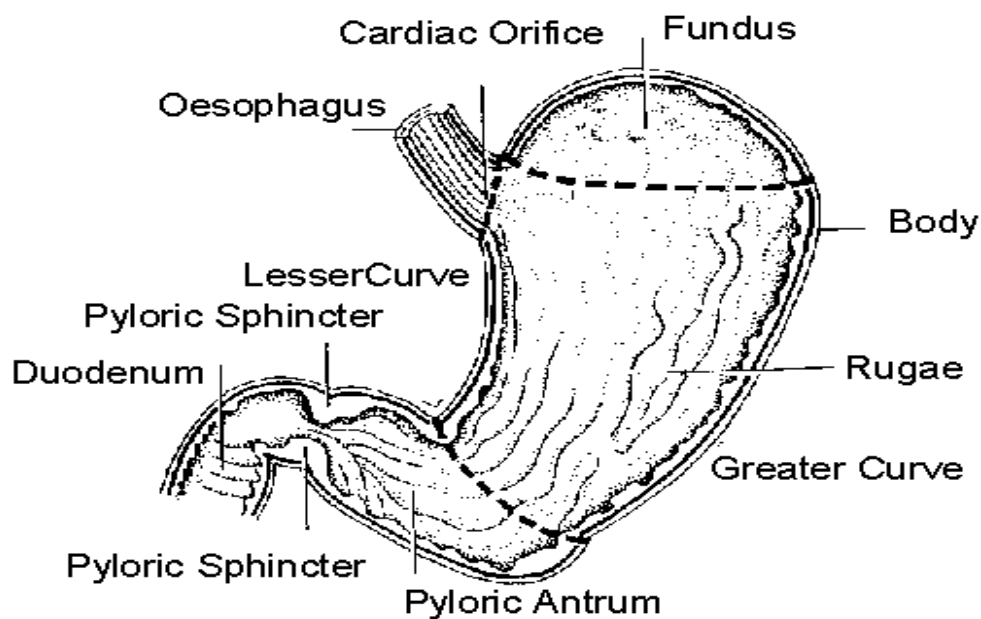


**Relations of the Oesophagus (For you to Label)**

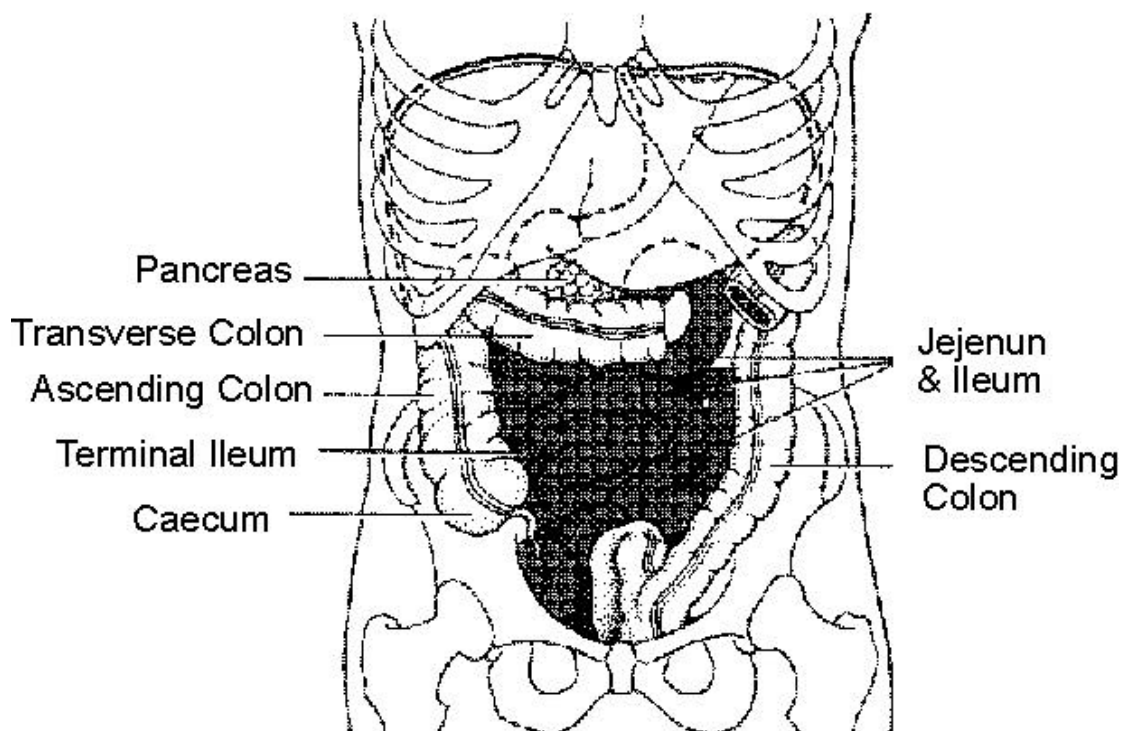


**Basic Anatomy, cont.**

Longitudinal stomach section.



**Diagram of the Positions of The large and small bowel.**



***Indications for Contrast Media studies of the Gastrointestinal Tract:***

Indications for contrast media radiographic and radiological examinations will be considered by examination,

**Barium Swallow,**

Dysphasia.

Pain,

Assessment of tracheo-oesophageal fistula

Assessment of left ventricular enlargement

Pre-operative assessment of Carcinoma of the bronchus.

Assessment of perforation site.

**Barium Meal,**

Dyspepsia.

Weight loss,

Upper abdominal mass.

Gastrointestinal haemorrhage, unexplained iron deficiency anaemia.

Partial obstruction

**Small Bowel Meal / Barium Follow Through.**

Pain,

Diarrhoea,

Bleeding,

Partial obstruction.

**Barium enema,**

Change in bowel habit.

Pain.

Palpable mass.

Melaena

## ***Diseases of the digestive system, investigated using 'Barium' studies.***

### **Barium swallow,**

Oesophageal atresia, a blind ending oesophagus in the new-born, often associated with tracheo-oesophageal fistula.

Acute oesophagitis, inflammation of the oesophagus may be due to infection or the swallowing of corrosive substances.

Chronic oesophagitis, inflammation of the oesophagus may be due to reflux from the stomach or may result from heavy alcohol intake.

Hiatus Hernia, the hernia develops due to an abnormality in the hiatus of the diaphragm that allows part of the stomach to herniate up into the chest.

Achalasia of the cardia, a failure of the cardiac sphincter of the stomach to open enough for the contents of the oesophagus to drain readily.

Diverticula of the oesophagus, small localised weakness points in the wall of the oesophagus producing small protrusions that may become infected or even perforate.

Varices, dilation of the venous plexus of the oesophagus due to portal hypertension in liver disease, which becomes life threatening if rupture of the dilated varices occurs, a tamponade using a 'Celestion' tube or similar is required to compress and seal of the bleeding varices.

Oesophageal obstruction, from swallowed foreign bodies, local carcinoma or metastases or external compression by lymph node enlargement.

### **Barium meal,**

Pyloric stenosis, a severe narrowing of the pyloric sphincter, with a thickening around the sphincter due to hypertrophy of the muscles of the sphincter, most often seen in babies at around 4 - 6 weeks.

Peptic ulcer, an ulcer occurring in the oesophagus, stomach and or first part of the duodenum due to the action of the digestive secretions on unprotected mucosa.

Most often found in the first part of the duodenum and the lesser curve of the stomach.

Perforation, usually occur as a result of ulceration or diverticula and can occur along the whole length of the alimentary canal.

Haemorrhage, frequently occurs at the site of ulceration.

Tumours, mainly benign tumours such as lipoma and fibromas are found in the stomach.

Malignant tumours, mainly adenocarcinomas and found predominantly on the lesser curve and the pyloric and cardiac regions.

Polyps, are outgrowths of the mucosal lining and may become malignant.

Carcinoma of the head of pancreas will cause classic enlargement of the diameter of the first part of the duodenum.

**Barium meal with follow through, small bowel enema,**

Hirschprung's disease, a failure of the nervous system that results in a permanently contracted portion of bowel that may be a cause of obstruction.

Inflammation, other causes of inflammation include Tuberculosis, parasite e.g. Schistosomiasis, Typhoid and bacterial infections (food poisoning), e.g. Salmonella.

Malabsorption, the small intestine is responsible for the absorption of fats vitamins water and electrolytes. Conditions causing inflammation and impaired nutrient absorption may be investigated using 'barium' contrast studies.

Coeliac disease is an example of mal-absorption, where the gut wall produces an allergic reaction to gluten found in flour and other cereals.

Mekel's diverticulum, a remnant of embryonic omphalomesenteric duct lined with gastric mucosa rather than normal small bowel mucosa usually located in the distal 100cm of the ileum, which causes pain.

## **Barium Enema**

Megacolon, congenital megacolon causes the colon to be grossly distended and subject to faecal compaction.

Crohn's disease, is regional enteritis with recurrent periods of severe inflammation followed by periods of calm, the inflamed bowel becomes delicate and friable and may tear easily. On barium studies the bowel may appear to be narrowed due to the localised oedema and normal mucosal pattern may disappear in the inflamed region. Repeated inflammation may give a characteristic cobble-stone appearance, and repeated inflammation may produce characteristic 'rose thorn' deep ulceration patterns.

Intussusception, this is the invagination of a portion of bowel into the lumen of the bowel, most commonly the ileum invaginating into a portion of colon.

Volvulus, is a twist in the bowel that obstructs the bowel, rather as making a loop pulling the ends apart reducing the radius until obstruction occurs.

## **Diseases of the digestive system, investigated using 'Barium' studies cont.**

Paralytic Ileus, is the obstruction of bowel due to an impairment in the nerve supply such occurs in Hirschprung's disease but also occurs post operatively and due to malignancy.

Herniation, of the bowel through the inguinal ligament or the diaphragm may cause strangulation and or obstruction and necrosis.

Ulcerative colitis, this is an inflammatory bowel disease of unknown origin, confined to the colon. It affects all age groups. The disease starts in the rectum and affects variable lengths of the colon. Widespread inflammation and ulceration of the bowel wall are seen.

Diverticula disease, is caused by weakness in the colonic musculature, allowing the mucosa to herniate throughout the wall of the bowel, this is most frequently found in the sigmoid colon.

Tumours of the colon can occur at any point but are common in the sigmoid and recto-sigmoid region producing an 'apple core' appearance to the contrast filled bowel.

**Barium Sulphate based Contrast Media Examples.**

Barium sulphate suspension consists of barium sulphate with a particle size of around 0.1 - 3.0 µm in a non ionic suspension medium with a pH of 5.3. These later two properties ensures the barium remains in suspension and does not 'clump' in the presence of the acid in the stomach. The compounds may contain dimethicone, sorbitol or one of its derivatives to prevent foaming and increase its coating properties. The oral media may containing flavouring agents to make them more palatable.

Propriety Name	Density % weight/volume
	Barium Sulphate Based agents
Baritop 100	100
Baritop G powder	150
Barosphere	110
EPI-C	150
E-Z Paque	170
E-Z HD	250
Micropaque Liquid	100
Microtrast Paste	70
X-Opaque	216
Water Soluble Contrast Agents	Iodine Concentration mg/ml
Gastro-Miro Sodium Iothalamate 60%	360
Gastrograffin Sodium + Megluamin Diatrizoate	370

## **Additional Drugs that may be used during barium studies.**

Buscopan

Hyoscine-N-butyl bromide

### **Action**

Smooth muscle relaxant

Rapid onset of action but effective for only 15 minutes

Typical Adult dosage

20 mg Intravenously.

### **Function**

Reduced peristaltic action during examination.

Side Effects

Blurred vision, urinary retention, acute gastric dilation, tachycardia.

Contra-Indications

Glaucoma, Cardiovascular disease

## **Glucagon**

Glucagon Nova

### **Action**

Smooth muscle relaxant

Typical Adult dosage

0.3mg - 1.0 mg Intravenously

### **Function**

Smooth muscle relaxant, more effective than Buscopan, and not contra indicated in glaucoma

### **Side Effects**

Possible hypersensitivity as it is a protein.

### **Contra-Indications**

Use with care in diabetics,

More expensive than Buscopan.

Additional Drugs that may be used during barium studies. cont.

**Maxalon**

Metaclopramide

**Action**

Increases gastric peristalsis

Typical Adult dosage

20 mg oral or Intravenously

**Function**

Reduces gut transit times in small bowel studies.

**Side Effects**

Extra pyramidal reactions.

Drowsiness, fatigue

**Contra-Indications**

Phaeochromocytoma, recent bowel surgery.

**Carbex Granules & Liquid.**

Sodium bicarbonate 1.25g and dimethicone 42mg per sachet

Solution of 10% citric acid

**Action**

Releases carbon dioxide gas.

Typical Adult dosage

1 sachet + 10ml liquid

**Function**

To dilate the stomach in double contrast 'barium' studies.

**Baritop effervescent tablet**

Sodium bicarbonate 35mg, tartaric acid 35mg, calcium carbonate 5mg and dimethicone 3mg.

**Action**

Releases carbon dioxide gas.

Typical Adult dosage

20 -30 tablets + 20mls water

## Function

To dilate the stomach in double contrast 'barium' studies.

## Picolax

Sodium Picocosulphate,

## Action

Strong Purgative,

Typical Adult dosage

5 -15 mg dissolved in water 12 to 15 hours before the examination time,

## Function

To clear the bowel of faecal matter before 'barium' enema examination.

Note:All contrast media and drugs given must be recorded in the patients documentation and any side effects noted, with inpatients the ward must be informed of all drugs given. Patients taking medication for any other complaint must have the possibility of drug interactions checked.

## ***Radiographic Equipment Requirements.***

Fluoroscopy table with +90°/-15° Tilt.

Image intensifier with image hold facility, video and replay facility.

Ceiling suspended plain radiographic equipment.

Remote control fluoroscopy equipment can be useful but may be of limited use in debilitated patients particularly the old and very young.

100mm cut or roll spot film device,

Immobilisation and movement assisting handles and grips.

Mattress with wipe clean cover,

Selection of cassettes and grids of various sizes.

Draw a picture of a typical fluoroscopy unit

A 'Typical' Fluoroscopy Unit in the Upright Position

### ***Nursing and 'barium' administration equipment.***

#### **Barium meal, small bowel meal & Swallow**

Trolley with:

Barium solution at body temperature,

Jug of water,

Table-spoon or medicine measure for effervescent tablets and granules,

Disposable drinking cups/feeders/bottles & teats, straws,

Receiver's and vomit bowels,

Needles 21G and 2 - 5 ml syringes for smooth muscle relaxants,

Skin / mouth cleaners,

Sharps box and disposal bag.

Nasogastric tube (Bilbao Dotter tube) and associated equipment, for small bowel enema.

Lignocaine spray and lozenges,

Suction apparatus.

#### **Barium enema**

Drip stand

Trolley with:

Barium solution at body temperature,

Rectal catheters

Lubricant e.g. K.Y. Jelly,

Air bulb syringes e.g. Higginson's syringe,

Gauze swabs,

Disposal bag.

Needles 21G and 2 - 5 ml syringes for smooth muscle relaxants,

Skin / cleaners,

Colonic washout equipment.

## ***Typical Examination regimes.***

### **BARIUM SWALLOW**

Contraindications

Impending surgery

Contrast media

100ml or more of 150% w/v barium sulphate suspension,

Up to 100 ml of 75% w/v barium sulphate suspension for tracheo oesophageal fistula investigation.

For assessment of perforation water soluble contrast media must be used, e.g. Dionasil or Gastromiro.

Patient Preparation

None, but as for barium meal if stomach is also to be examined.

Preliminary film

None.

### **Technique**

1. The patient is in the erect R.A.O. position to throw the oesophagus clear of the spine. An ample mouthful of barium is swallowed, and spot films of the upper and lower oesophagus are taken. Oesophageal varices are best seen in the R.P.O. position, as they will be more distended.

2. If rapid serial radiography is required, it may be performed in the right lateral, R.A.O. and PA positions.

3. To demonstrate a tracheo-oesophageal fistula in infants, a fine nasogastric tube is introduced to the level of mid-oesophagus, and the diluted barium is syringed in to distend the oesophagus. It is important to take lateral radiographs or the fistula may be missed. An n.g. tube is used since infants might reflux into the trachea if swallowing from a bottle.

The use of a n.g. tube bypasses the swallowing mechanism in infants prevents confusion between a fistula and small aspirations.

Aftercare.

Non special.

Complications

1. Barium leakage from an unsuspected perforation.

2. 2. Aspiration.

## **Barium Meal**

### **Contraindications**

Complete large bowel obstruction.

### **Contrast medium**

125ml Barium sulphate suspension 250% w/v

## **Patient Preparation**

Nil by mouth for 6 hr's prior to examination. Smoking should be avoided on the day of the examination since it increases gastric motility. It must be ensured that there are no contraindications to the pharmacological agents used.

### **Preliminary films**

None.

## **Technique**

1. A gas producing agent is swallowed. The requirements of these agents are as follows:-

- a) production of an adequate volume of gas ( 200-400 ml's).
- b) non-interference with barium coating.
- c) no bubble production.
- d) rapid dissolution, leaving no residue.
- e) easily swallowed.
- f) low cost.

Carbex granules and fluid satisfy most of these requirements

2. The patient then drinks the barium whilst lying on his left side, this prevents the barium from reaching the duodenum too quickly and so obscuring the greater curve.

3. The patient then lies supine and slightly on his right side, to bring the barium up against the gastro oesophageal junction, this manoeuvre is 'screened' to check for reflux and the patient is asked to cough to encourage reflux, some centres give water through a straw at this point to further encourage reflux.

Spot films are taken if reflux occurs.

4. An I.V. injection of a smooth muscle relaxant is given.

5. The patient is then asked to roll onto his right side then completely over to fully coat the stomach wall.

Films See A guide to Radiological Procedures.

Aftercare

The patient should be warned his bowel motions will be white for a few days, some centres advise a mild laxative for 48 hr's to encourage the passage of 'barium' and reduce the possibility of impaction.

The patient must not leave the department until the effects of any drugs given have worn off, i.e. the blurred vision sometimes experienced by patients who have been given Buscopan.

#### Complications

Leakage of 'barium' from unsuspected perforation,

Aspiration,

Obstruction,

Barium appendicitis.

Side effects of any other drugs used.

Barium Meal film sequence,

Write up from A guide to Radiological Procedures. (N&C)

## **Barium Follow Through**

### **Contraindications**

Complete obstruction

Suspected perforation

### **Contrast Agents**

300 ml 100% Barium sulphate

### **Patient Preparation**

Laxative abdominal preparation 24 hours before study

Metaclopramide 20 mg 20 minutes before examination

### **Technique**

The aim is to deliver a single column of barium into the small bowel. This is achieved by lying the patient on his right side after barium has been taken orally or by intubation\* of the duodenum to prevent filling of the stomach. Some centres use up to 500ml of cold water following oral barium intake to help maintain the barium column. \*See small bowel enema

### **Films**

Prone PA films of the abdomen are taken every 20 minutes during the first hour and subsequently every thirty minutes until the colon is reached. The prone positioning is used as the pressure on the abdomen helps to keep the loops of small bowel separated.

Spot films may be needed when the barium reaches the terminal ileum, and once again compression is used to displace overlying bowel.

### **Additional films**

Obliques to separate out loops of bowel

20-30 degree caudal angled abdomen

Erect abdomen may help to demonstrate diverticula.

### **Aftercare**

The patient should be warned his bowel motions will be white for a few days, some centres advise a mild laxative for 48 hr's to encourage the passage of 'barium' and reduce the possibility of impaction.

The patient must not leave the department until the effects of any drugs given have worn off, i.e. the blurred vision sometimes experienced by patients who have been given Buscopan.

### **Complications**

Leakage of 'barium from unsuspected perforation,  
Aspiration,  
Obstruction,  
Barium appendicitis.  
Side effects of any other drugs used.

## **Barium Small Bowel Enema / Follow Through**

This procedure gives better demonstration of the small bowel than a traditional barium follow through.

It has the disadvantage of being time consuming, more expensive and has lower patient tolerance.

### **Contraindications**

Complete obstruction,

Suspected perforation unless a water soluble contrast agent is used.

### **Contrast medium**

300 ml (150 ml after barium meal) 100% w/v barium sulphate suspension, diluted with 1000 ml water, this produces better mucosal coating and visualisation of loops of bowel behind anterior sections containing contrast agent.

### **Patient Preparation**

A low residue diet for two days before the examination,

Anti spasmotic drugs must be stopped for one day prior to the examination,

A laxative on the evening before the examination,

Amethocaine (topical local anaesthetic lozenge)

Metaclopramide 20 mg orally 20 minutes before the examination.

Immediately before intubation the pharynx is anaesthetised with Lignocaine spray.

Psychological patient preparation with a great deal of reassurance may be needed with some patients who may have both physical and psychological problems tolerating the barium administration tube.

Preliminary film.

Plain abdominal radiograph to check bowel preparation.

### **Technique**

A flexible soft tube is passed via the nose under 'screening' control until the tip passes through the pylorus into the fourth part of the duodenum.

'Barium' is then run in quickly and spot films taken at the leading edge of the 'barium' column until the column reaches the terminal ileum. The tube is then withdrawn into the stomach and any barium in the stomach aspirated using a syringe.

Some centres use methyl cellulose to propel the 'barium' column using only 100 ml of contrast agent.

### Additional films

Supine and prone abdominal films may be taken at any time.

### Aftercare

Nil orally for 5 hours (care with hot drinks if local anaesthesia of the oral cavity persists)

The patient should be warned that diarrhoea may occur due to the large volume of fluid used.

### Complications

#### Aspiration

Perforation of the bowel by the nasogastric tube guide wire.

## **Barium Enema**

### Methods.

Double contrast is now the norm.

Single contrast examination may be used in children and for the reduction of intussusception.

### Contraindications

#### Absolute

Toxic Megacolon

Pseudo membranous colitis

Rectal biopsy within the preceding three days, 7 days is preferable.

#### Relative

### Contrast medium

500 ml of 125% v/w barium sulphate suspension.

### Patient Preparation

Low residue diet for 3 days before the examination,

On the day before the examination fluids only and 'Picolax' at 08.00 hr's and 18.00 hr's.

The patient evacuates his bowels immediately before the examination.

## **Preliminary Film**

Plain abdominal radiograph to check abdominal preparation and exclude toxic megacolon.

### Technique

The patient is given 20 mg of Buscopan I.V.

The patient then lies on his left side and a twin ported rectal cannula is inserted into the rectum.

An inflatable balloon catheter may be selected for patients with poor sphincter control.

The catheter is connected to the barium reservoir and the air injection device.

The barium is introduced under fluoroscopic control as far as the splenic flexure then propelled round the colon to the terminal ileum with air producing a double contrast effect.

Spot films are taken as required.

See A guide to Radiological Procedures. Page 43.

## **Additional films**

Overcouch full size films are taken to demonstrate the complete large bowel.

Supine, Prone, Left and right lateral decubitus\* and a 30% caudad angled film of the sigmoid colon region. \*Decubitus films, the aspect in contact with the couch is indicated by the description Right or Left.

### Aftercare

The patient should be warned his bowel motions will be white for a few days, some centres advise a mild laxative for 48 hr's to encourage the passage of 'barium' and reduce the possibility of impaction.

The patient must not leave the department until the effects of any drugs given have worn off, i.e. the blurred vision sometimes experienced by patients who have been given Buscopan.

### Complications

Perforation, particularly the elderly, the very young and patients requiring the use of a balloon catheter.

Obstruction particularly if there is a constriction already present due to a neoplasm.

Venous extravasation causing a pulmonary embolus,

Water intoxication due to water absorption from large surface area of dilated bowel,

Intramural barium,

Cardiac arrhythmias due to rectal distension,

Transient bacteraemia,

Side effects of pharmacological agents used.

### **Typical Radiation Dose Values: (\*Dose = Typical Dose from N.R.P.B.)**

Examination	Typical Dose
Barium swallow	2 mSv
Barium meal	4 mSv
Barium follow through	7 mSv
Barium enema	10 mSv

An appropriate sequence of projections should be determined to minimise patient discomfort and maximise examination speed.

**Radiation Protection:**

Every attempt should be made to reduce the dose to patients undergoing fluoroscopic examinations.

Fluoroscopy should only be used to obtain clinical information which is otherwise unobtainable.

The field size should be kept as small as reasonably practicable,

Pulsed fluoroscopy with digit image hold should be used where possible,

Remote controlled fluoroscopic equipment should be used when practicable,

The fluoroscopy timer must be used and reset after each patient and the 'screening' time recorded for each patient.

The use of magnification should be limited as far as practicable.

100 ml photo-fluorographic systems should be used if possible.

Video-tape may help to reduce 'screening' times and the number of films taken particularly during swallowing studies.

**General Patient Aftercare:**

General psychological reassurance.

Check patient understands how to receive the results.

Replace any splints and dressings removed.

Ensure patient understands any preparation instructions are finished

Ensure the effects of any smooth muscle relaxant drugs have completely worn off.

Advise patients their motions will be discoloured white for a few days.

Advise patients that a mild laxative may be needed to avoid 'barium' impaction as well as an increase in fluid intake for 24 hours.

Escort to changing rooms or waiting area and bid good-bye.

**Additional Imaging Techniques:**

Radionuclide investigations may be useful for the following,

The quantification of gastro-oesophageal reflux, Meckel's diverticulum, bleeding studies and specific absorption studies.

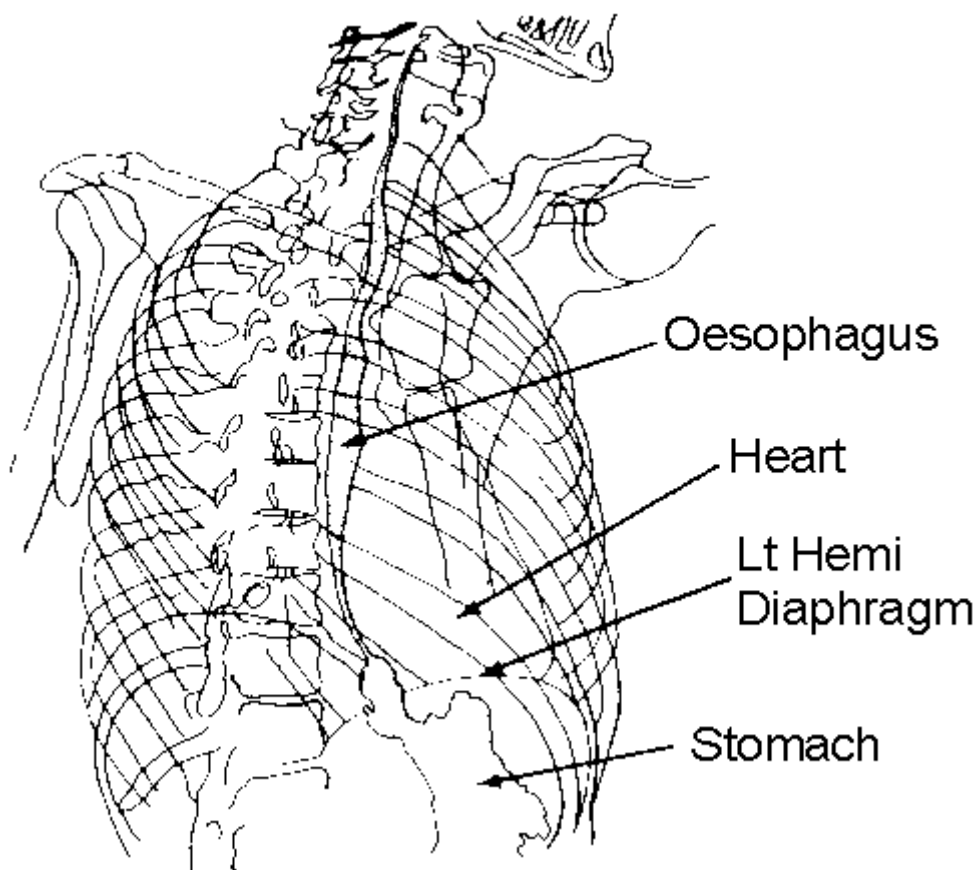
Ultrasound imaging, may be useful in the examination of abdominal masses.

Computer tomography is useful in imaging structures compressing the bowel from outside rather than being within the bowel structure.

**Appearances of 'Spot' Films during 'Barium' examinations.**

Barium Swallow R.A.O. - LAT- & P.A. Positions.

**R.A.O.**



Evaluation Criteria.

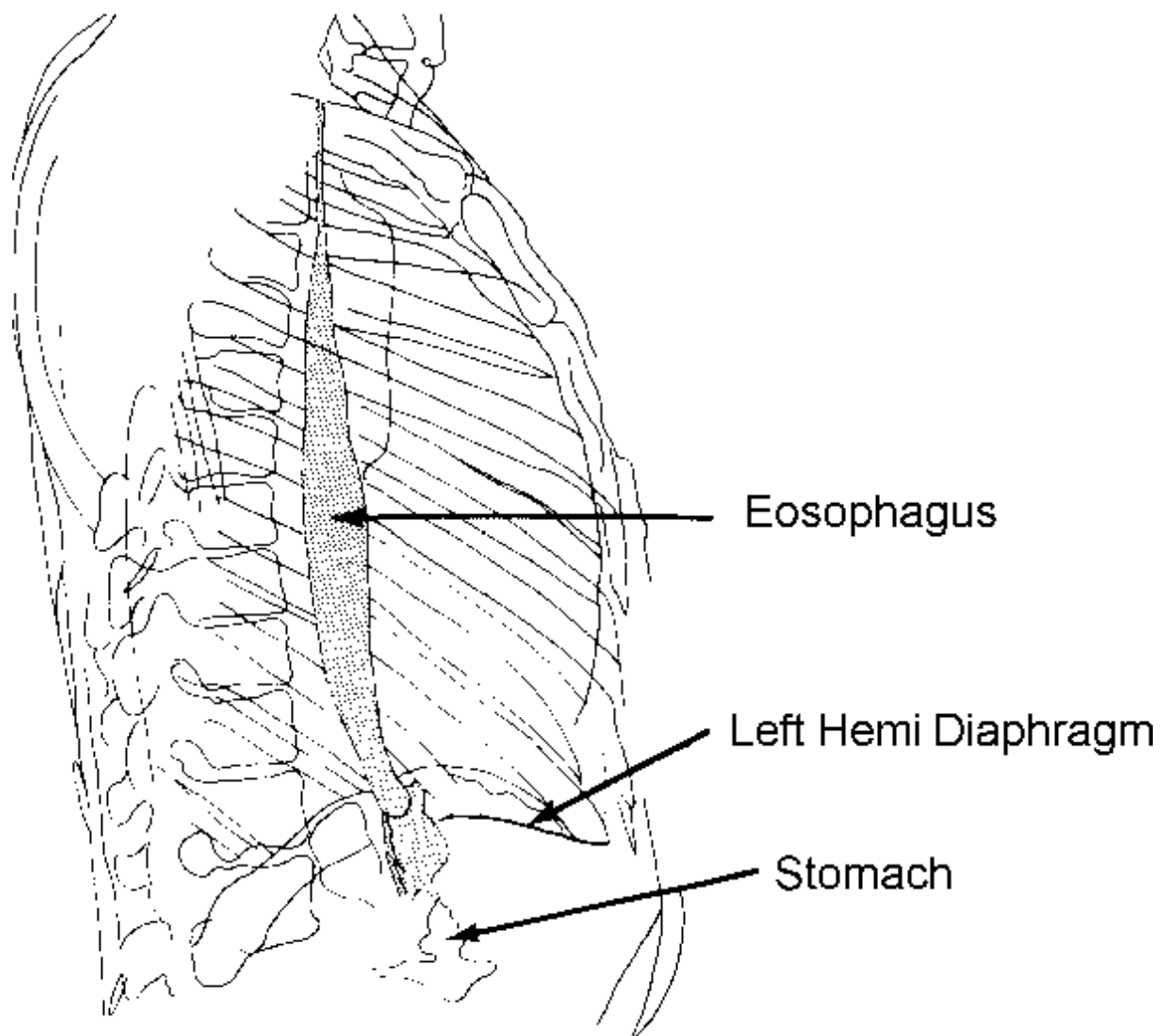
Oesophagus midway between heart and spine.

Entire oesophagus coated with contrast agent

No superimposition of upper limbs.

Appearances of 'Spot' Films during 'Barium' examinations.

Lateral



Evaluation Criteria.

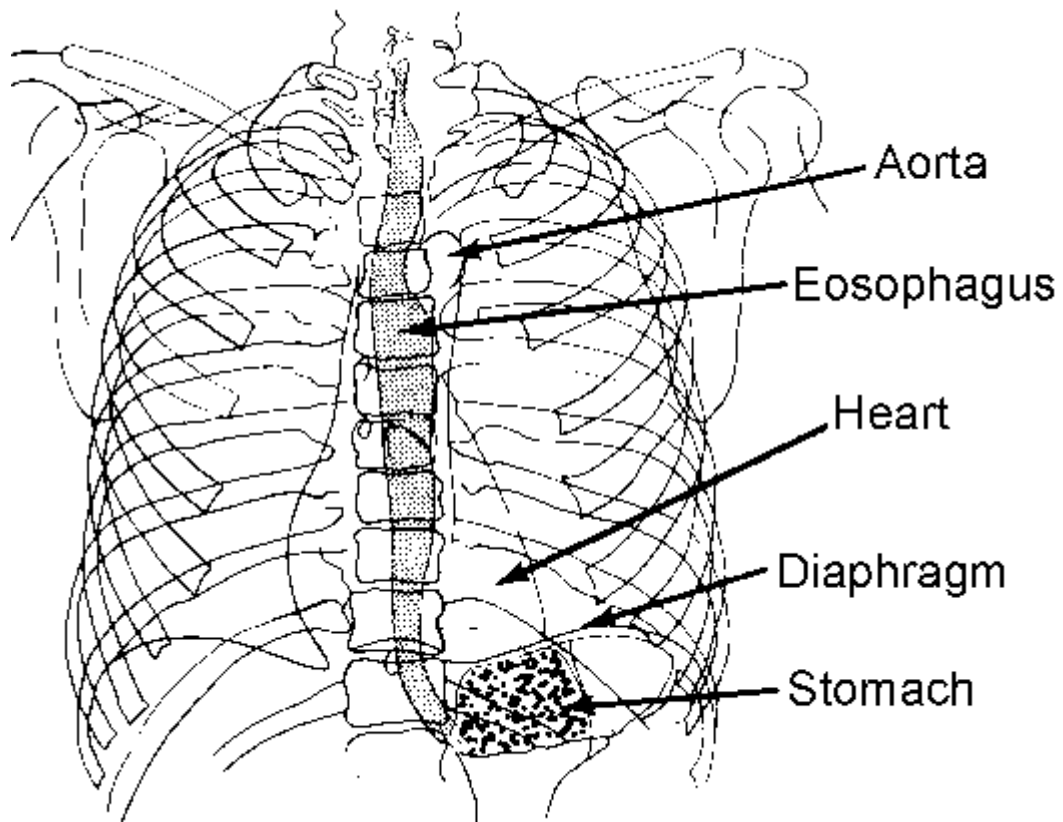
Oesophagus positioned between heart and spine.

Shoulder girdle not superimposed on oesophagus.

The entire oesophagus is coated with contrast agent

Appearances of 'Spot' Films during 'Barium' examinations.

P.A. Position.



Evaluation Criteria.

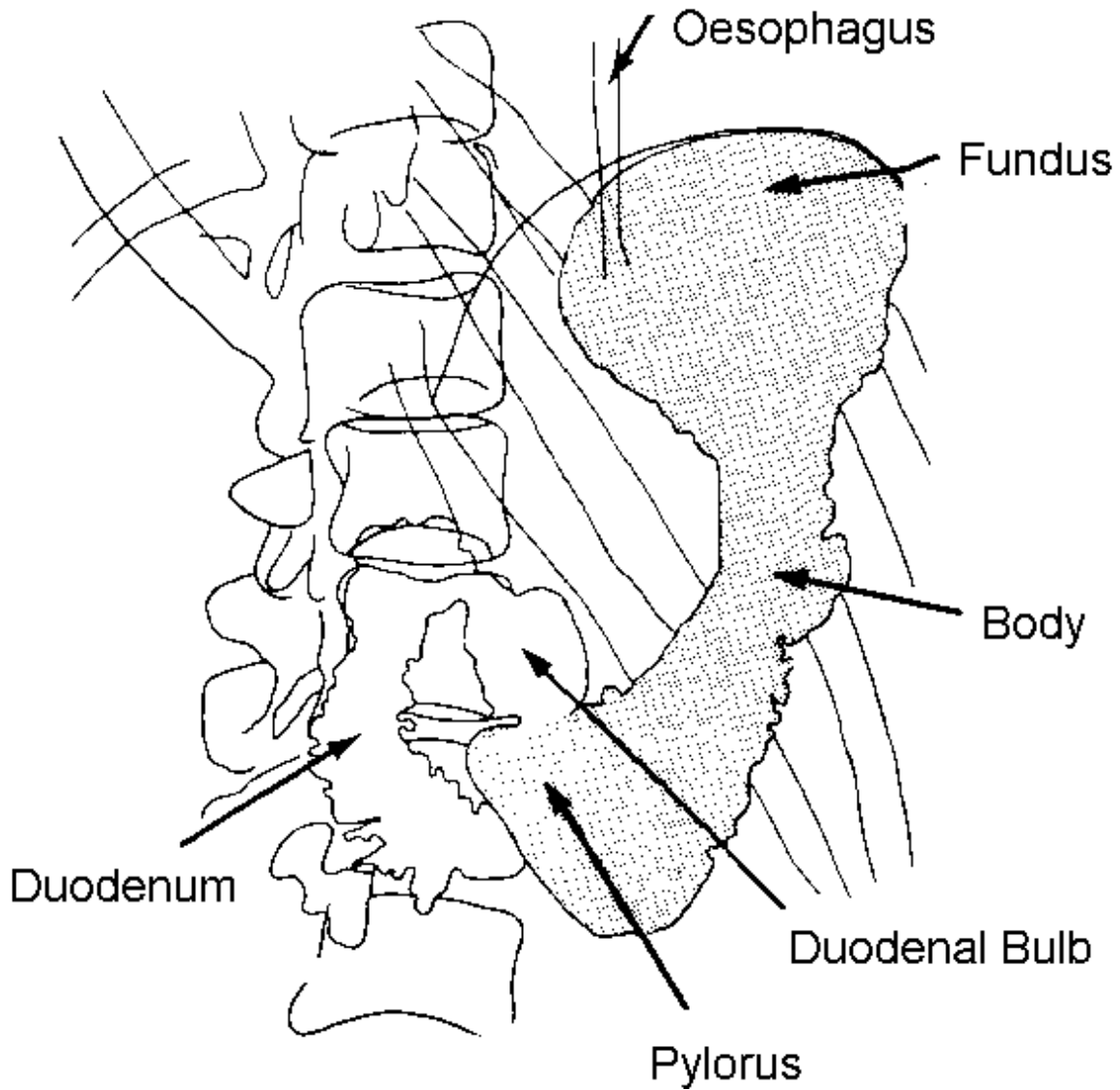
The entire oesophagus is coated with contrast agent.

No evidence of rotation, e.g. symmetry of sternoclavicular joints.

Appearances of 'Spot' Films during 'Barium' examinations.

**Barium Meal R.A.O. , Lateral and PA**

RAO



Evaluation Criteria.

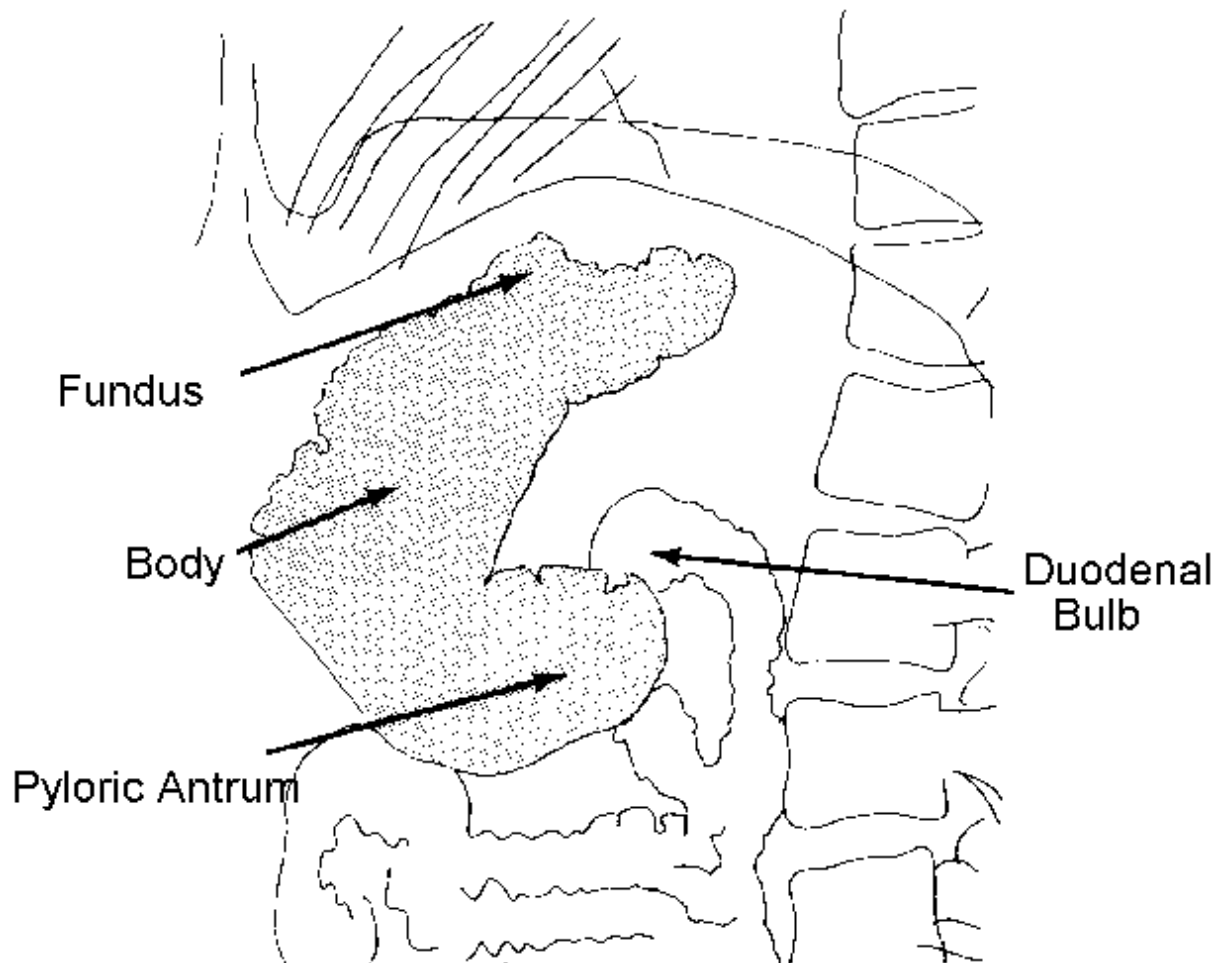
Entire stomach and 1<sup>st</sup> part of duodenum visualised.

Duodenal bulb seen in profile.

Gastric mucosal detail visible, not overfilled with contrast agent.

Appearances of 'Spot' Films during 'Barium' examinations.

Rt. Lateral.



Evaluation Criteria.

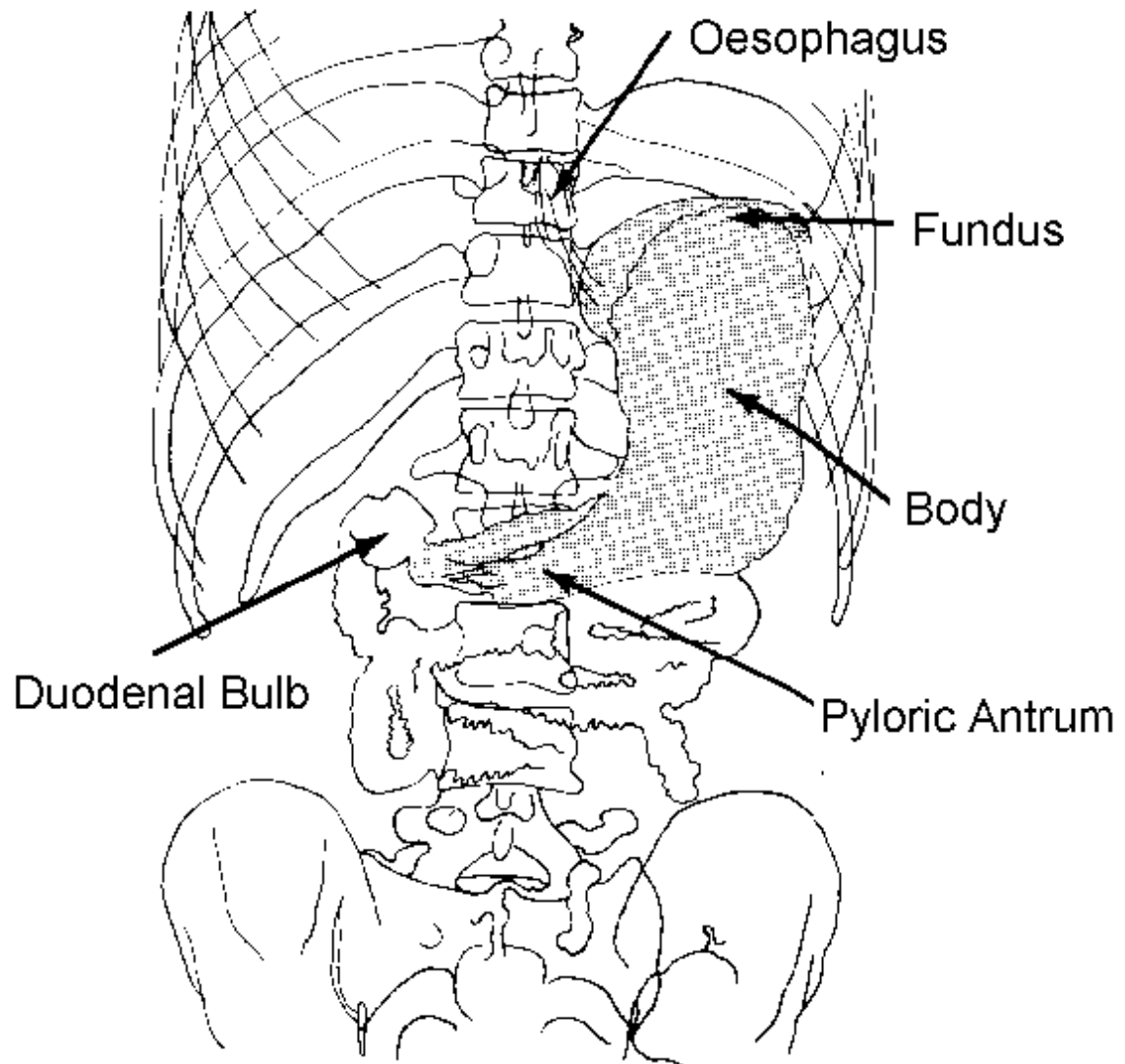
Entire stomach visualised.

Retrogastric space visible.

Vertebral bodies visible (as a reference)

Appearances of 'Spot' Films during 'Barium' examinations.

Barium Meal P.A.



Evaluation Criteria.

Entire stomach visible.

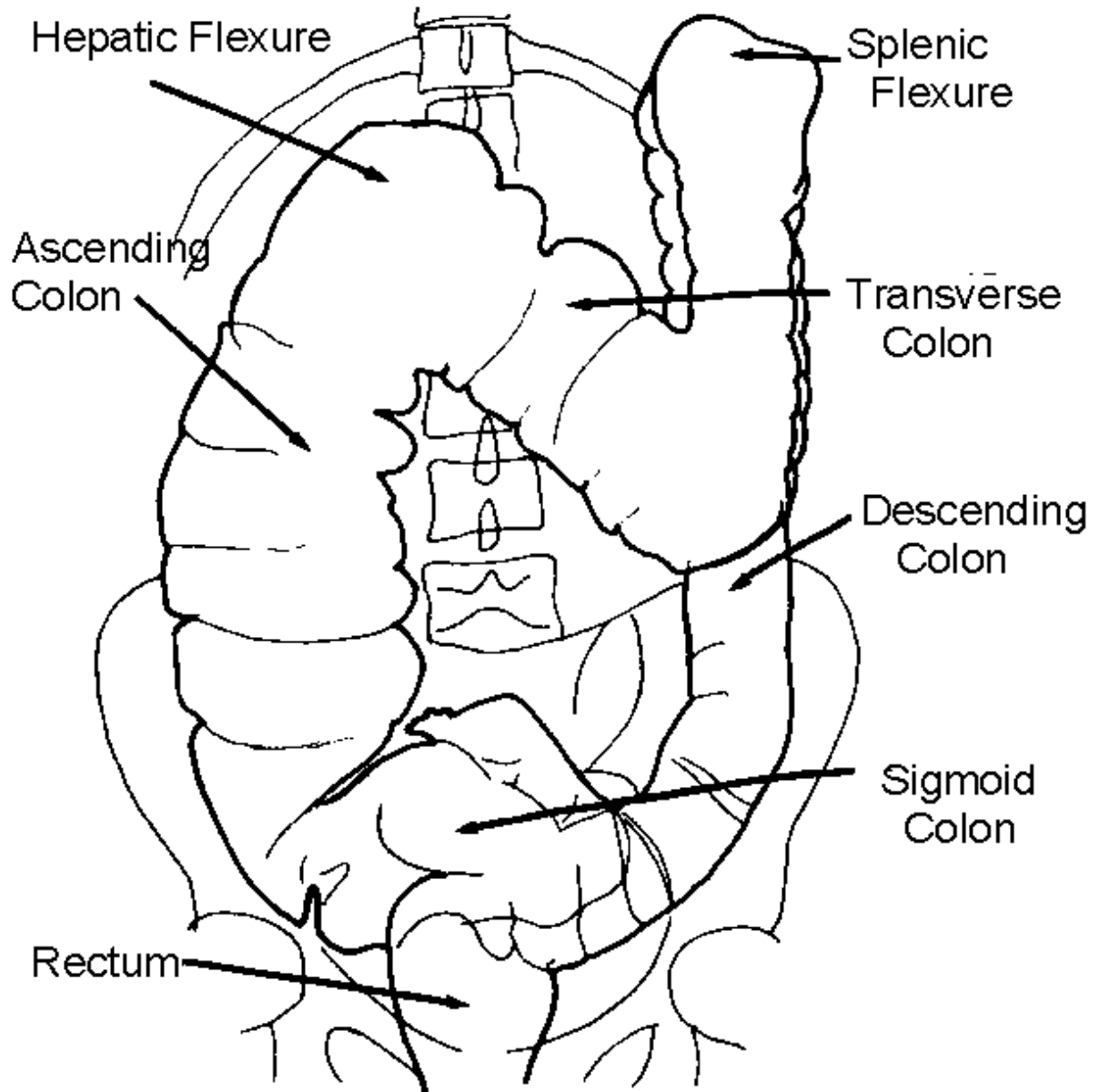
Body and pylorus filled with contrast agent.

Sufficient gas retained, with suitable contrast coating to see gastric mucosa.

Appearances of 'Spot' Films during 'Barium' examinations.

**Barium Enema, Prone, Lateral,**

Prone,



Evaluation Criteria.

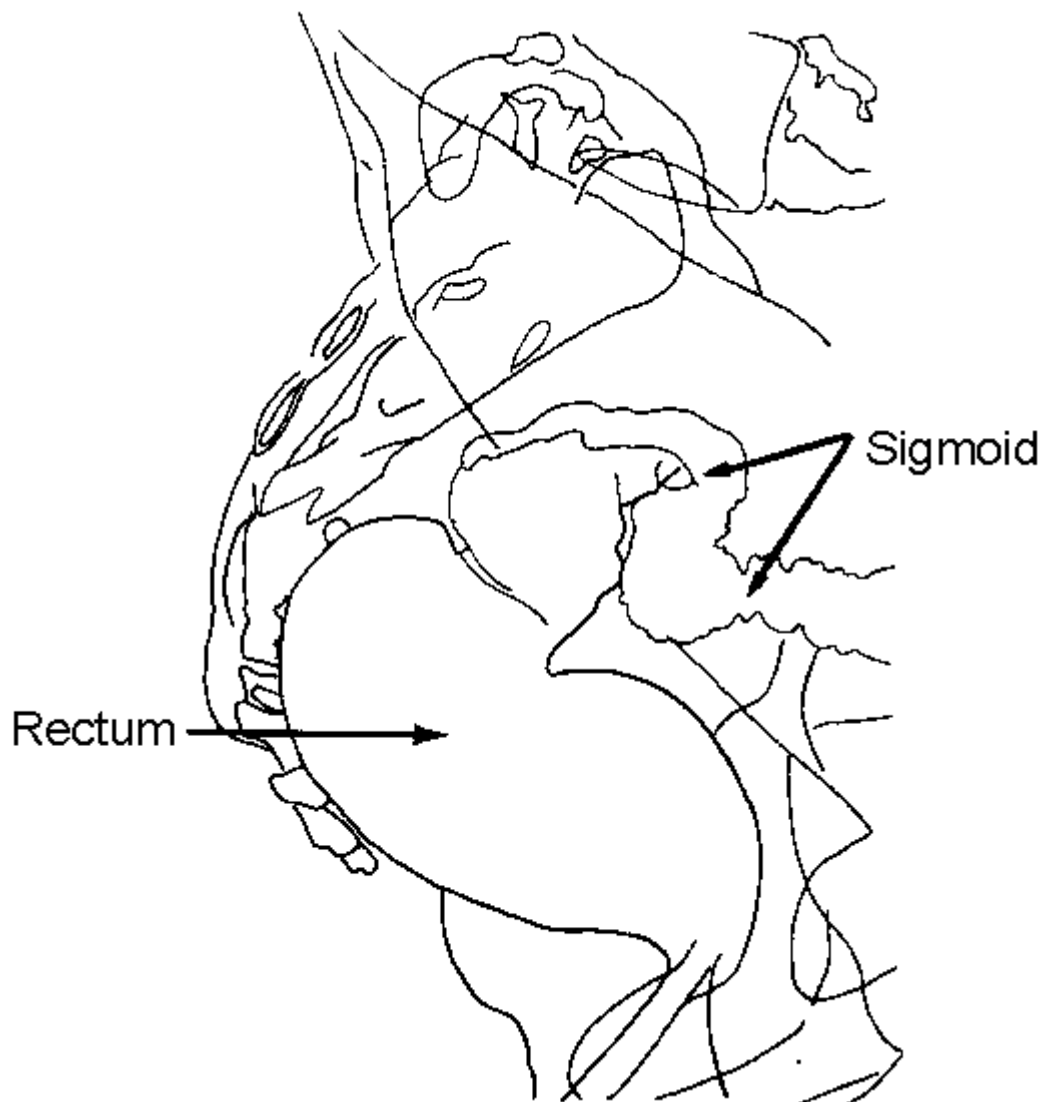
Entire colon visualised.

Patient position true P.A.

(check pelvis for rotation.)

Appearances of 'Spot' Films during 'Barium' examinations.

Lateral,



Evaluation Criteria.

No rotation,

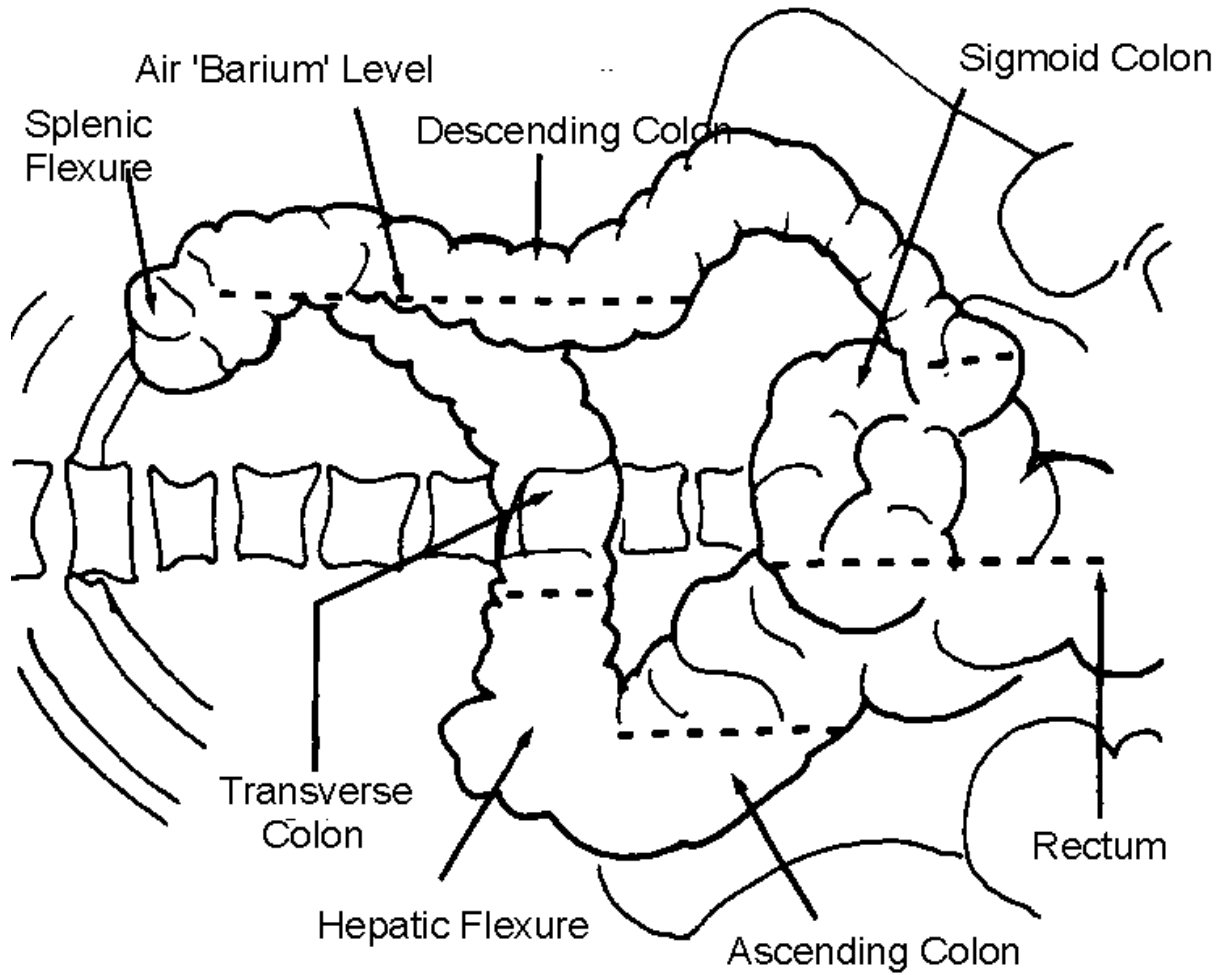
Check superimposition of greater trochanters.

Adequate exposure to penetrate region of interest.

No evidence of movement unsharpness due to long exposure time due to high exposure.

Appearances of 'Spot' Films during 'Barium' examinations.

Rt. Lateral Decubitus.



Evaluation Criteria.

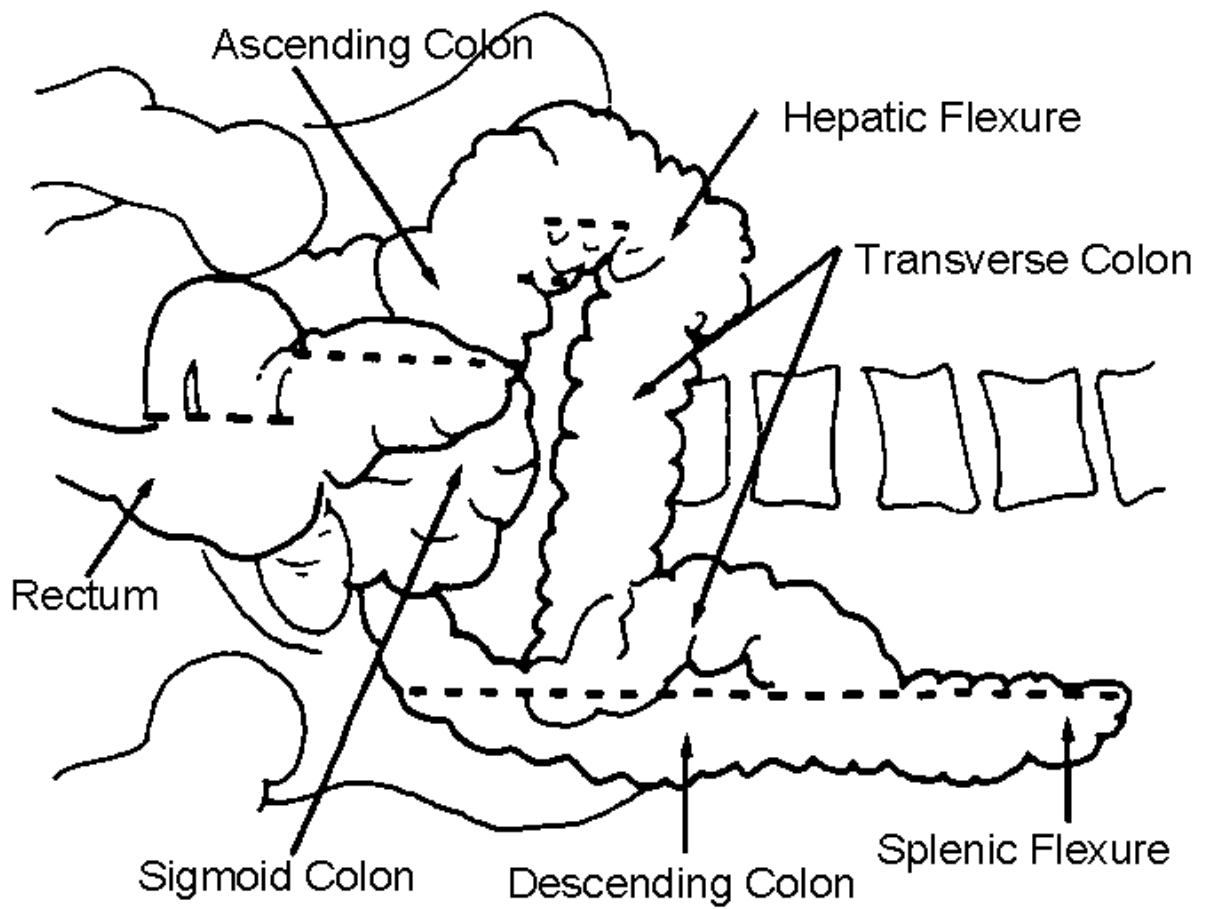
Entire colon visualised.

True A.P. projection, no rotation.

Mucosal patterns visible.

Appearances of 'Spot' Films during 'Barium' examinations.

Lt. Lateral Decubitus



Evaluation Criteria.

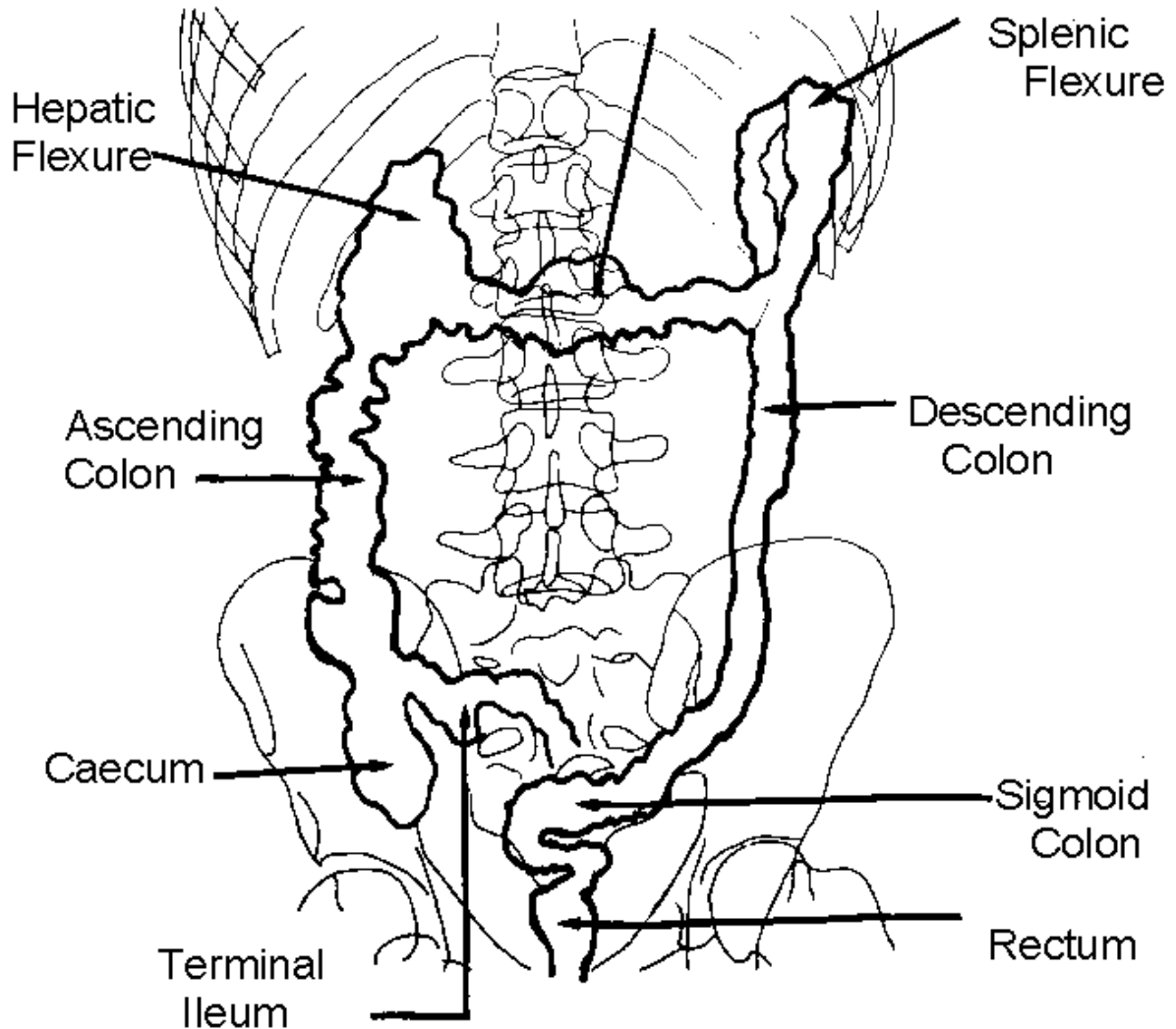
Entire colon visualised.

True A.P. projection, no rotation.

Mucosal patterns visible.

Appearances of 'Spot' Films during 'Barium' examinations.

Barium Enema, 'Post Evac'.



Evaluation Criteria.

Entire colon visualised.

True A.P. projection, no rotation.

Mucosal patterns visible.