THE ROLE OF ENTEROCLYSIS IN EVALUATING DIFFERENT SMALL BOWEL DISEASES

Submitted For Partial Fulfillment Of MD Degree

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Introduction

The small intestine is one of the most difficult areas to study radiographically in the gastro-intestinal tract; yet, satisfactory examinations are needed to give the maximum definition of every inch of the intestine ***(Dean et al., 2003).***

Even for the endoscopists, small intestinal examination remains one of the biggest challenges. Standard upper endoscopy is limited to visualization of the second or third portion of the duodenum. Colonoscopy with intubation of the terminal ileum can examine the most distal small bowel. Over the years, various techniques to examine the small intestine have been developed, including intra-operative endoscopy, retrograde ileostomy, sonde enteroscopy, push enteroscopy, and video enteroscopy. Recent experience suggests that the latest generation of video enteroscopy offers the best combination of diagnostic and therapeutic capabilities with ease of use. Unfortunately, even with the latest technology and under the best conditions, the entire small intestine cannot routinely be visualized ***(Marc et al., 2002).***

Therefore, barium radiology remains the method of choice for diagnosis and evaluation of many small intestinal disorders ***(Davidson et al., 1999).***

Small bowel follow through is the most commonly performed radiographic procedure for evaluation of the small bowel. Now, it is recognized beyond any doubts that the conventional barium meal follow through examination is inadequate as the diseases of the small bowel do not lend themselves easily because of the great length and overlapping coils obscuring each other and hiding minor pathology ***(Vincent ., 2000).***

Enteroclysis (small bowel enema) is proving to be a quick and efficient way of examining the small intestine. It is now widely used for examining the jejunum and ileum. The technique is ideal for demonstrating the extent and severity of disorders that cause morphological changes to the small intestine ***(Laura et al., 2002).***

Recent advances in intubations and infusion techniques and the availability of improved barium suspensions have renewed the interest in small bowel

enteroclysis. This is because the barium suspension is introduced into the intestine directly through a tube, allowing much better intestinal distension than can achieved with the follow-through examination. Enteroclysis represents a significant improvement in the method of small bowel examination, yielding accurate diagnosis of a wide variety of lesions as well as confident demonstration of small bowel normality ***(Dean et al., 2003).***

Aim of the work

The aim of this work is to study the small intestinal lesions by small bowel enema (enteroclysis) in a trial to evaluate its accuracy in detection and diagnosis of different small bowel changes in patients presenting clinically by subacute and acute symptoms & signs suspecting different small bowel diseases and to overcome the disadvantages of the conventional barium follow-through in an attempt to reach a complete and accurate diagnosis.

NORMAL DEVELOPMENT

The epithelium of the alimentary tract, except at its commencement and termination, is derived from the endodermal cells of the roof of the yolk sac. The latter, during the third and fourth weeks of development, is gradually drawn inside the embryo as it changes from a plate to a cylinder. The yolk sac then comes into intimate contact with the overlying ectoderm at two locations, forming the prochordal (prechordal) plate cranially, and the cloacal membrane caudally. The former denotes the site of the oral cavity and the latter the urethral and anal openings ***(Alien et al., 1997)***.

During the third week a cord of cells called the head process grows forward from the primitive (Hensen's) node at the caudal end of the neural plate between the ectoderm and the yolk sac. It canalizes and insinuates itself in the yolk sac roof to provide a transient communication between the amniotic and yolk sac cavities, called the neurenteric (Kovalevsky's) canal. After about 24 hours the canal closes, and the former head process, now the notochord, separates from the yolk sac to become the axis around which mesodermal sometimes later form the vertebrae. Normally, the notochord disappears except for those portions that give rise to the nucleus pulposus of the inter-vertebral discs ***(Andrew et al., 1998)***.

Also in the third week, a condensation of mesoderm, the transverse septum, appears ventral to the yolk sac, and its caudal portion forms the supporting tissue of the liver ***(Balinsky., 1997)***.

During the fourth and fifth weeks the primitive alimentary tract shows four distinct regions, called the ***foregut, midgut, hindgut,*** and ***tailgut***. At first, the foregut is separated from the stomodeum (primitive mouth) by the buccopharyngeal membrane (formerly the prochordal plate), but at the end of the fourth week it begins to disrupt and the two passages become continuous. During the sixth week the cloaca and its membrane are divided

by the urorectal septum into urogenital and anal components, the latter breaking down between the seventh and eighth weeks, so that the hindgut communicates with the amniotic sac ***(Bamett ., 1996).***

The foregut forms part of the mouth, all of the pharynx, esophagus, and stomach, and the duodenum as far as the duodenal papilla (ampulla of Vater). The latter is the point of origin of the hepatic diverticulum, precursor of the liver, gallbladder, and biliary ducts. The respiratory tract is also an outgrowth of the pharyngeal portion of the foregut, and for a time, the veins of the developing lungs communicate with those of the esophagus, stomach, and liver ***(Bauroganen et al., 1995)***.

The midgut forms the remainder of the duodenum, the jejunum, ileum, and the large intestine as far as the junction of the middle and left thirds of the transverse colon. The hindgut gives rise to the remainder of the large intestine, where as the tailgut is transitory and soon resorbs ***(Bellairs., 1996)***.

Each portion of the gut receives blood from a specific branch of the aorta: the ***foregut*** below the diaphragm is supplied by the celiac axis artery, the ***midgut*** by the superior mesenteric artery, and the ***hindgut*** by the inferior mesenteric artery. Derivatives of these three regions retain the same blood supply in the adult. When the alimentary tract is first established, it has a lumen; as development continues, however, that of the small and large intestines becomes temporarily blocked by the growth of epithelium. This is followed by recanalization, and the lumen is restored ***(Hamilton., 1999).***

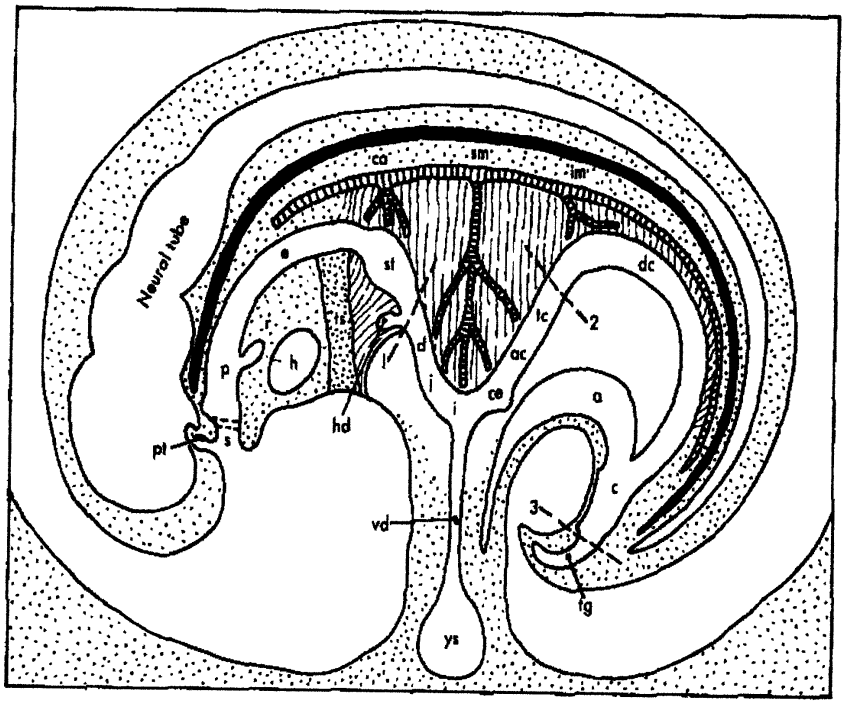


Figure (1): Diagram of developing alimentary tract and related structures. Notochord, forerunner of vertebral column, is shown in black. Branches of aorta enter dorsal mesentery, and hepatic diverticulum is growing into ventral mesentery. Derivatives of foregut, midgut, and hindgut are indicated. Buccopharyngeal membrane has disrupted, although cloacal membrane is still intact *(Coated From William et al., 2000).*

Keys:

a, Allantois; ***ac,*** ascending colon; ***c,*** cloaca; ***ca,*** celiac axis; ***ce,*** cecum; ***d,*** duodenum; ***dc,*** descending colon; ***e,*** esophagus; ***h,*** heart; ***hd,*** hepatic diverticulum; ***i,*** ileum; ***im,*** inferior mesenteric artery; ***j,*** jejunum; ***p,*** pharynx; ***pt,*** pituitary pouch; ***r,*** respiratory tract; ***s,*** stomodeum; ***sm,*** superior mesenteric artery; ***st,*** stomach; ***tc,*** transverse colon, ***tg,*** tailgut; ***ts,*** transverse septum; ***vd,*** vitellointestinal duct; ***ys,*** yolk sac. ***1,*** Junction of foregut and midgut; ***2,*** junction of midgut and hindgut; ***3,*** junction of hindgut and tail gut. Paired broken lines indicate site of buccopharyngeal membrane.

JEJUNUM AND ILEUM

Most of the small intestine and a sizable portion of the large intestine are derived from the midgut loop, which commences at the duodenojejunal junction and terminates at its junction with the hindgut. At the beginning and end of the loop, the mesenchym of the dorsal mesentery is thickened to form retention bands, which restrain the movement of the gut at these points ***(Hutchinson.,1998).***

During the sixth week of pregnancy the midgut loop, which is growing rapidly, herniates into the umbilical cord, probably as a result of the enlarging liver reducing space within the abdominal cavity. As it undergoes this maneuver, it begins to rotate in a counter-clockwise direction around an axis consisting of the superior mesenteric artery and the vitello-intestinal duct. The cranial portion of the loop (proximal limb) grows rapidly and gives rise to the jejunum and most of the ileum; the caudal portion of the loop (distal limb), growing more slowly, forms the remainder of the ileum, the ceacum, the appendix, the ascending colon, and about two thirds of the transverse colon ***(Frazer et al., 1998).***

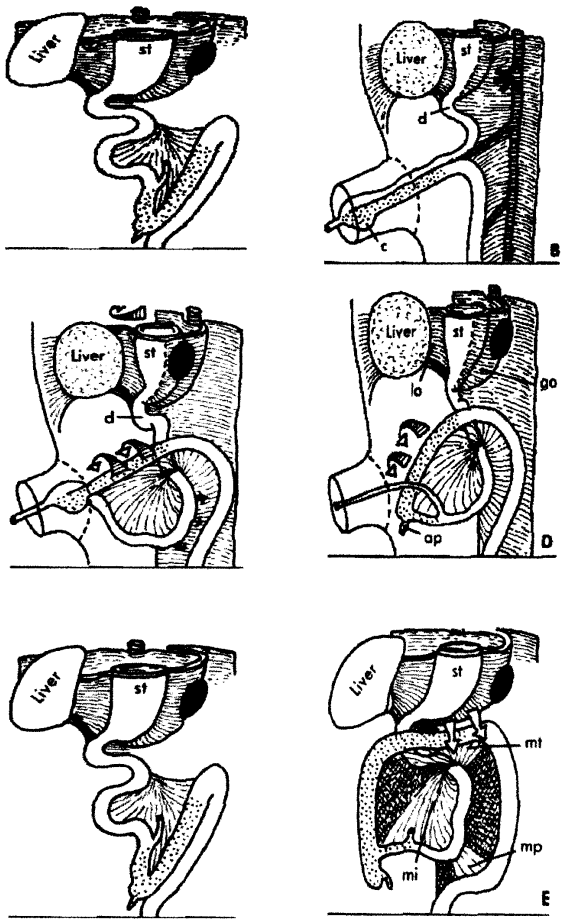
Most of the midgut loop remains herniated into the umbilical cord until about the tenth week, when the proximal limb derivatives return to the abdominal cavity, followed by those of the distal limb. When the former return, they push the hind-gut and its mesentery toward the left ***(Keith., 1998).***

The counterclockwise rotation of the midgut loop continues during the period of herniation and is completed when the distal limb derivatives (terminal ileum, ceacum, ascending colon, and part of the transverse colon) enter the abdominal cavity and sweep cranially to the superior mesenteric artery to gain the right side; the ceacum then comes to rest close to its definitive location ***(Abbie .,1993).***

At first, the ascending colon is short and lies in a line with the transverse colon, but it gradually lengthens, especially during the postnatal period, when

it acquires its characteristic form. The total rotation of the midgut loop amounts to about 270 degrees and its principal stages are depicted in. The vitello-intestinal duct atrophies during the second month ***(Waddington., 1996).***

The greater omentum develops as an extension of the dorsal mesentery (mesogastrium), and eventually the transverse colon and its mesentery (mesocolon) are incorporated within its layers. Of the original dorsal mesentery, only those portions of it attached to the stomach, the jejunum, the ileum, and the transverse and pelvic colons remain unfused with the posterior abdominal wall ***(Wachington., 1996).***



Fig(2): Rotation of stomach, duodenum, and mid-gut loop
(Coated From, William et al., 2000).

KEYS:

A, Midgut loop about to herniate into umbilical cord. Anchored by superior and inferior retention bands within dorsal mesentery, it rotates counterclockwise around superior mesenteric artery; its proximal limb passes to right, and its distal limb passes to left. Vitello-intestinal duct is attached to its apex.

B, Within umbilical cord, midgut (especially its proximal limb) lengthens. Ceacum appears on distal limb. Stomach and duodenum rotate, and dorsal mesentery extends to left.

C, Proximal limb, greatly lengthened, reenters abdominal cavity and pushes hindgut and its mesentery to left. Distal limb returns and, continuing counterclockwise rotation, moves to right. Spleen is shown in black.

D, Distal limb lies obliquely across abdominal cavity on completion of rotation.

E, Mesentery of intestine fuses with peritoneum of abdominal wall, except for portions that form transverse mesocolon, mesentery of small intestine, and pelvic mesocolon. Dorsal mesentery (mesogastrium) extends caudally to form greater omentum.

F, Incomplete rotation of gut with ceacum and ascending and transverse colon lying toward left side. (In all diagrams liver is depicted smaller than actual size),

a. Aorta; ***ap,*** vermiform appendix; ***b,*** common bile duct; ***c,*** ceacum; ***ca,*** celiac axis artery; ***d,*** duodenum; ***dm,*** dorsal mesentery; ***go,*** greater omentum; ***i,*** inferior retention band; ***im,*** inferior mesenteric artery; ***lo,*** lesser omentum; ***mi,*** mesentery of small intestine; ***mp,*** pelvic mesocolon; ***mt,*** transverse mesocolon; ***s,*** superior retention band; ***sin,*** superior mesenteric artery; ***st,*** stomach; ***vd,*** vitellointestinal duct; ***vm,*** ventral mesentery; ***y,*** yolk sac.

ABNORMAL DEVELOPMENT

Cysts and communications between the alimentary tract and the spinal cord or the skin, when located in the sacral region, may be due to persistence of all or part of the neurenteric canal. However, similar abnormalities further headword are more likely caused by secondary communications between the yolk sac roof and the neural tube or ectoderm. In both instances there are accompanying vertebral defects ***(Wendell et al., 1994).***

Parts of the entire alimentary tract may be duplicated, especially the esophagus and the ileum, and congenital cysts, which sometimes communicate with the bowel lumen, are not infrequent. Such abnormalities may result from the formation of more than one lumen following the transitory "solid stage" ***(WHO., 1992).***

Diverticula are occasionally found in association with the stomach or intestine and may represent persistence and enlargement of out-budding of the gut epithelium at about the seventh or eighth week; these normally disappear. The point of attachment of the vitello-intestinal duct to the ileum can persist as Meckel's diverticulum ***(Zeeman ., 1994).***

Stenosis or atresia of the gut lumen is frequent in the esophagus, duodenum, jejunum, ileum, and rectum and may be caused by incomplete canalization of the bowel lumen, vascular disturbance during fetal life, or compression by another structure. Such malformations predispose to volvulus and intussusception ***(Wonnsley ., 1994).***

Fistulas can occur between the trachea and the esophagus, the ileum and the umbilicus, the rectum and the urethra in the male, and the rectum and the vagina in the female ***(Waddington., 1996).***

In situs inversus viscerum, all or part of the alimentary tract may be transposed. In such situations, especially in the partial forms, malformations of the cardiovascular and other systems are frequent ***(Acheson ., 1998).***

Causation of congenital abnormalities

Congenital abnormalities of clinical significance occur in about 3% of newborns. The causes of such defects fall into two broad categories: genetic (intrinsic) and environmental (extrinsic). It is thought that about 10% result from defective genes, around 5% from chromosomal aberrations (altered number, breakage, ring formation, etc.), and perhaps 3% from teratogens; the remainder apparently are due to the interplay of both genetic and environmental factors ***(Tandler et al., 1998).***

Teratogens include physical and chemical agents as well as pathogens. Teratogens that cause congenital abnormalities in humans include x-irradiation, thalidomide, rubella, toxoplasmosis, cytomegalic inclusion disease, organic mercury, syphilis, sex hormones, and ethanol. Many others, however, are under suspicion ***(Tanner., 1998).***

Congenital abnormalities tend to be multiple, and when one is found, others should be sought. Some minor abnormalities may be associated with more serious internal ones; thus a single umbilical artery may occur along with malformations of the urogenital and other systems, polydactyly with cystic disease of the kidney, and low-set ears with renal agenesis ***(Russell., 1999).***

A relationship between certain congenital abnormalities and neoplastic conditions is now recognized, for example, aniridia and hemi-hypertrophy tend to be associated with nephroblastoma, and in Down's syndrome (mongolism), there is an increasing tendency toward leukemia with age ***(Rock et al., 1998).***

The small intestine is a coiled tube, extends from the pylorus to the ileo-ceacal valve, where it joins the large intestine. It is usually said to be 6-7 m long, gradually diminishing in diameter towards its termination. Its length was correlated with the height of the individual but was independent of age. The small intestine occupies the central and lower parts of the abdominal cavity, usually within the colonic loop. It is completely covered by peritoneum, except along its mesenteric border where the two mesenteric layers diverge to enclose it ***(Underbill .,1995)***.

It has related, in front, with the greater omentum and abdominal parities, and is connected to the vertebral column by a fold of peritoneum, which is the mesentery. The small intestine is divisible into three portions: a short, curved sessile section the **duodenum,** and a long greatly coiled part attached to the posterior abdominal wall by the mesentery the proximal two-fifths being the **jejunum,** and the distal three-fifths the **ileum** ***(Treves., 1995)***.

The Duodenum

Has received its name from being about equal in length to the breadth of twelve fingers (25 cm.). It is the shortest, the widest, and the most fixed part of the small intestine, and has no mesentery, being only partially covered by peritoneum. Its course presents a remarkable curve, somewhat of the shape of an imperfect circle, as follows: commencing at the pylorus it passes backward, upward, and to the right, beneath the quadrate lobe of the liver to the neck of the gall-bladder, varying slightly in direction according to the degree of distension of the stomach; it then takes a sharp curve and descends along the right margin of the head of the pancreas, for a variable distance, generally to the level of the upper border of the body of the fourth lumbar vertebra. It now takes a second bend, and passes from right to left across the vertebral column, having a slight inclination upward and on the left side of the vertebral column it ascends for about 2.5 cm., and then ends opposite the second lumbar vertebra in the jejunum. As it unites with the jejunum it turns abruptly forward, forming the duodeno-jejunal flexure. The

duodenum may be divided into four portions: **superior, descending, horizontal,** and **ascending** ***(Anson et al., 1996).***

Jejunum and Ileum

The remainder of the small intestine from the end of the duodenum is named **jejunum** and **ileum;** the former term being given to the upper two-fifths and the latter to the lower three-fifths. They run diagonally from the left side of the second lumbar vertebral body to the right sacro-iliac joint, crossing successively the horizontal part of the duodenum, aorta, inferior vena cava, right ureter and right psoas muscle. The peritoneal layers contain: the jejunum, ileum, jejunal and ileal branches of the superior mesenteric vessels, nerves, lacteals and lymph nodes, together with a variable amount of fat ***(Argeme et al 1990).***

There is no morphological line of distinction between the two, and the division is arbitrary; but at the same time the character of the intestine gradually undergoes a change from the commencement of the jejunum to the end of the ileum, so that a portion of the bowel taken from these two situations would present characteristic and marked differences ***(Ashworth., 1993).*** These are briefly as follows:

The Jejunum (*intestinum jejunum*)**:** is wider, its diameter being about 4 cm, and is thicker, more vascular, and of a deeper colour than the ileum. The first jejunal coil occupies a recess between the left part of the transverse mesocolon and the left kidney ***(Barclay., 1996).***

The circular folds (*valvulæ conniventes*) of its mucous membrane are large and thickly set, and its villi are larger than in the ileum. The aggregated lymph nodules are almost absent in the upper part of the jejunum, and in the lower part are less frequently found than in the ileum, and are smaller and tend to assume a circular form ***(Bell., 1999).***

The Ileum (***intestinum ileum***)**:** is narrow, its diameter average of 3.75 cm, and its coats thinner and less vascular than those of the jejunum. It possesses but few circular folds, and they are small and disappear entirely

toward its lower end, but aggregated lymph nodules *(Peyer's patches)* are larger and more numerous. The jejunum occupies the umbilical and left iliac regions, while the ileum occupies chiefly the umbilical, hypogastric, right iliac, and pelvic regions. The terminal part of the ileum usually lies in the pelvis, from which it ascends over the right psoas muscle and right iliac vessels; it ends in the right iliac fossa by opening into the medial side of the ceacum. The jejunum and ileum are attached to the posterior abdominal wall by an extensive fold of peritoneum, the *mesentery,* which allows the freest motion, so that each coil can accommodate itself to changes in form and position ***(Belt., 1995).***

The Ileo-ceacal Valve

The ileum opens into the postero-medial aspect of the large intestine, at the junction of the ceacum and colon. A surface marking of this structure is the intersection of the right lateral and trans-tubercular planes; about 2 cm below this the vermiform appendix opens into the ceacum. The ileocecal orifice has a so-called 'valve', consisting of two flaps projecting into the lumen of the large intestine. At their ends, the flaps coalesce, continuing as narrow membranous ridges, *the frenula* of the valve. In the natural state the valvular lips project as thick folds into the ceacal lumen, the orifice appearing like a slit or oval. Circular and longitudinal muscle layers of the terminal ileum continue into the valve to form a sphincter ***(Bockman et al., 1993).***

The margin of the ileocecal valve is a reduplication of the intestinal mucosa and circular muscle, longitudinal fibres are partly reduplicated as they enter the valve, but the more superficial and the peritoneum continue uninterruptedly from the small to the large intestine ***(Abbot., 1992).***

The ileal valvular surfaces are covered with villi and have the structure of the mucosa of the small intestine; their ceacal aspects display no villi but numerous orifices of tubular glands peculiar to the colonic mucosa. It is usually said that the valve not only prevents reflux from the ceacum to the ileum but is probably also a sphincter regulating the passage of ileal contents

into the ceacum. The valve is kept in tonic contraction by sympathetic innervations ***(Anand., 1990).***

INTESTINAL WALL STRUCTURE

The wall of the small intestine is composed of four coats:

Serous coat (tunica serosa):** is derived from the peritoneum. The superior portion of the duodenum is almost completely surrounded by this membrane. The rest of the small intestine is surrounded by the peritoneum, excepting along its attached or mesenteric border; here a space is left for the vessels and nerves to pass to the gut ***(Bloom et al., 1996).

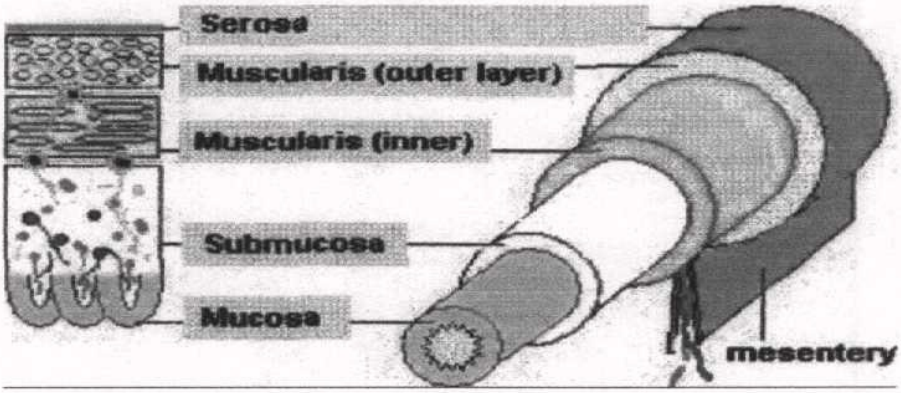


Fig (3): Intestinal wall structure

(Coated From, William et al., 2000)

Muscular coat (tunica muscularis):** consists of external, longitudinal, and an internal circular layers (Bloom et al., 1996).***

Areolar or submucous coat (tela submucosa):** connects together the mucous and muscular layers. It consists of loose, filamentous areolar tissue containing blood vessels, lymphatics, and nerves ***(Bloom et al., 1996).

***Mucous membrane (tunica mucosa):** It consists of the areolar or submucous coat, the muscularis mucosa internal to this is a quantity of retiform tissue, enclosing in its meshes lymph corpuscles, and in this the blood vessels and nerves ramify, lastly, a basement membrane, supporting a single layer of epithelial cells, which throughout the intestine are columnar in character. The mucous membrane presents the following structures, contained within it or belonging to it:

1) Circular folds
2) Duodenal glands
3) Villi
4) Solitary lymphatic nodules
5) Intestinal glands
6) Aggregated lymphatic nodules

The intestinal villi (*villi intestinales*) are highly vascular processes, projecting from the mucous membrane of the small intestine throughout its whole extent, and giving to its surface a velvety appearance. They are largest and most numerous in the duodenum and jejunum, and become fewer and smaller in the ileum ***(Bloom et al., 1996).***

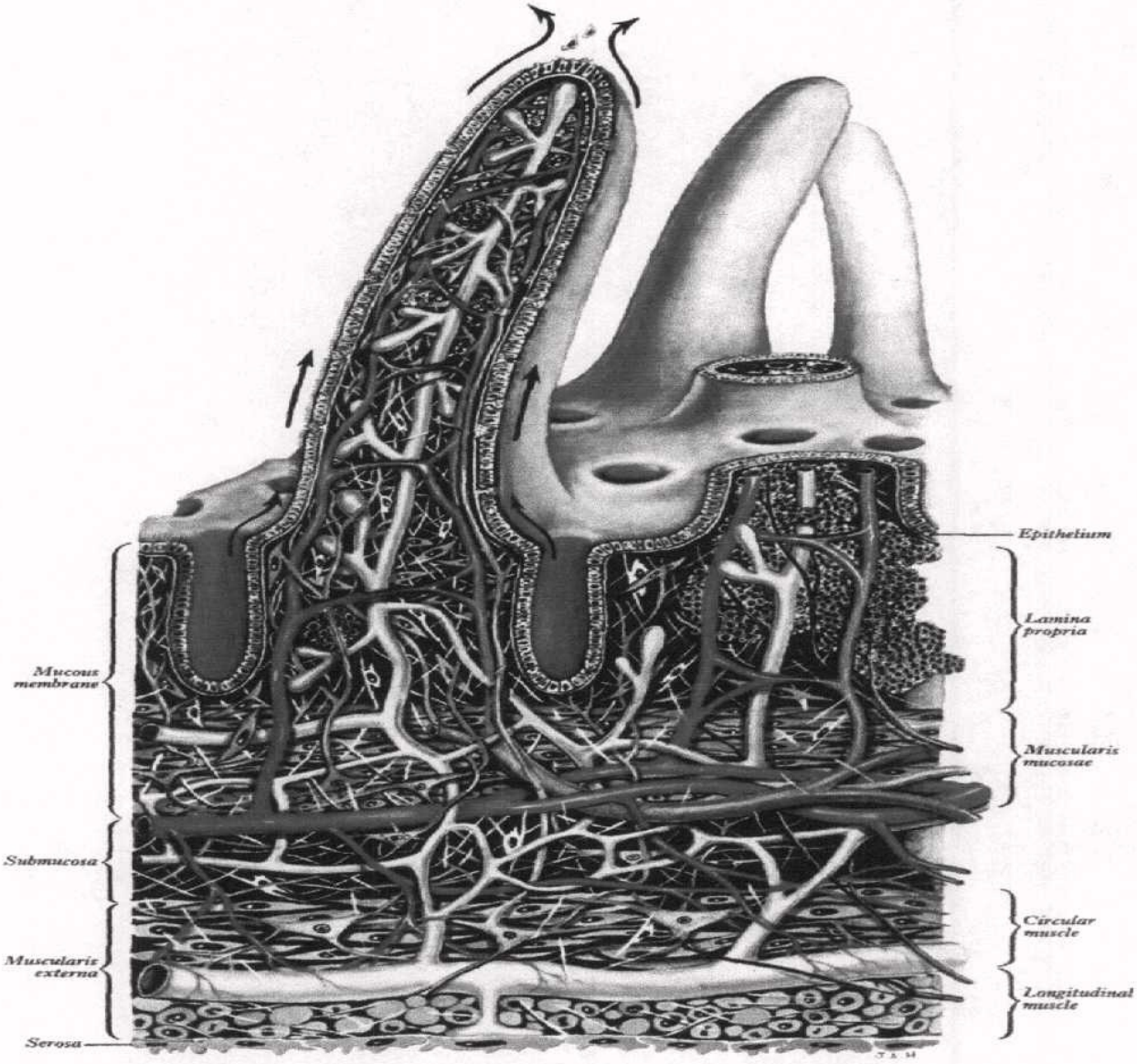


Fig (4): A three-dimensional reconstruction of the architecture of the intestinal villi and subjacent wall: arteries and arterioles (red), veins and venules (blue), central lacteals and other lymphatic channels (orange), aggregations of lymphocytes (yellow), neural elements (green), non-striated muscle fibres (magenta), fibroblasts (white). Arrows indicate the direction of cell migration ***(Coated From, William et al., 2000).***

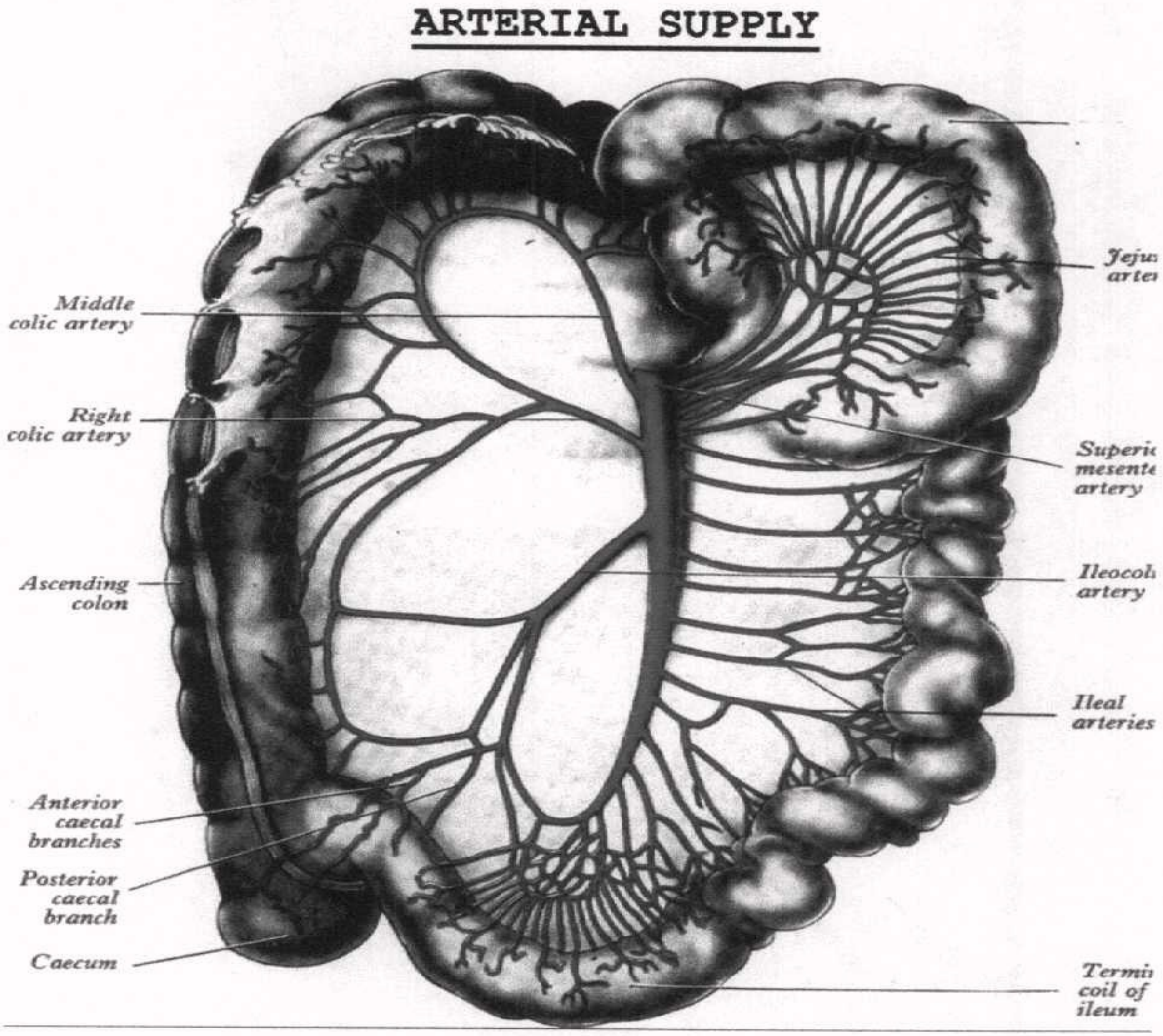
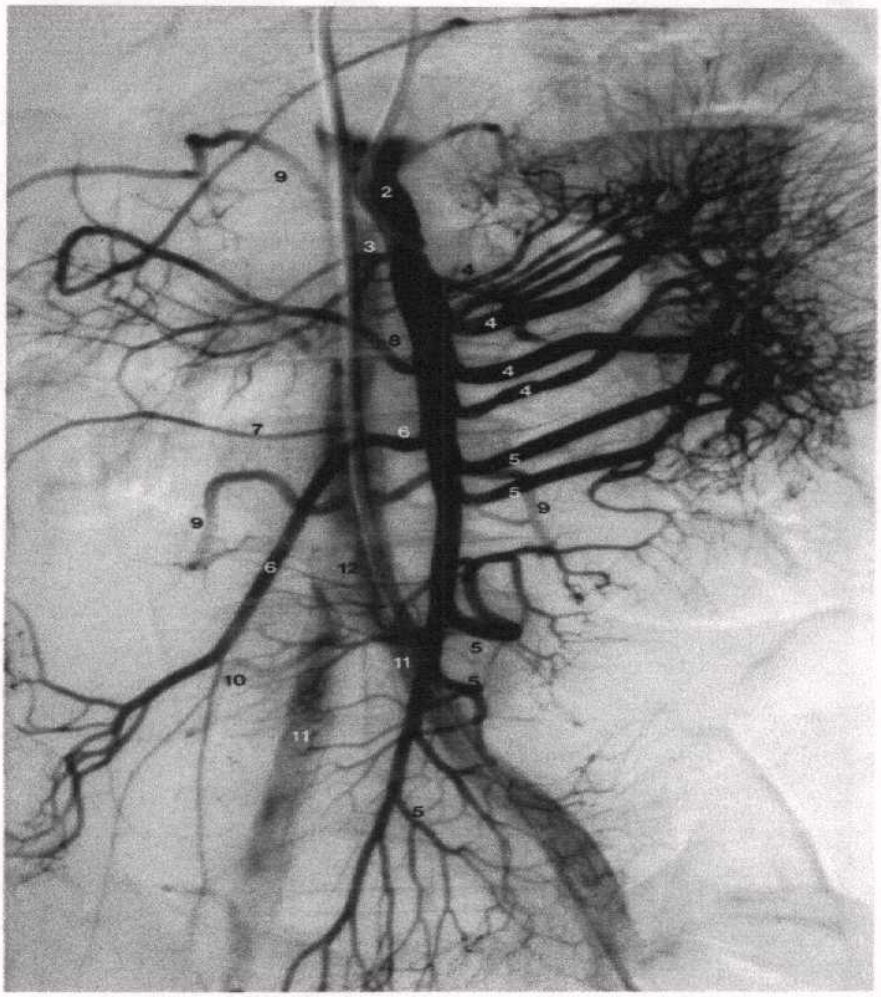


Fig (5): The superior mesenteric artery and its branches
(Coated From, William et al., 2000)

Mainly through the **superior mesenteric artery**, which supplies the whole length of the small intestine, except the superior part of the duodenum. It arises from the front of the aorta, about 1.25 cm. below the celiac artery. The superior mesenteric vein, which lies to its right side, accompanies it and the superior mesenteric plexus of nerves surrounds it *(Cokkinis., 1995)*.

Branches:

1) Superior &Inferior pancreatico-duodenal
2)Ileocolic
3)Intestinal
4) Right Colic
5) Middle Colic



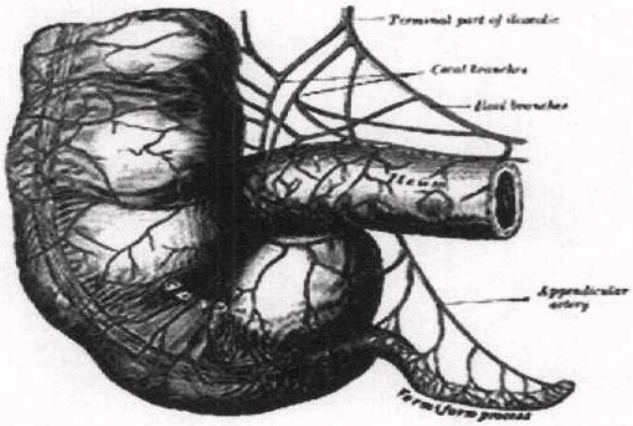
Fig(6): Subtracted superior mesenteric arteriogram
(Coated From, Weir et al., 1996)

1) Catheter with tip selectively in superior mesenteric artery **2)**Superior mesenteric artery
3) Inferior pancreaticoduodenal artery **4)** Jejunal branches **5)** Ileal branches
6) Ileocolic artery **7)** Right colic artery **8)** Middle colic artery
9) Lumbar arteries arising from abdominal aorta **10)** Appendicular artery
11) Iliac artery **12)** Aorta

- **Inferior pancreatico-duodenal Artery:** is given off from the superior mesenteric or from its first intestinal branch, opposite the upper border of the inferior part of the duodenum. It distributes branches to the head of the pancreas and to the descending and inferior parts of the duodenum ***(Holmes., 1995).***
- **Intestinal Arteries:** arise from the convex side of the superior mesenteric artery. They are usually from twelve to fifteen in number, and are distributed to the jejunum and ileum. They run nearly parallel

with one another between the layers of the mesentery ***(De-Busscher., 1998)***.

- **Ileocolic Artery:** is the lowest branch arising from the concavity of the superior mesenteric artery.



Fig(7): Arteries of the terminal ileum, ceacum& vermiform appendix
(Coated From, William 2000).

It passes downward and to the right behind the peritoneum toward the right iliac fossa, where it divides into a superior and an inferior branch. The inferior branch of the ileo-colic runs toward the upper border of the ileo-colic junction and supplies the following branches:

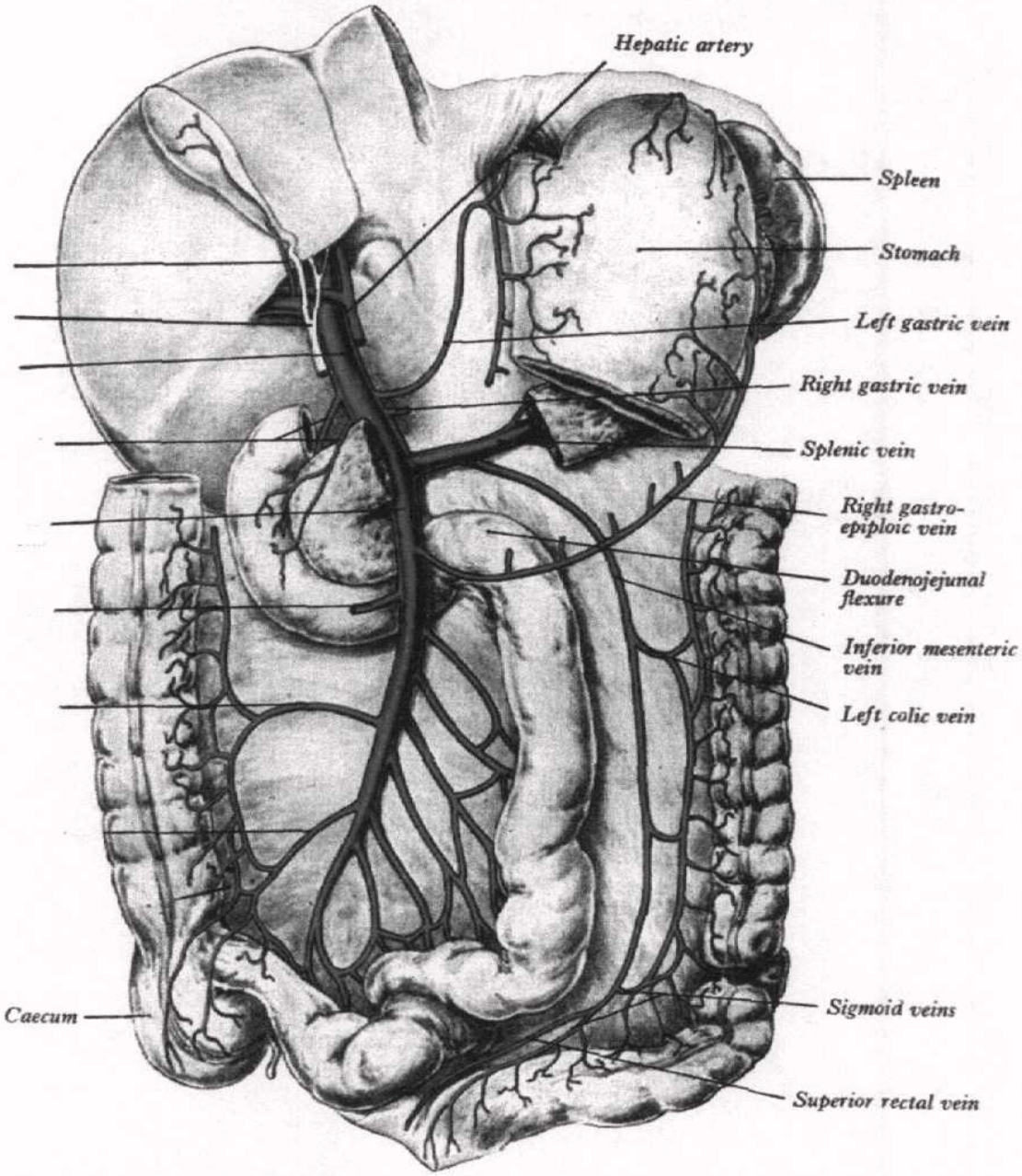
(a) **Colic,** which pass upward on the ascending colon.

(b) **Anterior** and **posterior ceacal,** which are distributed to the front and back of the ceacum.

(c) **Appendicular artery,** which descends behind the termination of the ileum and supply the vermiform process.

(d) **Ileal,** which run upward and to the left to anastomose with the termination of the superior mesenteric ***(De-Busscher., 1998)***.

VENOUS DRAINAGE



Fig(8): The portal vein and its tributaries
(Coated From, William et al., 2000)

The superior mesenteric vein:

Drains the small intestine, ceacum, ascending and transverse parts of the colon. Beginning in the right iliac fossa by the union of tributaries from the terminal ileum, ceacum and vermiform appendix, it ascends in the mesentery on the right of the superior mesenteric artery, passing anterior to the right

ureter, inferior vena cava, the horizontal part of the duodenum and uncinate process of the pancreas, joining the splenic vein behind its neck to form the portal vein ***(Hollinshead., 1997)***.

Its tributaries are:

1) Jejunal **2)** Ileal **3)** Ileo-colic,

4,5) Right & middle colic **6)** Right gastro-epiploic

7) Superior & inferior pancreatico-duodenal

NERVOUS SUPPLY OF THE JEJUNUM AND ILEUM

The *nerve supply* of the jejunum and ileum are derived from the plexuses of sympathetic nerves around the superior mesenteric artery. From this source they run to the *myenteric plexus* (*Auerbach's plexus*) of nerves and ganglia situated between the circular and longitudinal muscular fibres from which the nervous branches are distributed to the muscular coats of the intestine. From this a secondary plexus, the *plexus of the submucosa* (*Meissner's plexus*) is derived, and is formed by branches, which have perforated the circular muscular fibers. This plexus lies in the submucous coat of the intestine ***(Sundier.,1998)***.

Innervation is by the vagi and thoracic splanchnic nerves through the celiac ganglia and superior mesenteric plexuses. Fibres pass to the *myenteric plexus* of nerves and ganglia between the circular and longitudinal layers of the muscularis externa, which they supply. From this a secondary, *submucous plexus* is derived, formed by branches perforating the circular, muscular layer; it also contains ganglionic neurons from which fibres pass to the muscularis mucosae. Nerve bundles in the submucous plexus are finer. Ganglion cells in both plexuses are essentially parasympathetic (vagal). In general the sympathetic system inhibits peristalsis but stimulates the sphincters and muscularis mucosae. The parasympathetic generally augments peristalsis and inhibits the sphincters. The results of parasympathetic stimulation depending on the state of contraction or relaxation of the organ at the time of

stimulation. The parasympathetic also augments intestinal secretion ***(Gray., 1994)***.

LYMPHATIC DRAINAGE

The Lymphatic Vessels of the Jejunum and Ileum are termed lacteals, from the milk-white fluid they contain during intestinal digestion. They run between the layers of the mesentery and enter the mesenteric glands, the efferent of which end in the pre-aortic glands ***(Schoefl., 1998)***.

Lymph from most of the abdominal wall and all abdominal viscera (except a small hepatic region) is returned via the thoracic duct. Lymphatic vessels run with their corresponding arteries, the lymph nodes forming a large number of intermediary groups along the arteries concerned and a few terminal groups near the abdominal aorta ***(Alien.,1996)***.

The lymph vessels (lacteals) are arranged at two levels, mucosal and muscular. Lymph vessels of villi commence, form an intricate plexus in mucosa and submucosa, are joined by vessels from lymph spaces at the bases of solitary follicles and drain to larger vessels at the mesenteric aspect of the gut. Lymph vessels of the muscular tunic form a close plexus running mostly between the muscle layers; they communicate everywhere with mucosal vessels and open like them into the lacteal drainage at the attached border of the gut ***(Aschoff., 1994)***.

The visceral glands are associated with the branches of the celiac, superior and inferior mesenteric arteries ***(Aschoff., 1994)***. Our concern will be toward the superior mesenteric group.

Superior mesenteric nodes:

The superior mesenteric glands receive afferents from the jejunum, ileum, ceacum, vermiform appendix, the ascending and transverse parts of the colon; their efferent pass to the pre-aortic glands. The superior mesenteric glands may be divided into three principal groups: **mesenteric, ileocolic,** and **mesocolic** ***(Code., 1994)***.

* **Mesenteric nodes** (*lymphoglandulæ mesentericæ*):

Lie between the layers of the mesentery, numbering 100-150 & comprise three series: one close to the intestinal wall among the terminal rami of the jejunal and ileal arteries *(mural);* a second is among the loops and primary branches of the vessels *(intermediate);* and a third is along the upper trunk of the superior mesenteric artery *(juxta-arterial).* Vessels from the terminal centimetres of the ileum follow the ileal branch of the ileocolic artery to the ileo-colic nodes ***(Navaratnam., 1995).***

* **Ileo-colic nodes:**

They form a *chain* of 10-20 around the ileo-colic artery but tend to form two groups: near the duodenum and along the artery's terminal part. The chain divides with the artery into:

- **Ileal nodes:** close to the ileal branch.
- **Anterior ileo-colic nodes:** (usually 3) in the ileocecal fold near the ceacal wall
- **Posterior ileo-colic nodes:** mostly in the angle between ileum and colon but partly behind the ceacum at its junction with the ascending colon.
- **Appendicular node:** in the meso-appendix ***(Jit et al., 1994).***

* **Mesocolic Glands**:

They are numerous, and lie between the layers of the transverse mesocolon, in close relation to the transverse colon; they are best developed in the neighbourhood of the right and left colic flexures. One or two small glands are occasionally seen along the trunk of the right colic artery and others are found in relation to the trunk and branches of the middle colic artery ***(Rusznyak et al., 1996).***

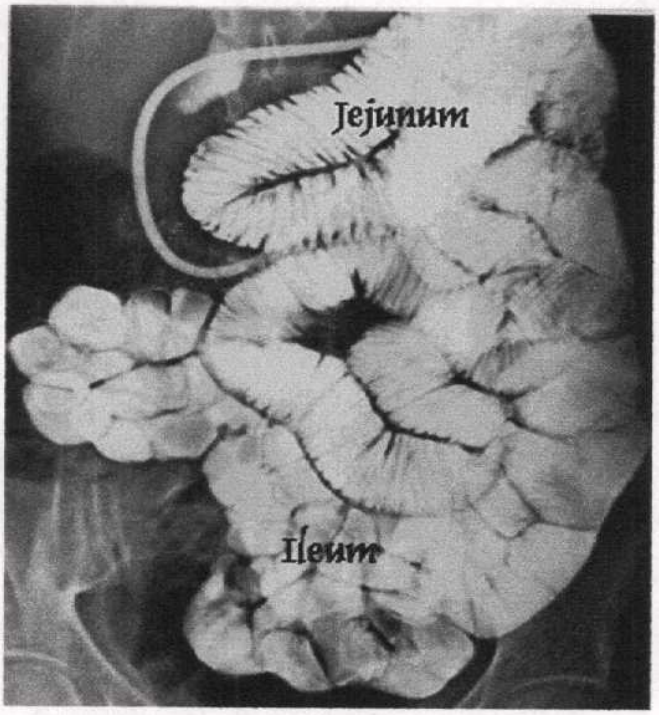


Fig (9): Normal radiological appearance of the small intestine

(Coated From Alexander et al., 1983)

The radiological changes of small bowel diseases depend on changes of the mucosal pattern, character of the intestinal wall and the intestinal lumen, so the normal radiological appearance of the small intestine is of great importance ***(Herlinger et al., 1990).***

The small intestine extends from the pyloric canal to the ileo-ceacal junction. It consists of three parts, the duodenum, the jejunum, and the ileum. Each segment has rather distinctive radiological characteristics, although the junction of one with the other is imperceptible, however, the anatomic position of the duodeno-jejunal junction is accurately identified posterior to the stomach at the suspensory attachment of the ligament of Treitz ***(Asteley et al., 1991).***

The position of the small intestinal loops varies greatly in different individuals and even from one time to another within the same individual ***(Bouslog., 1994).***

The roentgenologic identification of the segments of small intestine depends on their location in the abdomen and the appearance of their mucosal folds, known as the valvulae conniventes or the plicae circularis ***(Chambeerlin., 1990).***

So, in brief the X-ray examination of the small intestine should permit observation of:

- **Contour of mucosal surface and mucosal folds.**
- **Size of lumen.**
- **Thickness of the wall.**
- **Flexibility and motility of the wall.**
- **Distance between loops.**

Normal anatomical appearance via barium examination:

The jejunum extends from the duodeno-jejunal junction at the ligament of Treitz to its junction with the ileum. The point of transition between jejunum and ileum is ill-defined and consists of gradual change in mucosal pattern. The proximal portion of the jejunum lies in the left upper quadrant of the abdomen, the middle and distal portion of the jejunum in the mid abdomen, and the ileum in the lower abdomen and the pelvis. The mucosal pattern of the upper jejunum consists of deeply serrated plicae which, when coated with barium, have a characteristic fine, feather, or lace like pattern. The narrowness and closely packed arrangement of the plicae in the proximal jejunum may occasionally simulate the coiled-spring appearance of an intussusception. After the barium has passed through the jejunum, the particles which remain adherent to the mucosa often produce a snowflake effect .The jejunal plicae become gradually shorter and more widely spaced on progression toward the ileum ***(Wells., 1990).***

In the distal portion of the jejunum and the proximal ileum, the folds are no longer feathery or lace like, but are coarse and have a cogwheel outline. The mucosal folds become more widely spaced in the mid-portion of the ileum and in the distal portion, the borders of the barium column are smooth and tubular ***(Herlinger et al., 1990).***

This typical radiographic pattern of the various segments of the small bowel is seldom, though occasionally, seen in the very young infant, but become increasingly evident after the fourth or fifth month. The explanation for absence of the characteristic pattern in the neonatal period is not clear, since the plicae are well

developed. However, the gaps between the plicae are perhaps too small or blocked by mucus to allow complete filing by the contrast material ***(Fryx., 1991).***

In the ileum, the mucosal pattern of the terminal portion is not clearly identified unless pressure films are obtained or an exposure is made during contraction of this segment of bowel. In such instances three patterns may be encountered, transverse folds, longitudinal folds, or a cobblestone effect produced by the relative large lymphoid patches in children, which result in multiple filling defects and the cobblestone effect that will be due to the normally large Peyer's patches in children (most often encountered in children between 3 and 10 years of age) ***(Bouslog., 1994).***

In the young infant no definite mucosal pattern is characteristic, but occasionally pressure films will show longitudinal striations characteristic of adult ileum, or at times transverse folds. Abdominal scout films of both infant and older children occasionally show superior displacement of the terminal small bowel by a distended urinary bladder ***(Golden., 1990).***

Normal lumen diameter

	Small bowel meal (cm)	Enteroclysis (cm)
Proximal jejunum	3	4
Mid small bowel	2.5	3.5
Distal ileum	2	3

Small bowel folds during enteroclysis

	Jejunum	Ileum
Number of folds per inch	4–7	2–4
Fold thickness (mm)	1–2	1–1.5
Fold height (mm)	3–7	1–3

(Rubes et al., 2003).

Contour of mucosal surface and mucosal folds:

In the jejunum the mucosal folds lying close together and traverse the full width of the lumen and do not obliterate by distension ***(Laurance et al., 1990).***

In the ileum, the folds vary greatly in the degree of separation. The mucosal folds of the ileum disappear when the lumen is distended, but are sometimes lacking

or infrequent even when the lumen is normal in calibre ***(Laurance et al., 1990).***

Mucosal folds of both jejunum and ileum are usually transverse in the resting phase, but turn longitudinally as the contractions pass through. The size and shape of the folds are governed principally by the function of the muscularis mucosa ***(Laurance et al., 1990).***

The regularity of the margins reflects the contour of the mucosal surface. Destruction of the mucosa is usually associated with obliteration of the fold pattern ***(Herlinger et al., 1990).***

Fig (10): Normal wall Thickness
(Coated From Alexander et al., 1983)

At the ileo-ceacal valve the lumen of the ileum narrows in a beak-like fashion as it passes between the lips of the valve (represented by a smoothly rounded filling defect in the medial margin of the ceacum). The mucosal contour in the terminal segment of the ileum may be longitudinal, linear or may present multiple rounded defects, which suggest a cobblestone pattern. The latter best seen in pressure films and is more common in children than the longitudinal linear pattern that is characteristic of adults. The cobblestone pattern represents filling defects caused by solitary and conglomerate lymph follicles, which are most abundant and largest in the terminal ileum during adolescence and pre-adolescence ***(Chambeerlin., 1990).***

Size of the lumen: The shadow of the barium filled jejunum is a little wider than that of the ileum. The tonus of the small intestine evidenced by the calibre of the lumen differs in each individual and at different times of the same examination ***(Wells., 1990).***

Haworth & Handson et al., 1970 had measured the diameter of the small bowel in normal subjects, including 61 children aged 9 months to 15 years. In brief, this resulted in that: The calculated standard measurements for children increased from 12 mm at 6 months to 21 mm at 8 years and 23 mm at 15 years of age.

Thickness of the Wall: In some patients, the fat deposits along the serosa are sufficient to outline the outer aspect of the intestinal wall. Thus with either gas or barium in the lumen and radiolucent fat along the serosa, the actual thickness of the wall can be demonstrated. Indirect evidence of thickness of the wall is offered by the degree of separation of the intestinal loops and to a certain extent by the degree of flexibility of the intestinal wall. Loops may also be separated by adjacent abdominal masses, but if the separations are relatively uniform between parallel adjacent segments, it can be assumed that the wall is thickened by oedema or infiltration ***(Caffey., 1992).***

Some authors reported the combined wall thickness of two adjacent loops to be not more than 3 mm in normal cases taking in consideration that the two loops should be adjacent and parallel to each other for at least 4 cm ***(Herlinger et al., 1990).***

Flexibility and motility of the wall: Loops of small intestine normally have smoothly curving contour, which vary under manual pressure or during peristaltic rushes or respiratory motion ***(Golden., 1990).***

Loops of small intestine normally lie free in the abdominal cavity and their motion is limited only by the mesenteric attachment. Thus a segment seen on the left side of the abdomen during one part of the examination may be seen in the right side of the abdomen at another time ***(Fryx., 1991).***

Although a wide range of mobility is infrequent, it should be possible to move any loop of small intestine except those lying deep in the pelvis or those lying far posteriorly in a thick abdomen. Inability to displace loops indicates fixation to adjacent structures or impingement of a mass within the intestine ***(Asteley et al., 1991).***

❖ Intestinal pathological conditions could be classified into:

I) Congenital.

II) Acquired.

III) Mechanical disturbances.

IV) Vascular disturbances.

V) Inflammatory conditions.

VI) Malabsorption syndrome.

VII) Gastrointestinal manifestations of systemic diseases.

VIII) Neoplasms.

CONGENITAL ANOMALIES

- Atresia.
- Duplications & Enteric Cysts.
- Heterotopias.
- Meckel's Diverticulum.
- Miscellaneous Anomalies.

******

A) Atresia:

Interruption in the continuity of the bowel lumen, which may be partial (stenosis) or complete (atresia), manifests itself in early infancy and is incompatible with life without prompt surgical correction ***(De-Lorimer et al., 1996).***

Intestinal atresia may be associated with meconium ileus, which some investigators have considered to be the cause of the atresia ***(Kiesewetter et al., 1994).***

B) Heterotopias:

Gastric mucous membrane may be found in the cervical oesophagus or associated with other malformations such as Meckel's diverticulum, duplications, or enteric cysts (***Estrada.,1998).***

Pancreatic tissue occurs most commonly in the stomach and duodenum and less frequently in the jejunum and Meckel's diverticulum ***(Martinez et al., 1998).***

C) Duplications and Enteric Cysts:

These are segments of gastro-intestinal tube in apposition to any portion of the alimentary canal that may be completely independent of the adjacent normal intestine or share its lumen, mesentery and muscle coats ***(Bremer., 1994).***

Duplications are most common in the region of the terminal ileum, whereas enteric cysts are most often intra-thoracic and related to the oesophagus. They may be lined by small intestinal, gastric, or even bronchial mucous membrane ***(Bremer., 1994).***

D) Meckel's Diverticulum:

Meckel's diverticulum is a diverticulum on the anti-mesenteric aspect of the terminal ileum, 2.5 cm to 1.83 cm proximal to the ileocecal valve, and possesses all

the layers of small bowel. Its mucosa is usually that of the small intestine, but in 25% of the cases gastric mucosa with or without pancreatic tissue may be present ***(Johns et al., 1995).***

It may be manifested clinically by peptic ulceration and haemorrhage, obstruction of its lumen, Intussusception, or diverticulitis ***(Seagram ., 1998).***

E) Other Miscellaneous Anomalies:

A variety of anomalies of position may involve the gastrointestinal tract, such as the presence of portions of the tract in internal, external or diaphragmatic hernial sacs, malrotation or failure of descent of the intestine, transposition associated with transposition of other viscera, and variations in development or attachment of the mesentery. Any or all of these anomalies may be responsible for volvulus and intestinal obstruction ***(Edwards ., 1997).***

ACQUIRED CONDITIONS

- Diverticulae.
- Endometriosis.
- Pneumatosis cystoides intestinalis.

******

A) Diverticulae:

Diverticulae of the gastrointestinal tract are most commonly "false" (pulsion diverticula), representing herniations of the mucous membrane and muscularis mucosa through weakened areas or defects in the muscularis propria. Their walls do not have all the layers of the segment of alimentary tract from which they arise ***(King., 1997).***

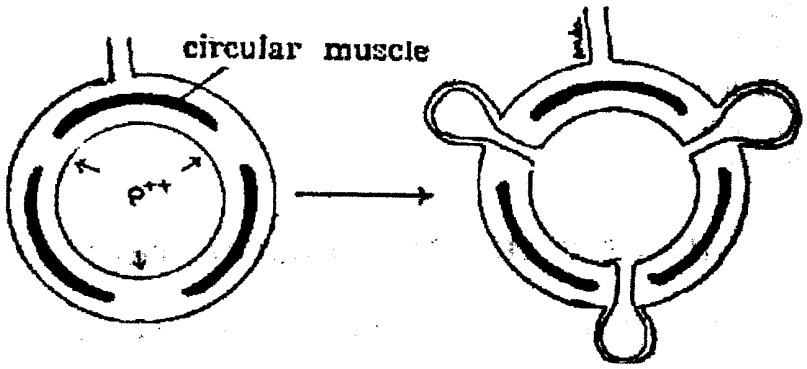


Figure (11): *(Coated from Kissane et al., 1996)*

Jejunal diverticulae are due to herniation of mucosa through the submucosa and muscularis mucosa on the mesenteric side of the intestine at the points of entrance of blood vessels. They are uncommon, occurring mostly in elderly patients ***(Painter et al., 1995).***

Jejunal diverticulosis should always be considered in elderly patients who present with malabsorption and megaloblastic anaemia. Other complications include intussusception, intestinal obstruction, rupture, diverticulitis and bleeding ***(King., 1997).***

Diverticulae of the ileum are relatively rare, unlike diverticulae in the jejunum. Complications are extremely rare but perforation, diverticulitis, fistula formation and bleeding have been reported ***(Borow et al., 1997).***

B) Pneumatosis cystoides intestinalis:

In pneumatosis intestinalis, gas-filled cysts are found in the submucosa or wall of the small intestine ***(Ecker et al., 1997).***

It now appears that the condition can be explained on a mechanical basis in association with ***(1)*** obstruction with ulceration, ***(2)*** trauma from biopsy, or sigmoidoscopic examination etc., ***(3)*** respiratory disease with severe cough. In the last case, it is assumed that pneumomediastinum occurs after pulmonary alveolar rupture, since the air then dissects retroperitoneally and reaches the intestine along the path of the mesenteric blood vessels. The gas cysts range in diameter from a few millimetres to a centimetre or more. The cysts do not communicate with the intestinal lumen or with each other ***(Kevtmg ., 1997).***

C) Endometriosis:

Foci of endometrial glands and endometrial stroma may involve the colon, usually the sigmoid or rectum, appendix, or small bowel. It may be responsible for obstructive symptoms, colic, and diarrhoea, or even rectal bleeding. Obstruction is the result of fibrosis or muscle spasm ***(Tagart., 1999).***

MECHANICAL DISTURBANCES

- Obstruction
- Neoplasms.
- Obturation Obstruction.
- Adynamic (paralytic) Ileus.
- Hernia.
- Intussusception.
- Adhesions.
- Volvulus.
- Stricture.

******

A) Obstruction:

The most common causes are; hernias, adhesions, and neoplasms. Other causes are volvulus, foreign objects, inflammatory disease, stricture, external compression by cysts, and congenital lesions such as meconium ileus ***(Mayo et al., 1997).***

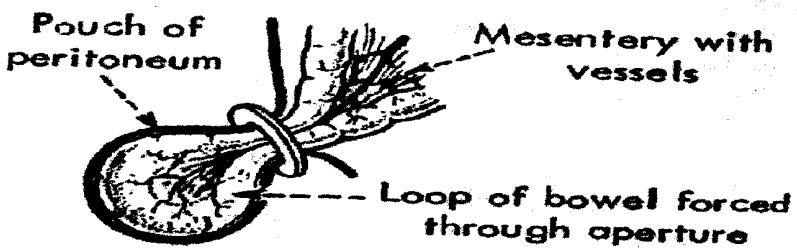


Fig (12) : *(Coated from Kissane et al., 1996)*

B) Hernia:

The majority of hernias are abdominal, resulting from herniation of abdominal contents through the internal or external inguinal rings, femoral ring, or defects in the abdominal wall resulting from trauma or improper healing after a surgical procedure ***(Barret ., 1994).***

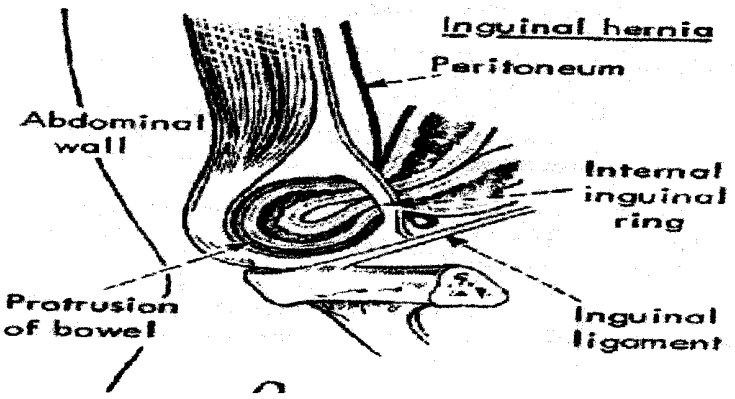
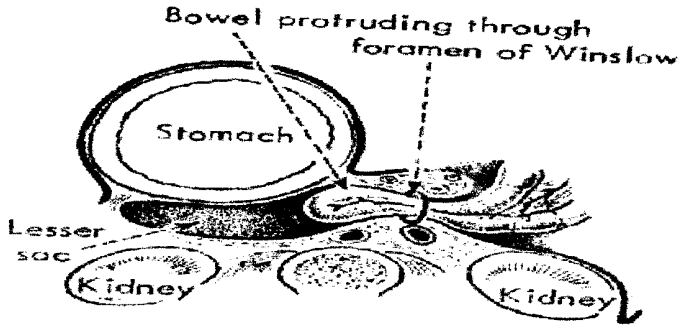


Figure (14) : *(Coated from Kissane et al., 1996)*

Less common are internal hernias, where loops of intestine penetrate a normal

small peritoneal recess, such as the fossa at the junction of the duodenum and jejunum ***(Grimes et al., 1995).***



Fig(14):*(Coated from Kissane et al., 1996)*

C) Adhesions:

In addition to congenital bands, peritoneal adhesions resulting from inflammation or after laparotomy may be responsible for intestinal obstruction ***(Marchand., 1996).***

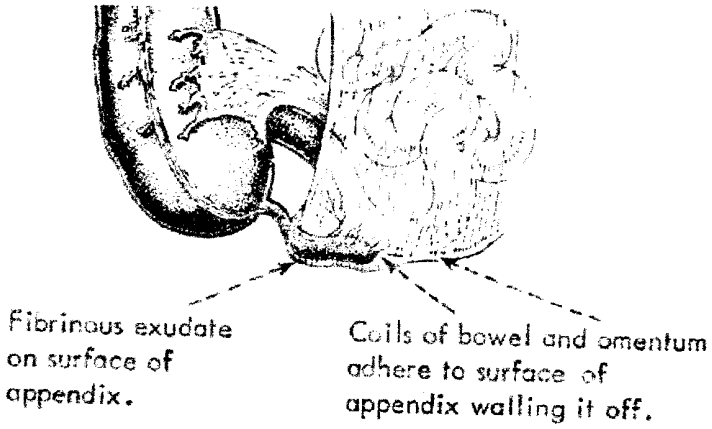


Figure (15):*(Coated from Kissane et al., 1996)*

D) Neoplasms:

Intestinal obstruction may result from primary or secondary bowel involvement by neoplasm, most commonly the encircling carcinomas ***(Marston ., 1995).***

E) Intussusception:

Intussusception is the invagination of a segment of intestinal tract (the intussusceptum) into the immediately adjacent (almost always distal) intestine (the intussuscipiens). It is primarily a disease of infants and young children, but it does occur in adults, in whom it may be initiated by a pedunculated benign or malignant

tumour growth. In children it is more common in the ileocecal region. Masses of lymphoid tissue, polyps, or the ileocecal valve itself may form the advancing head of the intussusception, which may result in bowel obstruction or regional compromise of blood supply ***(Benson et al., 1993).***

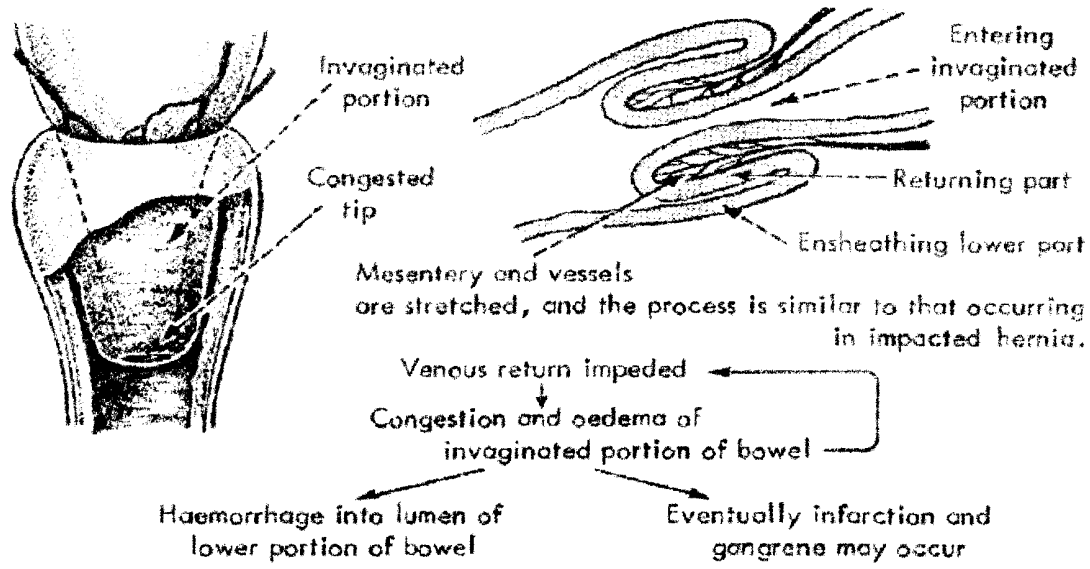


Figure (17):*(Coated from Kissane et al., 1996)*

E) Volvulus:

Volvulus is the twisting of a loop (or loops) of intestine upon itself through 180 degrees or more, producing obstruction of both the intestine and the blood supply of the affected loop. Causative factors are usually long mesenteric attachment, redundant intestine, or abnormal bands (congenital or acquired) ***(Bernstein ., 1996).***

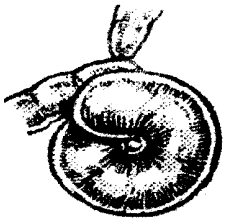


Figure (18):*(Coated from Kissane et al., 1996)*

G) Obturation Obstruction:

A foreign body, exogenous or endogenous, large or small, may obstruct the intestinal lumen by inducing bowel spasm or becoming entrapped in areas of anatomic or pathologic narrowing of the intestinal lumen. Gallstone obstruction of the small intestine complicating cholecystogastric or cholecystoduodenal fistula is an

example of common endogenous obstruction. Exogenous obstruction may result from parasitic infestation, particularly *Ascaris lumbricoides* ***(Norberg ., 1996).***

H) Stricture:

Intrinsic narrowing of the intestinal lumen may be the result of scarring in one or more of its layers as a result of; x-ray irradiation, scarring at the sites of surgical anastomosis or intestinal resection, and scleroderma ***(Perkins et al., 1996).***

I) Adynamic (paralytic) Ileus:

The clinical picture of acute intestinal obstruction may occur in the absence of mechanical or organic obstruction as a result of paralysis of the musculature of a portion or the entire intestinal tract. It frequently occurs after laparotomy, usually in a mild form. Peritonitis resulting from acute appendicitis with perforation, perforated peptic ulcer is probably the most important single underlying cause ***(Ochsner et al., 1996).***

VASCULAR DISTURBANCES

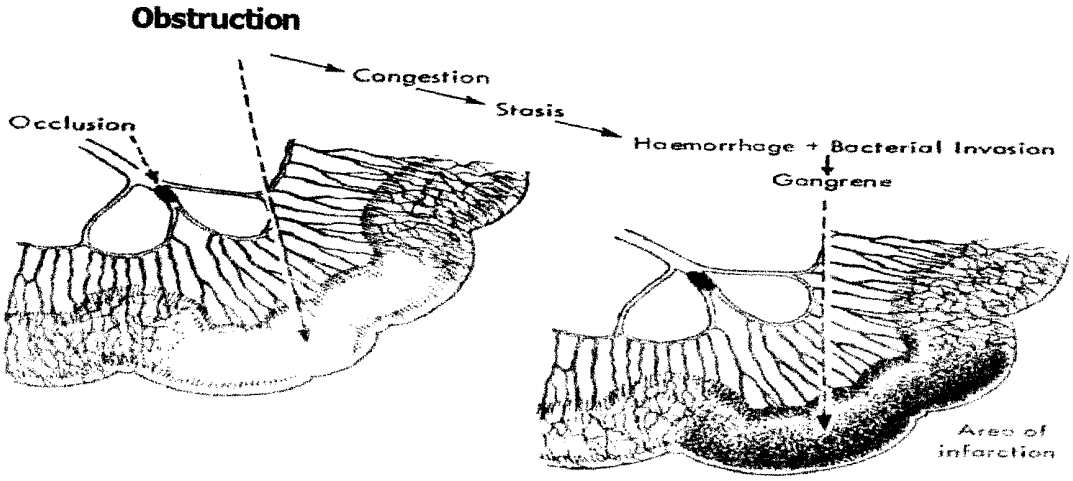
- Ischaemic Bowel Disease. -Gastrointestinal Haemorrhage.

******

A) Ischaemic Bowel Disease:

The complex control of the mesenteric circulation (cardiac, autonomic nervous system, peripheral collateral circulation, and peripheral auto regulation), coupled with the degree of local vascular disease, makes the bowel vulnerable to ischemia in a variety of ways ***(Norris., 1997).***

Excluding strangulation, as discussed previously, the causes of bowel ischemia are sclerosis of the mesenteric arteries with or without associated thrombosis; embolism (thrombotic, atherosclerotic plaques, or tumour) & venous thrombosis, sometimes associated with contraceptive drugs, and vascular diseases such as thrombo-angitis obliterans & vasculitis of various types. The superior mesenteric vessels and consequently the jejunum and proximal part of the ileum are most frequently involved ***(Marston ., 1995).***



Fig(18):*(Coated from Kissane et al., 1996)*

A complete arterial occlusion result in full-thickness infarction of the bowel, which is usually anaemic initially but with time becomes hemorrhagic. Venous occlusion

preceding arterial blockage causes infarction that is hemorrhagic from its inception. Paralysis of the bowel muscle may evolve producing intestinal obstruction ***(Thompson ., 1995).***

Reduction in blood flow to the intestine insufficient to produce a full-thickness infarct may result in a variety of non-specific lesions as ischemic enteritis, ulceration, inflammation, cicatrisation with stricture formation, and as well as intestinal angina ***(Civetta et al., 1995).***

B) **Gastrointestinal Haemorrhage:**

Bleeding into the gastrointestinal tract may be the result of a wide variety of lesions and may be minimal, producing anaemia, or massive and life threatening ***(Brief et al., 1995).***

Diverticular disease or the polyps of the Peutz-Jeghers syndrome may cause massive bleeding from the rectum or anus. However, these lesions also may be associated with bleeding of small amount, as in, regional enteritis, ulcerative colitis, and anal fissure ***(Thompson et al., 1999).***

Other potential causes of gastrointestinal bleeding include telangiectasis (Rendu-Osler-Weber disease), other vascular malformations, any of the blood dyscrasias, and anticoagulant therapy ***(Smith et al., 1996).***

INFLAMMATORY CONDITIONS

- Gastroenteritis.
- Inflammatory Fibroid Polyp & Eosinophilic Gastroenteritis.
- Inflammatory Bowel Disease.
- Pseudomembranous Enterocolitis.
- Tuberculosis.
- Necrotizing Enterocolitis.
- Fungal Infections.
- Parasitic Infestations.
- Other Causes of Gastrointestinal Inflammation.

******

A) Gastroenteritis:

May result from exogenous agents, such as ethanol, therapeutic drugs (e.g. salicylates), and irradiation, or endogenous agents, such as bacterial & viral agents and allergy ***(Moses et al., 1996).***

B) Inflammatory Fibroid Polyp and Eosinophilic Gastroenteritis:

They manifest themselves as either a localized, fibrotic, polypoid, tumour-like mass or a diffuse infiltration throughout all coats of the gut wall. Sites of involvement in order of frequency include the stomach, jejunum, ileum, and ceacum ***(Johnstone., 1998).***

C) Inflammatory Bowel Disease:

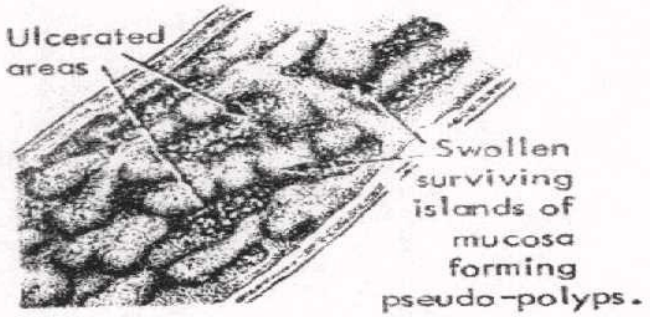
The term *inflammatory bowel disease* (IBD) includes regional enteritis (Crohn's disease CD) and ulcerative colitis UC, being preponderant in whites. Men and women are about equally affected, with a slightly greater incidence of UC in women. Both diseases can occur at any age but are more common in young adults, with a peak incidence at 20 to 30 years of age ***(Mitchell et al., 1996).***

- ***Aetiology:*** Although many theories been written regarding the aetiology of IBD, it remains uncertain. A genetic role has been considered important in view of a familial incidence and an association with ankylosing spondylitis, which is known to have genetic transmission. More recently an immune-mediated mechanism for both diseases has been given much attention ***(Dew et al., 1996).***
- ***Clinical features:*** The onset of both diseases may be acute or insidious;

their course is manifested by exacerbations and remissions. Diarrhoea and rectal bleeding occur in both diseases but are less frequent and severe in CD. Perirectal abscesses, fistulas, and bowel strictures are common in CD ***(Nesbit., 1996).***

❖ **Ulcerative colitis:**

It frequently begins in the rectum or sigmoid and progresses to involve part or the entire colon. The terminal ileum is involved in approximately one fourth of cases. Invariably there is hyperaemia, and the mucosa is dark red or purplish red. At last, tiny erosions appear, becoming deeper and coalescing to form linear ulcers, which have the appearance of longitudinal furrows distributed in the long axis. In acutely progressing cases, the entire colon is extremely friable and bleeds freely. The muscle is thickened, apparently by contraction, and rigid, having lost all or part of its distensibility, which may result in its shortening ***(Valdes-Dapena ., 1996).***



Fig(19):*(Coated from Kissane et al., 1996)*

The earliest histologic lesion in most cases is a crypt abscess. Other usual changes of inflammation that is, hyperaemia, edema, haemorrhage, and, more deeply, accumulation of lymphocytes and plasma cells, are present. Some authors have emphasized vasculitis as an early feature. UC is primarily a mucosal disease, with infrequent and usually limited involvement of the other layers ***(Akwari ., 1995).***

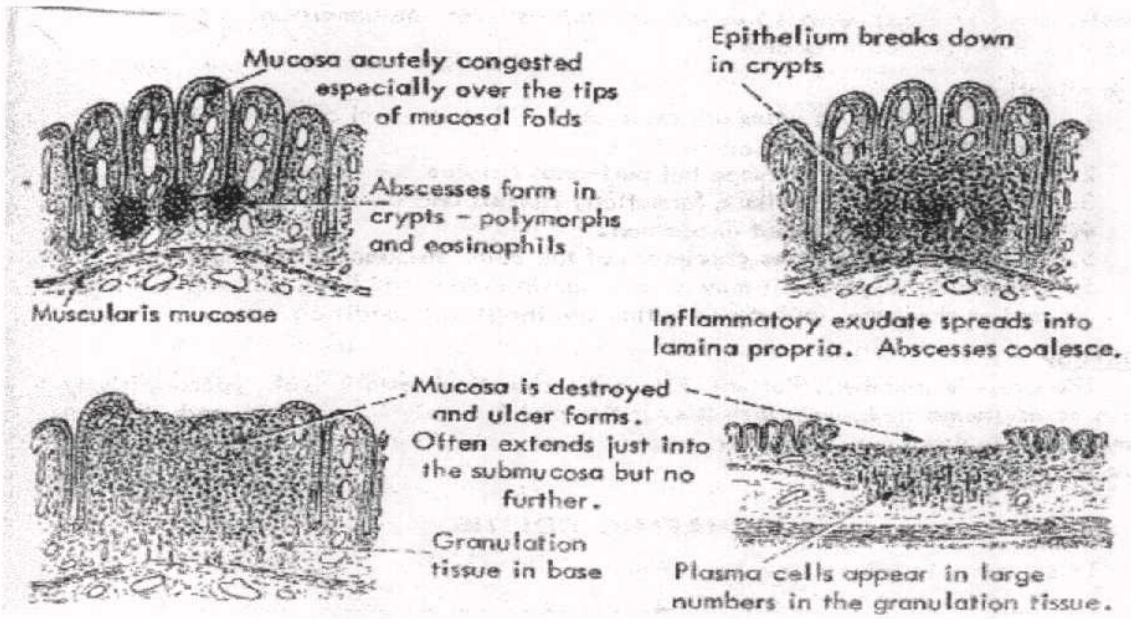


Figure (20):*(Coated from Kissane et al., 1996)*

Pseudo-polyps are a frequent and striking finding in UC, varying greatly in size and shape; however, true adenomatous polyps do occur ***(Dew.,1996).***

❖ **Crohn's disease:**

Unlike UC, Crohn's disease may involve any portion of the gastrointestinal tract, although it is most commonly found in the terminal ileum, often with extension into the ceacum and sometimes into the ascending colon as well. In more than half of the cases, multiple areas of both small and large intestines are involved in segmental fashion; that is, lengths of normal intestine separate areas of disease the so called skip areas ***(Kern., 1996).***

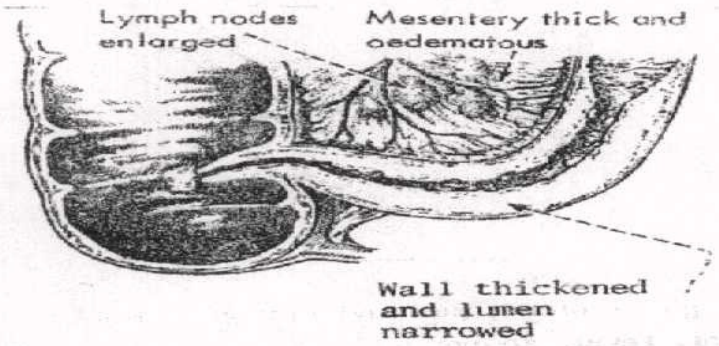


Figure (21):*(Coated from Kissane et al., 1996)*

The inflammatory changes are non-specific and more or less granulomatous. The

mucosal surface has a red, nodular, cobblestone-like appearance, with multiple linear and serpiginous ulcerations often extending varying distances into the bowel wall. All coats of the diseased intestine are thickened ***(Weedon ., 1995).***

Crypt abscesses are not as conspicuous as in UC. Deep ulcers may give rise to sinus tracts and perforations, which usually are walled off by omentum or adhesions. Fistulas may complicate long-standing cases, being internal; involving other organs or other segments of intestine, or external; opening on the skin of the abdomen after surgical procedures. The lymph nodes are enlarged and usually show non-specific inflammatory changes ***(Glass et al., 1996).***

- **Complications:**

Bowel obstruction from stricture or adhesions, fistulas, or perforation is more frequent in CD. Carcinoma is a well-known complication of UC, the incidence being 3% to 5% of patients with long-standing disease. Carcinomas with CD also do occur but in a less frequent fashion (***Mitchell et al., 1996).***

D) Pseudomembranous Enterocolitis:

Pseudo-membranous enterocolitis is a term used to describe an often lethal gastrointestinal lesion characterized by discrete, raised, yellow-green, adherent, sometime coalescing plaques separated by normal or oedematous congested mucosa. Any part of the intestinal tract may be involved, but the ileum and colon are more common. The pseudo-membrane is composed of mucin, fibrin, nuclear debris, and neutrophils. The mucosa underlying the pseudo-membrane may be partially or completely necrotic ***(Price et al., 1997).***

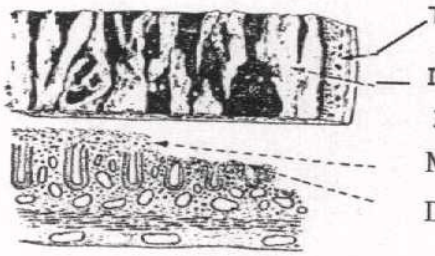


Figure (23):*(Coated from Kissane et al., 1996)*

There has been an association with major surgical procedures (usually of the intestinal tract), ischemic cardiovascular disease, hypotension, staphylococcal infection, heavy metal poisoning, septicaemia, uraemia, and a variety of antibiotics

(Bartlett ., 1997).

E) **Tuberculosis:**

Primary intestinal tuberculosis, ordinarily the result of ingestion of infected foods (especially dairy products) with the bovine tubercle bacillus, or associated with advanced open pulmonary disease with discharge from the lung lesions, and subsequent swallowing, of large numbers of bacilli ***(Abrams et al., 1994).***

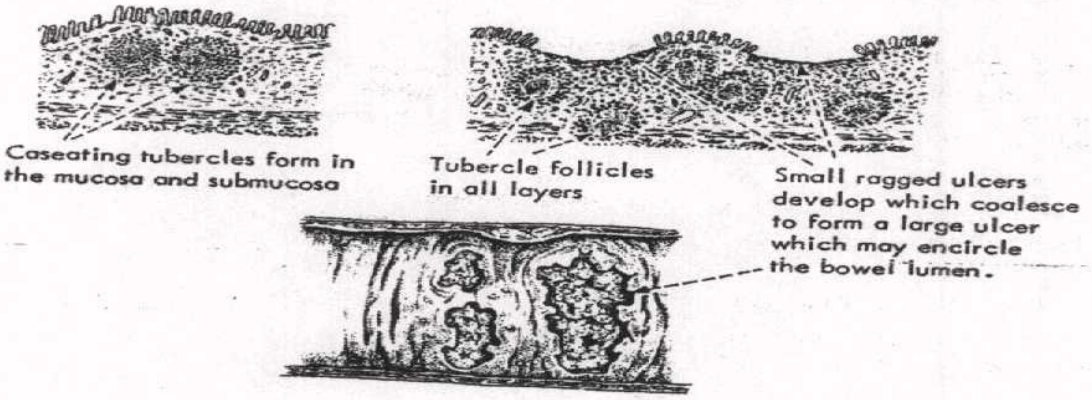


Figure (24):*(Coated from Kissane et al., 1996)*

The usual isolated gastrointestinal lesion involves the ileocecal or anal region. Rarely the oesophagus, stomach, or intestine may be involved ***(Cullen ., 1998).***

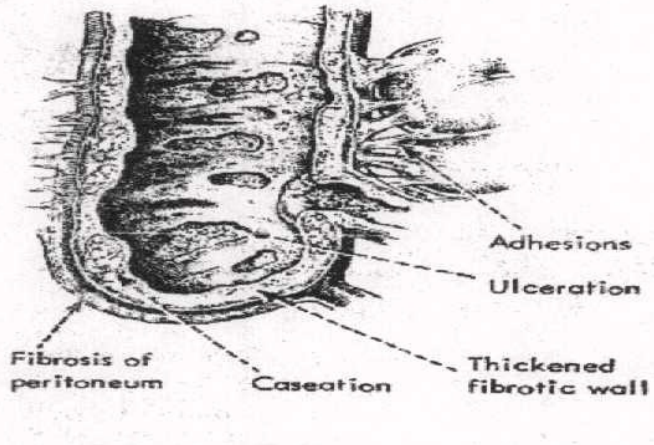


Figure (25):*(Coated from Kissane et al., 1996)*

F) **Necrotizing Enterocolitis:**

An inflammatory process that involves primarily the mucosa and submucosa or the entire wall of the terminal ileum and varying lengths of the colon, principally of

premature infants within the first few days of life and less commonly full-term infants or children in the first 2 months of life. Factors considered important in the aetiology of the condition are ischemia, shunting of blood from the involved areas as might occur with hypoxia and anoxia that is commonly seen in these infants, and bacterial infections ***(Torma ., 1997).***

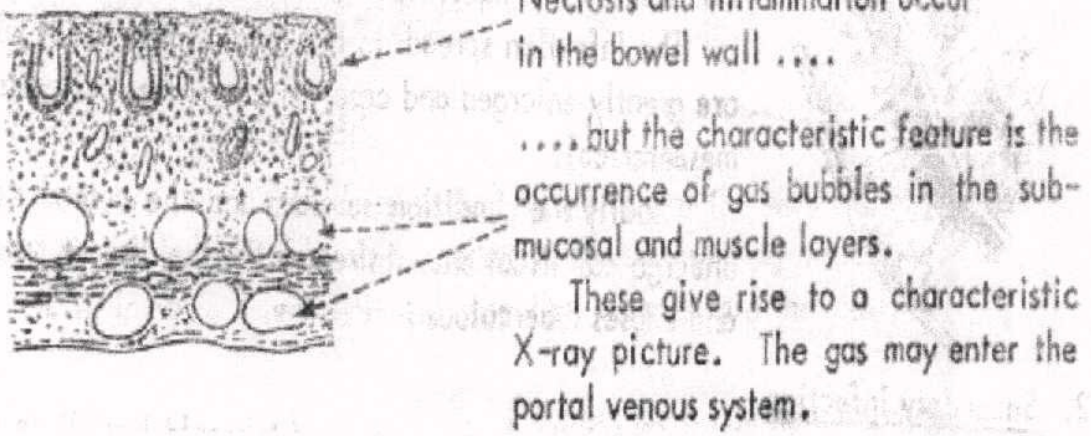


Figure (26):(Coated from Kissane et al., 1996)

G) Fungal Infections:

Involvement of the gastrointestinal tract is not an uncommon finding in patients who had chronic debilitating diseases or received prolonged intensive antibiotic therapy ***(Rubin ., 1997).***

Intestinal histoplasmosis may mimic tuberculosis in histopathological detail, and its differentiation is made by demonstration of the causative organism either in microscopic sections or in cultures. It is most common in the ileocecal region, but widespread gastrointestinal lesions may be present as part of a generalized histoplasmosis ***(Putman et al., 1995).***

H) Parasitic Infestations:

- ***Amebiasis (Entamoeba histolytica):*** most frequently involves the ceacal or rectal region. The colon may be greatly thickened, and there may be many adhesions to adjacent loops of intestine or to the mesentery ***(Kean et al., 1996).***

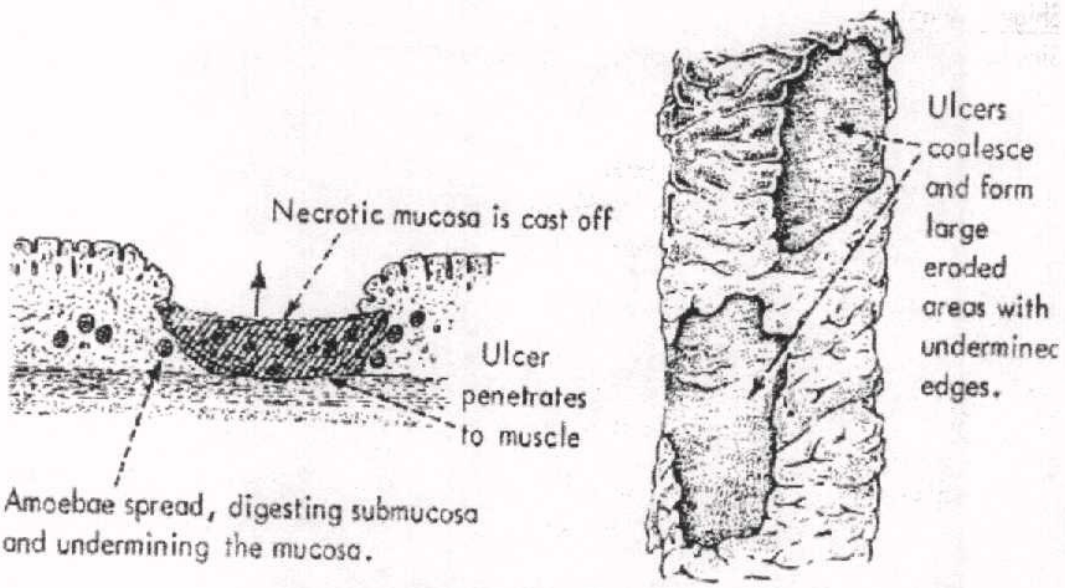


Figure (27):(Coated from Kissane et al., 1996)

- ***Schistosomiasis:*** Ova of the parasite *Schistosoma mansoni* or *S.japonicum* in the mucosa and submocosa may excite a tubercle-like reaction and a polypoid adenomatoid hyperplasia of the mucous membrane of the colon or rectum ***(Dimmette et al., 1996).***

- ***Ascariasis:*** Infestation of the gastrointestinal tract with *Ascaris lumbricoides* is very common in the tropics. If a large number are present in children, intestinal obstruction may develop ***(Dimmette et al., 1996).***

- ***Tapeworms:*** The beef and pork tapeworms, *Taenia saginata* and *Taenia solium,* may infest the gastrointestinal tract following the ingestion of contaminated raw or undercooked beef and pork ***(Kean et al., 1996).***

I) **Other Causes Of Gastrointestinal Inflammation:**

- ***Radiation:*** Ionising radiation given for treatment of cancer, usually of the female generative organs, may be responsible for inflammation in one or more focal areas of the small intestine or colon. Telangiectasia, edema and inflammatory cell infiltration of the submucosa and necrosis of mucous membrane are early changes. Radiation fibrosis, endarteritis, and vascular fibrosis may lead to bowel stricture or mucosal ulceration ***(Gelfand ., 1998).***

- ***Drugs:*** Drugs used in chemotherapy (e.g. 5-fluoro-uracil, lincomycin,

clindamycin) have been associated with changes in the intestinal tract. Non-specific ulceration of the small intestine, with blood and protein loss, may develop in patients on long-term treatment with non-steroidal anti-inflammatory drugs (NSAIDs) as well. Characteristic pathological findings include concentric, circumferential diaphragm-like narrowing that can progress to strictures ***(John et al., 2000).***

- ***Poisons:*** Mercury and arsenic may be responsible for non-specific inflammation or necrosis in the bowel ***(Conzales ., 1995).***
- ***Metabolites:*** Accumulation of metabolic products as occurs in patients suffering from uraemia may be responsible for minimal non-specific inflammation, while, some lesions may represent pseudo-membranous enterocolitis ***(John et al., 2000).***
- ***Virus infections:*** Intestinal changes associated with viruses are responsible for brief bouts of gastroenteritis ***(Schreiber et al., 1997).***

Malabsorption syndrome

The malabsorption syndrome is characterized by impaired intestinal absorption, especially of fats. The earliest phase characterized by fatigue, lassitude and mild diarrhoea. The onset is sharply defined. During the subsequent remission and exacerbations, there is progressive course characterized by steatorrhea, bloating of the lower abdomen and crampy abdominal pains, followed by explosive release of bulky foul smelling stools and malnutrition with attendant vitamin deficiencies, all in varying degrees. The cases may be subdivided into primary and secondary groups ***(Weinstein ., 1998).***

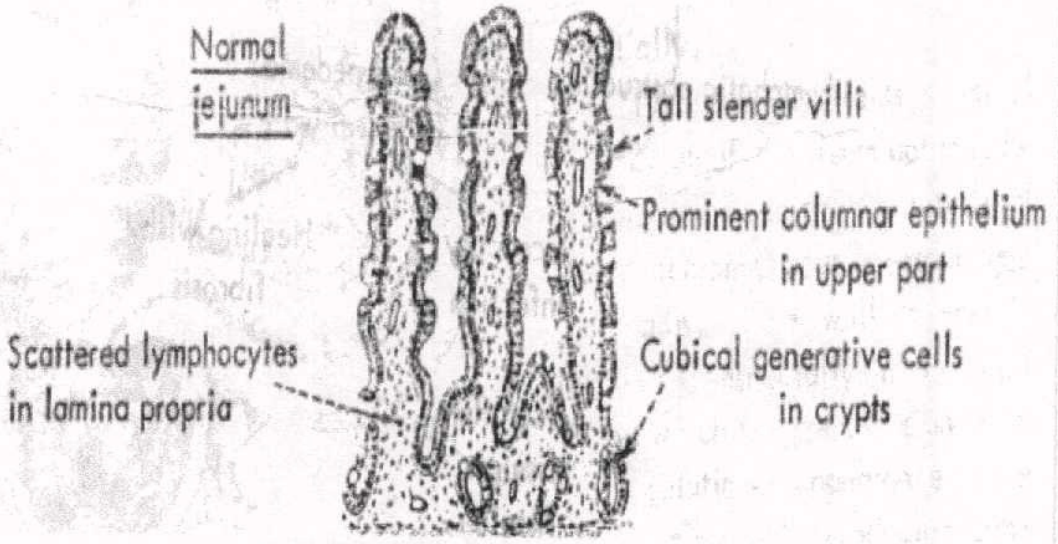


Figure (28)(Coated from Kissane et al., 1996)

Among the numerous causes of secondary malabsorption are cystic fibrosis of the pancreas, chronic incomplete intestinal obstruction, surgical resection of significant segments of the gastrointestinal tract, infections, antibiotics, biliary tract disease, scleroderma, Whipple's disease, parasitic infestations, regional enteritis, diabetes, as well as neoplasms (notably lymphoma) ***(Trier ., 1998).***

➢ **Tropical sprue:**

A primary malabsorption syndrome that means a chronic relapsing course. It is associated with a macrocytic anaemia and megaloblastic bone marrow, histological and radiological changes in the small bowel. Its aetiology remains unknown ***(Brow ., 1998).***

Aetiology and Pathology:** The aetiology of tropical sprue is unknown and still speculative. Many diseases that produce diarrhoea and malabsorption have been incorrectly called "sprue" ***(Davidson .,1997).

There are many theories concerning the aetiology of tropical sprue. These include infection, allergy, genetic, geographic and nutritional factors ***(Pomerantz ., 1997).***

Clinical Characteristics:** Whatever may be the aetiology of tropical sprue, there is primary damage to the mucosa of the gastrointestinal tract resulting in malabsorption of nutrients, mainly vitamins, minerals, fats and carbohydrates ***(Brow ., 1998).

The diagnosis is based on five parameters: ***(1)*** the clinical picture, ***(2)*** biochemical tests for malabsorption, ***(3)*** jejunal biopsy ***(4)*** radiological study of the small intestine ***(5)*** the response to therapy ***(Davidson .,1997)***.

➢ **Celiac sprue (non-tropical sprue):**

A type of a primary malabsorption or steatorrhea where there is sensitivity to gluten (gluten-sensitive enteropathy GSE). Elimination of gluten from the diet usually relieves the symptoms, although it does not cure the underlying defect ***(Waldmann .,1998).***

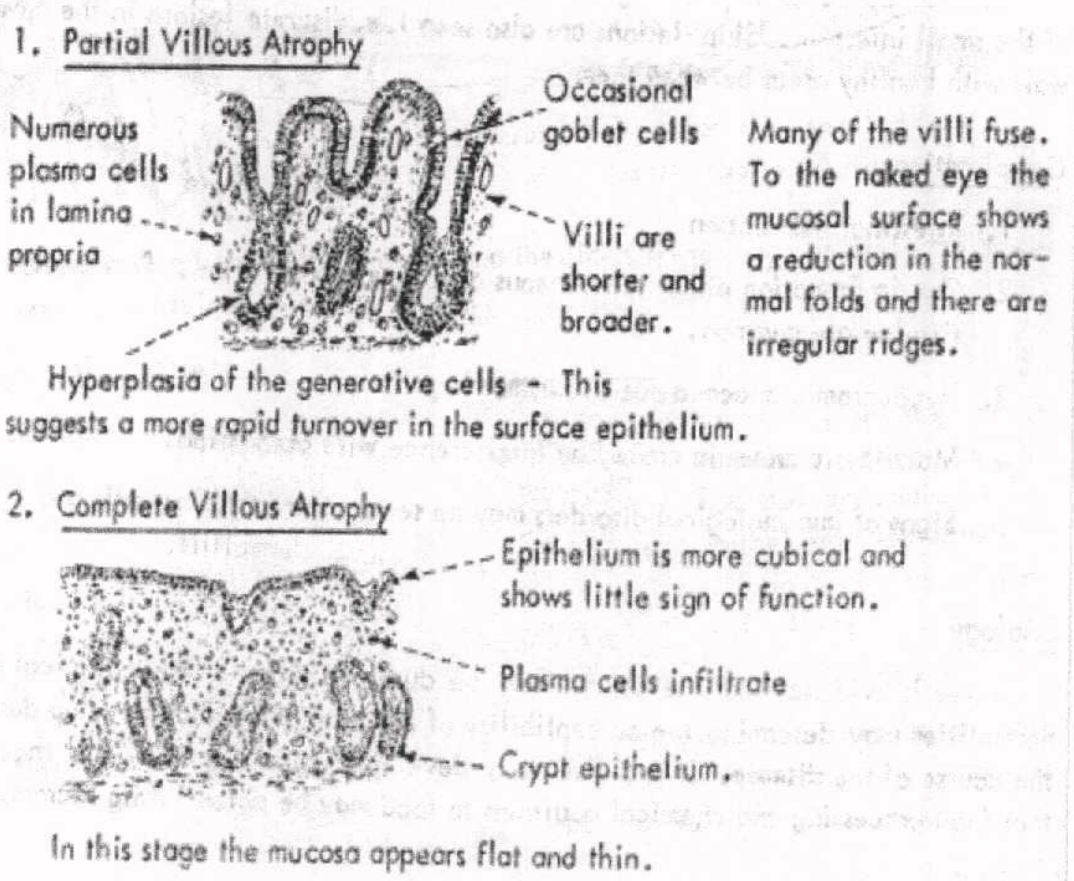


Figure (29)(Coated from Kissane et al., 1996)

The small intestine mucosa, of the upper jejunum in particular and to a lesser extent of the duodenum and ileum, has a flat surface partially or completely lacking in villi. The mucosal crypts appear elongated, dilated, and more widely spaced than normal. Numerous plasma cells and lymphocytes and fewer eosinophils and neutrophils are present in the lamina propria. Two theories of pathogenesis for the mucosal changes have been suggested:

(1) Toxic effect on the mucosa by increased gluten resulting from an enzyme deficiency in intestinal mucosal cells.

(2) Damage to mucosal cells by gluten-stimulated antibodies and lymphokines produced in the intestinal lymphoid tissue ***(Waldmann ,1998).***

GASTROINTESTINAL MANIFESTATIONS OF SYSTEMIC DISEASES

- Cystic Fibrosis.
- Progressive Systemic Sclerosis (Scleroderma).
- Whipple's Disease (intestinal lipodystrophy).
- Storage Disease.
- Acquired Immune Deficiency Syndrome (AIDS).
- Amyloidosis.

****

The gastrointestinal tract may be the site of involvement in a number of diseases involving multiple organs. Such involvement may produce symptoms, which are the first manifestations of the disease, or it may be occult. In both situations biopsy of the intestinal tract may be helpful in establishing the diagnosis. Symptoms that may be present diarrhoea, steatorrhea, and those of malabsorption ***(Di Sant'Agnese et al., 1998).***

A) Cystic Fibrosis:

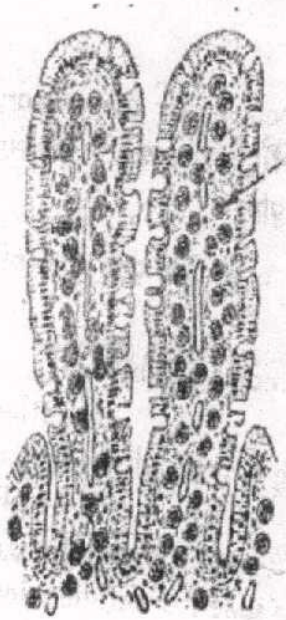
The most important gastrointestinal manifestation is malabsorption with steatorrhea. Approximately 10% of patients have intestinal obstruction in the newborn period as the result of meconium ileus. The abnormal accumulations of meconium distend the loops of intestine, which in one third of the cases rotate upon themselves producing a volvulus. Another complication is intestinal perforation in-utero with the development of sterile peritonitis, so-called meconium peritonitis ***(Donnison et al., 1996).***

B) Progressive Systemic Sclerosis (Scleroderma):

Although any portion of the intestinal tract may be involved, the oesophagus is the most frequent site. There is hyaline sclerosis of the submucosa with lymphocytic infiltration, as well as atrophy and fibrosis of the muscularis. The overlying mucous membrane may be thin and become ulcerated ***(Hoskins ., 1998).***

C) **Whipple's Disease (intestinal lipodystrophy):**

Originally considered to be a disorder of intestinal function involving lipid metabolism. Aggregates of large macrophages bearing intracytoplasmic sickle-shaped inclusions in the intestinal mucous membrane, lipid deposits are striking in lymph nodes, especially those of the mesentery ***(Bavless et al., 1997).***



The lesion in the jejunum is characteristic. Large macrophages fill the lamina propria of the villi. These contain mucopolysaccharides staining strongly with periodic acid Schiff (P.A.S.). Similar cells are found in the lymph nodes and sometimes in other organs. Fat accumulates in the lymphatics, possibly due to the obstruction by the macrophages. Bacteria have been found in the macrophages and antibiotics are curative. The disease is almost confined to middle-aged males.

Figure (30)*(Coated from Kissane et al., 1996)*

Whipple's disease is generally a condition of adult white men and may be familial. The manifestations are diarrhoea, gradual wasting, and migratory polyarthritis. An infectious aetiology has replaced the concept of a disorder of lipid metabolism. This is based on data generated from electron microscopic studies, bacterial cultures and favourable response of the disease to antibiotic therapy ***(Sicracki et al., 1999).***

D) **Storage Disease:**

Deposits of one of a number of substances seen in a variety of diseases such as: Tay-Sachs, Niemann-Pick, Fabry's, Gaucher's glycogen storage, Tangier and Wolman`s, may be found in ganglion cells, histiocytes, or nerve fibres in the gut ***(Lough ., 1998).***

Tangier disease is an autosomal recessive inherited disease in which there is

deposition of cholesterol esters in the reticuloendothelial system as well as in the mucous membrane of the pharynx and intestine ***(Bale ., 1997).***

Wolman's disease is also inherited as an autosomal recessive disease in which cholesterol esters may be found deposited in the lamina propria of the intestine as well as in the reticuloendothelial system of the liver, spleen, lymph nodes, and bone marrow ***(Dobbins ., 1996).***

E) **Acquired Immune Deficiency Syndrome (AIDS):**

The gastrointestinal tract is a major target organ in the acquired immune deficiency syndrome (AIDS) and there is evidence of small intestinal involvement in about half the patients. Opportunist infections, Kaposi sarcoma and AIDS-related lymphomas are the principal forms of intestinal involvement in AIDS patients. Clinical symptoms include a profuse watery diarrhoea and malabsorption ***(Ronald et al., 2001).***

F) **Amyloidosis:**

Infiltration of the gastrointestinal tract with amyloid occurs in the majority of patients with amyloid deposited in the walls of the blood vessels may produce vascular blockage resulting in edema of the mucosal folds of the intestine. The mucosal and muscle layers of the intestine are usually also involved ***(Ronald et al., 2001).***

NEOPLASMS

♦ Benign Neoplasms

- Leiomyomas.
- Adenomatous polyps, papillary adenomas and miscellaneous polyps.
- Lipomas.

♦ Malignant Neoplasms

➢ Primary Malignant Neoplasms

- Carcinoid tumours.
- Lymphoma.
- Primary carcinoma.
- Leiomyosarcoma.

➢ Secondary Neoplasms

♦ Miscellaneous Rare Tumours

- Pseudomyxoma peritonei.
- Vascular tumours.
- Tumours of nerve origin.
- Mesothelial cysts.

****

Primary neoplasms of the small intestine are rare and accounts for only 3-6 % of gastrointestinal neoplasms. Malignant neoplasms of the small intestine represent only 1 % of all gastrointestinal cancers. Pain, melena, iron deficiency, anaemia, and intussusception are the usual presenting symptoms ***(Ronald et al., 2001).***

Benign Neoplasms

A) Leiomyomas:

The most common primary benign neoplasm encountered in the small intestine. Patients usually present with acute bleeding. Leiomyomas may grow inwards into the lumen of the bowel or they may grow outwards to form a mass on the serosal surface. Some may grow in both directions and form a dumb-bell type of neoplasm ***(Forbes et al., 2000).***

It can be difficult to differentiate leiomyosarcomas from benign leiomyomas even on histological examination and the term leiomyomatous neoplasms has been suggested to include both types of smooth muscle neoplasm ***(Gourtsoyiannis et al., 1999).***

B) Adenomatous polyps, papillary adenomas and miscellaneous polyps:

Luminal projections of the gastrointestinal mucosa may result from a variety of neoplastic and non-neoplastic changes. The polypoid glandular neoplasms, adenomatous (tubular), papillary (villous), or mixed tubulo-papillary, occur throughout the gastrointestinal tract from the stomach to the rectum, but are most frequent in the colon and rectum ***(Muto et al., 1998).***

The adenomatous polyps are a very uncommon finding in the small intestine and when present are often symptomless. Their incidence increases after 30 years of age ***(Qizilbash et al., 1999).***

Villous adenomas are usually larger and sessile and have a papillary configuration. Large villous adenomas have been recognized as the occasional cause of severe fluid and electrolyte loss producing electrolyte imbalance, which may threaten life ***(Bussey ., 1998).***

C) Lipomas:

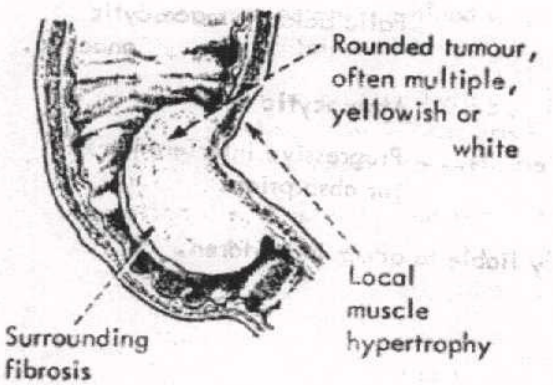


Figure (31)(Coated from Kissane et al., 1996)

Occasionally are encountered in various parts of the gastrointestinal tract, most often in the colon and rectum and particularly in the vicinity of the ileocecal valve,

where appreciable submucosal adipose tissue is usually present. They are submucosal, often superficially ulcerated ***(Higa ., 1998).***

Most of them are intramural or submucosal lesions, rarely causing symptoms although may lead sometimes to intussusception ***(Ronald et al., 2001).***

Malignant Neoplasms

➢ Primary Malignant Neoplasms

Can be divided into four main subdivisions consisting of carcinoid tumours, lymphomas, carcinomas and leiomyosarcomas ***(Darling et al., 1996).***

A) Carcinoid tumours:

One of the commonest primary neoplasms of the small intestine, and the most common site for tumours associated with the carcinoid syndrome is the small intestine. The ileum, particularly the distal ileum, is the site most frequently involved ***(Martin et al., 1994).***

Carcinoid (argentaffin) tumours of the small intestine should be regarded as being of low-grade malignancy with a very distinct liability to metastasise; a propensity that increases with their size ***(Could 1997).***

The carcinoid syndrome is the presenting complaint in many patients, which consists of diarrhoea, a peculiar cyanotic flushing of the skin, and right-sided heart failure, the last being based on organic disease of the tricuspid or pulmonary valve. Patients may also present with symptoms of intestinal obstruction, intussusception, abdominal pain, diarrhoea, abdominal mass or hepatic enlargement. The tumour often spreads to the mesenteric lymph nodes forming a mass, and segmental infarction of the small intestine may occur. Hepatic metastases may be few or numerous, small or large and are nearly always present in patients with the carcinoid syndrome ***(Williams et al., 1997).***

Narrowing of the lumen may be seen, sometimes with stricture formation.

Hypertrophy of muscle tissue occurs as a reaction to tumour infiltration of the *tunica muscularis*, this is associated with thickening of the *valvulae conniventes.* In cases with extensive mesenteric fibrosis (i.e. with the so-called desmoplastic reaction) the adjacent loops of intestine are compressed and it may be difficult to identify the primary tumour ***(Horn., 1996).***

B) Lymphoma:

Lymphoma is one of the commonest neoplasms of the small intestine, accounting for 40% of primary malignant neoplasms. Lymphomas of the gastrointestinal tract are malignant. Such malignant lymphomas may be a primary gastrointestinal tumour or a manifestation of generalized disease. The latter situation is more common ***(Comes et al., 1997).***

Gastrointestinal lesions in generalized malignant lymphoma are of importance when they are responsible for problems relative to gastrointestinal haemorrhage or obstruction ***(Dawson et al., 1998).***

Celiac disease and immunoproliferative small intestinal disease can predispose to secondary intestinal lymphoma. Patients with celiac disease who develop lymphoma are usually in the older age groups (most are over 50), being more frequently affecting the ileum than the jejunum ***(Azzopardi et al., 1997).***

While that complicates immunoproliferative small intestinal disease, usually affects the duodenum and proximal jejunum ***(Joseph et al., 1996).***

C) Primary carcinoma :

Carcinoma of the small intestine is an infrequent primary malignant tumour ***(Forbes et al., 2000).***

Primary carcinoma of the jejunum and ileum accounts for 15 % of small intestinal neoplasms. The jejunum is the usual site, with the ileum only rarely being the site of primary adenocarcinoma. There is an increased incidence of carcinoma of the small intestine in patients with familial polyposis, celiac and Crohn's diseases ***(Ronald et al., 2001).***

Stricture formation with mucosal destruction and shouldering of the margins,

ulcerating lesions and polypoid masses are characteristic ***(Ronald et al., 2001).***

D) Leiomyosarcoma:

They arise in any portion of the alimentary tract from the oesophagus to the rectum but are most common in the stomach. The small intestine is next most frequently involved where it is considered the fourth most frequently encountered primary malignant neoplasm of the small intestine ***(Forbes et al., 2000).***

Acute bleeding is the most common presenting symptom and massive gastrointestinal haemorrhage is frequent ***(Ronald et al., 2001).***

➢ Secondary Neoplasms

Secondary neoplasms involve the small intestine by direct invasion from adjacent organs, lymphatic extension, peritoneal seeding and embolic metastases. More than one mechanism of spread may be encountered in the same patient ***(Ronald et al., 2001).***

- ***Direct Invasion:*** of the small intestine from primary neoplasms of the ovary, colon, prostate, uterus and kidney ***(Darling et al., 1996).***
- ***Lymphatic Spread:*** plays a minor role in the spread of neoplasms to the small intestine; spread of ceacal carcinoma to the terminal ileum is a classic example of this type of spread ***(Kav ., 1999).***
- ***Intraperitoneal Seeding:*** of abdominal neoplasms frequently localizes in the right lower quadrant at the lower end of the mesentery. Stasis in the lower recess of the small intestinal mesentery results in the deposition and growth of secondary deposits ***(Kav ., 1999).***
- ***Blood Borne Metastases:*** to the small intestine from extra-abdominal sites are uncommon. The most common metastases are from malignant melanomas and primary carcinoma of the breast, lung, kidney and genital tract. ***(Darling et al., 1996).***

Miscellaneous Rare Tumours

- ***Pseudomyxoma peritonei,*** Most commonly it follows rupture of an appendiceal mucocele or mucinous ovarian tumour, but it may result from malignant mucinous tumours of other organs; in some instances the cause cannot be determined. The behaviour of pseudomyxoma peritonei is one of a locally infiltrating surface growth ***(Kav ., 1999).***

- ***Vascular tumours,*** especially cavernous haemangiomas have been reported as occurring in various parts of the gastrointestinal tract. Multiple haemangiomas may be seen as part of Osler-Weber-Rendu disease ***(Kav ., 1999).***

- The gastrointestinal tract and mesentery may be involved by tumours of nerve origin as *neurofibroma, neuroblastoma, ganglioneuroma* and *paraganglioma, teratoma,* and *choriocarcinoma* ***(Darling et al., 1996).***

- ***Mesothelial cysts*** are encountered rarely in the mesentery or retroperitoneum, of greater importance and slightly greater frequency are tumours arising from the serosal lining cells (mesotheliomas) ***(Limber et al., 1998).***

Any abnormality arising in the small intestine may be focal, long segment, or diffuse. The abnormality may alter the contour of the intestine; it can protrude into the lumen or extend outside of the expected luminal contour. A disorder involving the mucosa or submucosa disrupts the normal fold pattern of the small intestine ***(Rubes et al., 2003).***

Through analysing a combination of the following various factors, construction of rational lists of differential diagnoses can be established and provide a practical radiographic approach to small bowel disease.

- Calibre of the small bowel.
- Thickness and regularity of folds.
- Ulceration.
- Nodules.
- Concomitant gastric involvement.
- Filling defects.
- Mesenteric impressions.
- Desmoplastic response.
- Distribution of lesions.

Many radiology text books and articles handled the way of small bowel disease classifications in different manners, some use a pathologically dependent method putting them in separate disease entities as ***Margulis et al., 1983***, ***David Sutton et al., 2003*** , as well as ***Ronald Grainger et al., 2001***.

****

- **Inflammatory disorders and infestations:**

- **Crohn's disease:**

The radiological signs of Crohn's disease of the small intestine are as follows:

- Ulceration.
  - Discrete ulcers.
  - Fissure ulcers.
  - Longitudinal ulcers.
- Sinuses.
- Fistulae.
- Cobblestoning.
- Thickening of the Valvulae conniventes.
- Stenosis.

- Dilatation proximal to stenosis.
- Asymmetrical involvement.
- Skip lesions.
- False diverticula.
- Inflammatory polyps (pseudo-polyps).
- Featureless outline.
- Thickened wall.
- Enlarged ileoceacal valve.
- Gross distortion.
- A mass.
- Adhesions.

Discrete ulcers are mostly seen *en face* as small collections of barium with surrounding translucent zones due to oedema and are called **aphthoid** ulcers**. Fissure** ulcers are seen in profile and are usually short ***(Nolan et al., 2001).***

Fig. 35. Thick ileal folds in Crohn's disease. Thick, ovulated folds (*thick arrows*) are seen in the distal ileum. A subtle mesenteric border ulcer is seen (*thin arrows*). No narrowing has occurred yet ***(Coated from Rubesin 2003).***

Longitudinal ulcers, occur along the mesenteric border of the intestine. Fissure ulcers may lead to abscess formation and to the development of sinuses and fistulae ***(Nolan et al., 2001).***

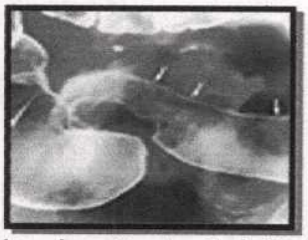


Fig. 36. Mesenteric border ulceration in Crohn's disease. A long, barium-filled groove (*arrows*) is seen in profile along the mesenteric border of the terminal ileum. The distal most ileum is narrowed and has shallow linear ulcers ***(Coated from Rubesin 2003).***

Fistulae usually pass to adjacent loops of ileum, the ceacum, the sigmoid colon or the urinary bladder, and occasionally they may pass to the skin or the vagina ***(Nolan et al., 2001).***

Cobble-stoning is seen fairly frequently in Crohn's disease of the small intestine and in most cases results from a combination of longitudinal and transverse fissures separating intact portions of mucosa ***(Nolan et al., 2001).***

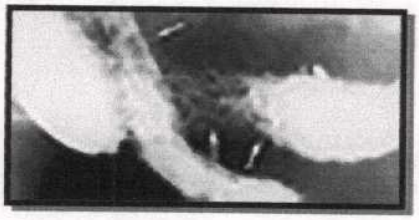


Fig. 37. Cobble stoning in Crohn's disease. Polygonal shaped, 3- to 5-mm radiolucent nodules are outlined by barium in transversely and longitudinally oriented knife-like clefts (representative areas of cobble stoning identified by *arrows*) ***(Coated from Rubesin 2003).***

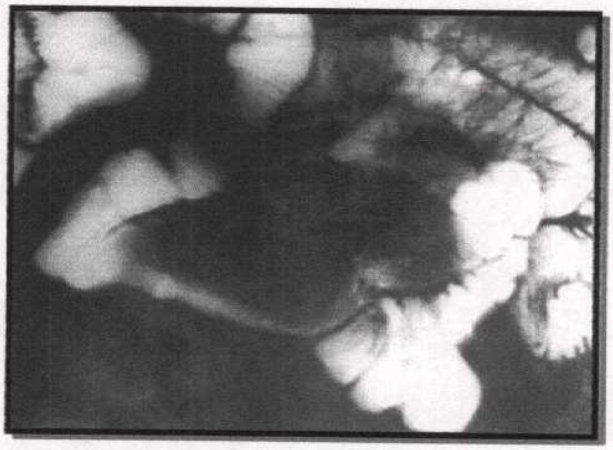


Fig 38. Crohn's disease. Marked thickening of the mesentery and mesenteric nodes produce a lobulated mass that widely separates small bowel loops ***(Coated from Eisenberg 2004).***

The valvulae conniventes are blunted, flattened, thickened and distorted or straightened. Aphthoid ulceration is the other early sign of Crohn's disease ***(Nolan et al., 2001).***

Strictures of the intestinal lumen are common and may be short, long, single or multiple. Multiple strictures are usually diagnostic of Crohn's disease. There may be dilated segments proximal to Crohn's strictures, although obstruction, particularly acute obstruction, may occur without significant dilatation of the intestine. Discontinuous involvement of the wall of the intestine by the disease process is a feature of Crohn's disease, shown radiologically as asymmetrical involvement and skip lesions. The diseased part of the intestine contracts and becomes shorter than the non- involved part.

When this happens in the same segment of intestine the characteristic 'pseudo-diverticula' are seen. Inflammatory polyps (pseudo-polyps) are seen in Crohn's disease as small discrete round filling defects though they are not a frequent finding. A smooth featureless outline replacing the normal mucosal pattern, without any significant changes in the calibre of the lumen, may occasionally be seen ***(Nolan et al., 2001).***

Fig 39. Crohn's disease. Compression view of the stenotic terminal ileum showing diffuse granular mucosal pattern both en face (long arrow) and tangially (short arrow) ***(Coated from Eisenberg 2004).***

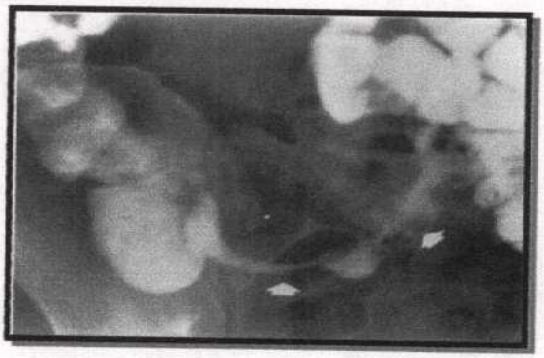


Fig 40. String sign in Crohn's disease. The mucosal pattern is lost in a severely narrowed, rigid segment of the terminal ileum ***(Coated from Eisenberg 2004).***

Thickening of the wall of the diseased intestine is shown radiologically as displacement of the adjacent barium-filled loops of intestine. In patients with ileoceacal Crohn's disease, enlargement of the ileoceacal valve may be seen. Gross distortion of the involved intestine sometimes occurs and is usually associated with abscess or fistula formation. A large mass in the right iliac fossa, caused by the presence of an abscess, may compress the terminal ileum and ceacum and displace the adjacent loops of intestine ***(Nolan et al., 2001).***

A long cobblestone segment or string sign associated with intramural fissures, sinuses, or fistulas suggests a diagnosis of Crohn's disease. The presence of aphthoid or larger ulcers proximal to the concentric lesion supports the diagnosis. The juxta-position of these three different types of lesions in the same intestinal loop has been proposed as the major radiological criterion of Crohn's disease in the small bowel, and the diagnostic reliability of this feature has been confirmed by further clinical experience. Conceivably, similar features may be observed in other chronic inflammatory lesions such as tuberculosis ***(Bodan et al., 1988).***

Sometimes the differential diagnosis may be difficult or even impossible to make and includes not only other inflammatory diseases such as infectious enteritis, especially yersiniosis and tuberculosis, ischemia, and radiation enteritis but also malignant lymphoma, carcinoid tumour, and carcinoma.

Fistulas may occasionally be observed which occur not only in cases of Crohn's disease but also in cases of tuberculosis, actinomycosis, radiation enteritis, and even atypical tumours ***(Bodart et al., 1997).***

- **Tuberculosis:**

The ileum, particularly the terminal ileum, is the most frequent site of involvement. Tuberculosis is usually shown on barium studies as a narrowed, thickened, rigid terminal ileum with some proximal dilatation, often with a small, distensible, thick, pulled-up ceacum and a disturbed ileoceacal angle ***(Vaidya et al., 1998).***

Fig. 54. Tuberculosis. The ceacum is markedly contracted and sacculated because of scarring. The inter-haustral folds of the ascending colon have disappeared and the colonic mucosa is granular. There is only mild nodularity of the terminal ileal mucosa ***(Coated from Rubesin 2003).***

It may be difficult to differentiate tuberculosis from Crohn's disease. In ileoceacal tuberculosis the segment of terminal ileum involved is usually

shorter than in Crohn's disease. Asymmetry and cobble stoning are features of Crohn's disease not seen in tuberculosis. Longitudinal ulceration sometimes occurs in Crohn's disease but is not seen in tuberculosis ***(Morson et al., 1990).***

- **Yersiniosis:**

The radiological changes of yersiniosis are limited to the distal 20 cm of ileum. The mucosal folds are tortuous, increased in number and thickened with the typical small, discrete nodular filling defects of lymphoid hyperplasia. Some thickening of the wall of the terminal ileum may be seen ***(Van Wiechen., 1994).***

- **Actinomycosis:**

Barium studies may show a mass causing ileoceacal compression. Enteroenteric, entero-colic, entero-cutaneous and entero-vesical fistulae may be demonstrated on contrast examination ***(Nolan et al., 2001).***

- **Giardiasis:**

Irregular thickening of the valvulae conniventes in the duodenum and proximal jejunum is the principal change observed on barium studies ***(Nolan et al., 2001).***

- **Strongyloidiasis:**

Barium studies may show delay in the passage of barium and thickening or absence of the valvulae conniventes in the duodenum and proximal jejunum. In severe cases a rigid 'pipe-stem' stenosis with irregular narrowing may be seen ***(Nolan et al., 2001).***

- **Anisakiasis:**

Barium studies show concentric narrowing of the involved segment of ileum, sometimes with proximal dilatation. The appearances may be indistinguishable from Crohn's disease although in anisakiasis the mucosa is usually intact ***(Nolan et al., 2001).***

- **Ascariasis:**

If a large number are present in children intestinal obstruction may develop. The worms can be seen on barium studies in adults as single or multiple smooth longitudinal or coiled filling defects, sometimes with a thin central track of barium outlining the worm's intestinal tract ***(Nolan et al., 2001).***

- **Tapeworms:**

The tapeworms are seen characteristically in the small intestine as a single, long, gradually tapering radiolucent line within the barium column ***(Reeder et al., 1989).***

- **Chronic radiation enteritis:**

The patient can develop symptoms of chronic radiation damage to the small intestine at any time from the end of treatment to as long as 25 years later. Characteristic signs shown on barium examination include thickened valvulae conniventes, stenosis, mural thickening, adhesions, mucosal tacking, effacement of the mucosal pattern, ulceration, sinuses and fistulae. Thickening of the valvulae is the most frequently encountered radiological sign. The thickened valvulae are usually straight and regular unlike Crohn's disease where there is irregular thickening and fusion of the valvulae. Narrowing of the lumen and stenosis are frequent findings, sometimes with evidence of intestinal obstruction. Stenosis may be single or multiple. Evidence of adhesions is demonstrated by constant angulations of intestinal loops, relative fixity of loops, or as a change in the mucosal pattern that has been termed 'mucosal tacking'. This is seen as angulations and distortion of the mucosal folds at the outside edge of the wall of the intestine where it is bound to the mesentery. Complete effacement of the mucosal pattern gives a featureless outline. The presence of adherent pelvic loops of ileum with a featureless outline in which it is difficult to distinguish individual segments gives rise to the characteristic 'pool of barium' appearance ***(Mason et al.,1990).***

Fig. 55. Smooth, thick folds caused by radiation enteropathy. Two loops demonstrate smooth, thick folds. When barium is trapped between thick folds it forms sharp points termed *inter-space spikes* ***(Coated from Rubesin 2003).***

- **Eosinophilic gastroenteritis:**

Radiologically there is thickening of the valvulae conniventes and the walls of the intestine. Severe luminal narrowing may produce intestinal obstruction ***(Schulman et al., 1990).***

- **Mastocytosis:**

Involvement of the small intestine is frequent and is shown radiologically as thickening of the valvulae conniventes with associated nodular mucosal defects, 2-5 mm in diameter. The mucosal nodules are usually seen in short segments of jejunum but can occur in the ileum ***(Clemett et al., 1988)***.

- **Idiopathic ulcerative enteritis:**

It involves the jejunum where malabsorption is associated with non-specific ulceration of unknown aetiology. Barium examination shows effacement of the mucosal pattern, narrowing and dilatation proximal to strictures. The strictures may be multiple ***(Nolan et al., 2001).***

- **Behcet's disease:**

Occasionally the small intestine, particularly the ileoceacal region, is involved in Behcet's disease. Barium examination shows ulceration and in some cases contraction of the lumen. The appearances may resemble ileoceacal tuberculosis or Crohn's disease ***(Baba et al., 1996).***

- **Non-steroidal anti-inflammatory drug enteritis:**

Characteristic pathological findings include concentric, circumferential diaphragm-like narrowing that can progress to strictures. These diaphragm-like narrowing and strictures can be seen on barium examination, particularly when enteroclysis is used ***(Levi et al., 1990).***

- **Celiac disease:**

Celiac disease is also known as gluten-sensitive enteropathy. The hallmark is which is usually more apparent in the proximal jejunum. The radiological appearances are not specific and a reliable diagnosis can only be established by a jejunal biopsy ***(Kumar et al., 1999).***

The most characteristic radiological sign of celiac disease on barium follow-through examination is dilatation of the small intestine ***(Nolan et al., 2001).***

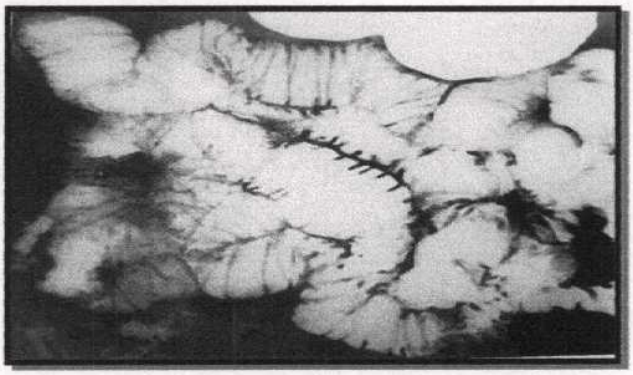


Fig 41. Tropical sprue. Generalized dilatation of the small bowel with normal fold thickness ***(Coated from Eisenberg 2004).***

The valvulae conniventes are straightened, moderately thickened and separated. Other signs of celiac disease include segmentation, flocculation, dilution of the barium and the 'moulage' sign. The latter refers to total effacement of the jejunal mucosal pattern with variation in the calibre of the intestine. Non-obstructive intussusception showing a 'coiled spring' appearance occurs quite frequently in celiac disease ***(Burrows et al., 1994).***

The features of celiac disease on enteroclysis include a smooth margin in the jejunum and a haustral-like pattern with fewer and thinner valvulae conniventes than are normally seen ***(Muller et al., 1996).***

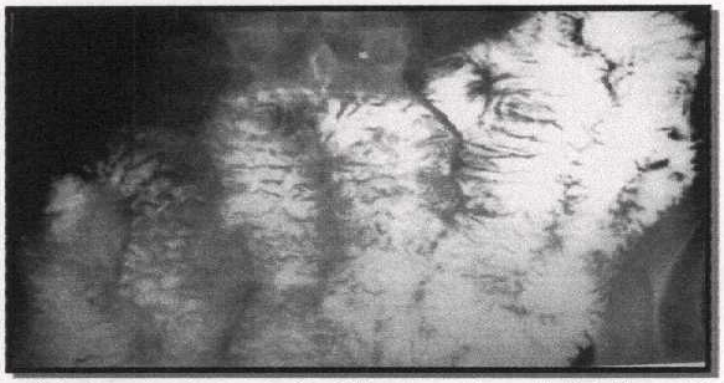


Fig 42. Idiopathic (non-tropical sprue). Diffuse small bowel dilatation with hypersecretion ***(Coated from Eisenberg 2004).***

Jejunal and ileal dilatation may be seen and numerous mucosal folds may be present in the ileum, the so called 'jejunization' pattern ***(Muller et al., 1996).***

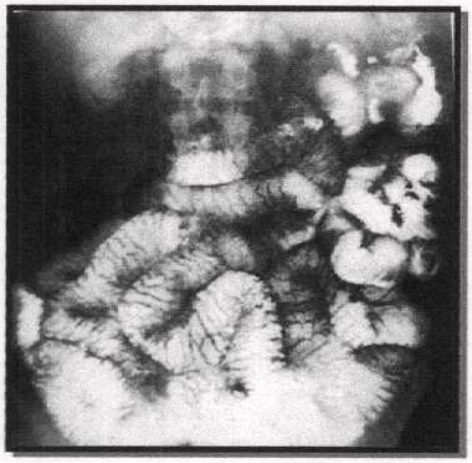


Fig 42. Reversal of jejuno-ileal fold pattern in sprue. There is dilatation and marked increase in number of folds in the ileum. The jejunum is smooth and atrophic, with dilution of barium due to increased secretion ***(Coated from Eisenberg 2004).***

- **Whipple's disease:**

The characteristic radiological change is thickening of the valvulae conniventes, often with a nodular appearance in the proximal small intestine ***(Clemett et al., 1989).***

- **NEOPLASMS:**

  - **Benign neoplasms:**

- Leiomyomas An intraluminal leiomyoma is shown on barium studies as a round smooth intraluminal-filling defect. A serosal neoplasm is recognized as a mass attached to the intestine indenting the lumen and causing displacement of adjacent barium-filled loops of intestine. Dumb-bell leiomyomas demonstrate the combined features of intraluminal and serosal neoplasms. It can be difficult to differentiate **leiomyosarcomas** from benign leiomyomas even on histological examination and the term leiomyomatous neoplasms has been suggested to include both types of smooth muscle neoplasm ***(Gourtsoyiannis et al.1992).***

- Adenomatous polyps they are demonstrated on barium studies as small sessile or pedunculated round filling defects in the barium column ***(Nolan et al., 2001).***

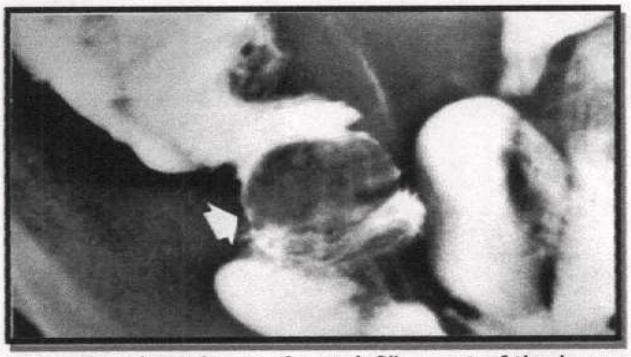


Fig 43. Adenoma. A smooth polypoid mass (arrow) fills most of the lumen of the terminal ileum ***(Coated from Eisenberg 2004).***

- **Hamartomatous polyps** are a developmental anomaly that may be present in large numbers in the small intestine of patients with the Peutz-Jeghers' syndrome**.** The polyps are shown on barium studies as multiple round or lobulated filling defects that are often pedunculated; intussusception is frequently demonstrated ***(Dodds ., 1996).***

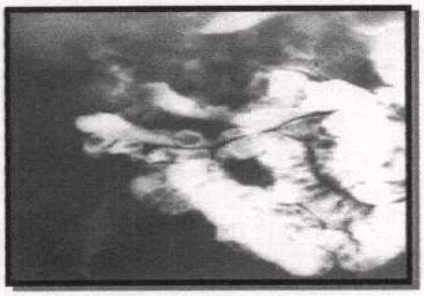


Fig 44. Peutz-Jegher`s syndrome. Multiple small bowel hamartomas are present in a patient with mucocutenous pigmentation ***(Coated from Eisenberg 2004).***

- **Haemangiomas** occasionally are shown on barium studies distorting the outline of a short segment of intestine ***(Nolan et al., 2001).***

Fig 45. Haemangioma. A filling defect (arrow) is seen in the jejunum ***(Coated from Eisenberg 2004).***

- **Lipomas** On barium studies multiple large intramural and mesenteric masses are shown displacing adjacent loops of small intestine ***(Nolan et al., 2001).***

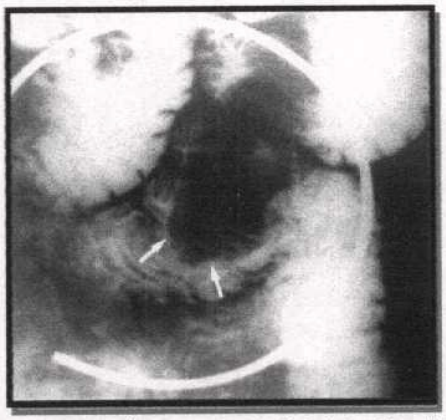


Fig 46. Lipoma. Polypoid jejunal mass just distal to the ligament of Treitz. Note the subtle irregularity of the mass, particularly at its apex (arrows) ***(Coated from Eisenberg 2004).***

- **Malignant neoplasms:**

- Carcinoid tumour:

The tumour often spreads to the mesenteric lymph nodes forming a mass, and segmental infarction of the small intestine may occur. It also may metastasise to the liver or bones ***(Jeffree et al., 1994).***

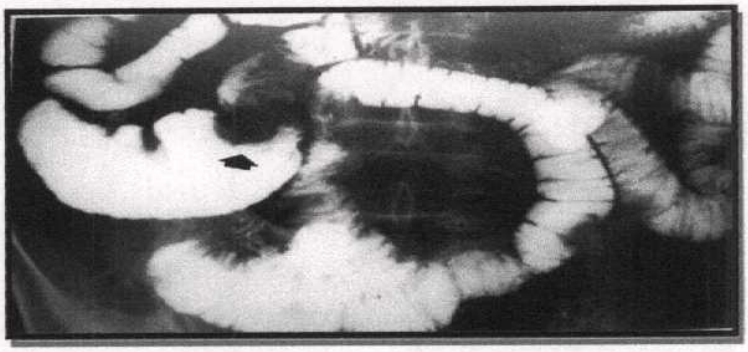


Fig 47. Carcinoid tumour. It appears as a polypoid filling defect (arrow) ***(Coated from Eisenberg 2004).***

Enteroclysis is a reliable method for detecting primary ileal carcinoid tumours. They are shown as single or multiple intra-mural or intraluminal filling defects in the distended ileum. Narrowing of the lumen may be seen, sometimes with stricture formation and there is radiological evidence of thickening of the valvulae conniventes ***(Murray et al., 1993).***

Intestinal wall thickening is seen as an increased distance between the intestinal loops. In cases with extensive mesenteric fibrosis (i.e. with the so-called desmoplastic reaction) the adjacent loops of intestine are compressed and it may be difficult to identify the primary tumour ***(Nolan et al., 2001).***

- Lymphoma:

The lymphoid follicles of the submucosa are the sites of origin of lymphoma and as these are more numerous in the ileum the disorder is encountered more frequently in the ileum than the jejunum. An exception is lymphoma complicating immunoproliferative small intestinal (alpha-chain) disease, which usually affects the duodenum and proximal jejunum ***(Khojasteh et al. 1993).***

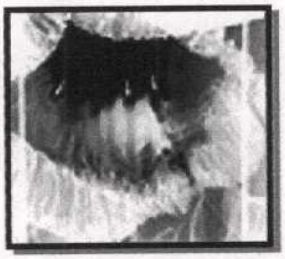


Fig. 48. Focal fold enlargement caused by lymphoma. An 8 cm in length area of ileum has thick, straight folds (*arrows*) that are only slightly undulating ***(Coated from Rubesin 2003).***

Characteristic radiological signs include luminal narrowing with mucosal destruction and occasionally shouldering of the margins and stricture formation, broad-based ulceration, cavitation, thickening of the valvulae conniventes, discrete intraluminal filling defects and an extra-luminal mass. Small nodules or polyps may be seen throughout the small intestine ***(Nolan et al., 2001).***

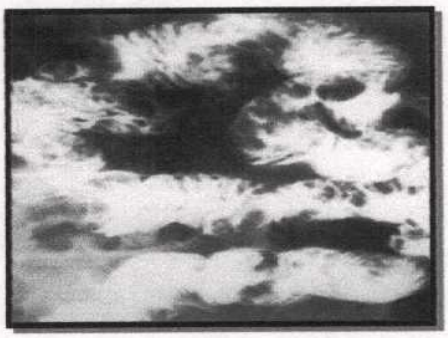


Fig 49. Lymphoma. Small bowel involvement in a large nodular pattern ***(Coated from Eisenberg 2004).***

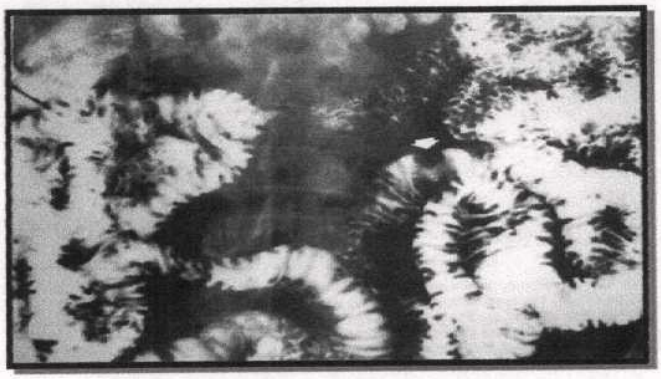


Fig 50. Lymphoma. In addition to the generalized, irregular thickening of small bowel folds there is segmental circumferential infiltration by tumour, causing a constricting napkin ring lesion (arrow) ***(Coated from Eisenberg 2004).***

Focal 'aneurysmal' dilatation, without evidence of an associated stricture, is characteristic but is only occasionally seen. Ileo-ileal fistula formation may result from a cavitating mass invading other ileal loops ***(Gourtsoyiannis et al., 1998).***

Marshak et al., 1979, had classify the different radiological appearance of malignant lymphoma into: (1) Multiple nodules, (2) Infiltrating tumour, (3) Polypoid mass, (4) Endo-exo-enteric form with excavation and fistula formation,(5) Mesenteric invasion with extra-luminal masses or production of sprue pattern.

- **Primary carcinoma:**

On barium examination stricture formation with mucosal destruction and shouldering of the margins, ulcerating lesions and polypoid masses are characteristic ***(Savery et al., 1993).***

- **Leiomyosarcoma:**

The main feature on barium examination is a large cavity filled with barium and it may be difficult to identify the connection between the small intestine and the cavity ***(Nolan et al., 2001).***

- **Secondary neoplasms:**

Direct invasion of the small intestine from primary neoplasms of the adjacent organs. The characteristic radiological appearance is of a mass invading the adjacent intestine, often over a considerable length with mucosal

destruction, narrowing of the lumen and obstruction. Tethering of the mucosal folds may be a conspicuous feature ***(Meyers et al., 1991).***

Lymphatic spread plays a minor role in the spread of neoplasms to the small intestine; spread of caecal carcinoma to the terminal ileum is a classic example of this type of spread ***(Moffat et al., 1980).***

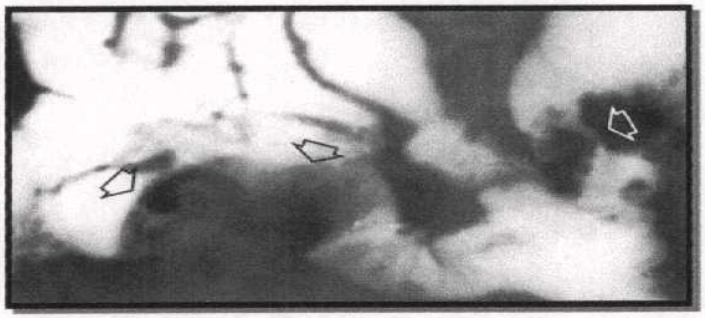


Fig 51. Metastatic breast carcinoma. Involvement of the small bowel and mesentery produces large mass impressions ***(Coated from Eisenberg 2004).***

Intraperitoneal seeding of abdominal neoplasms frequently localizes in the right lower quadrant at the lower end of the mesentery. Stasis in the lower recess of the small-intestinal mesentery results in the deposition and growth of secondary deposits. As a result the ileal loops in the right lower quadrant became separated with angled tethering of the mucosal folds and the narrowed loops may align in a parallel configuration described as 'palisading' ***(Meyers et al., 1991).***

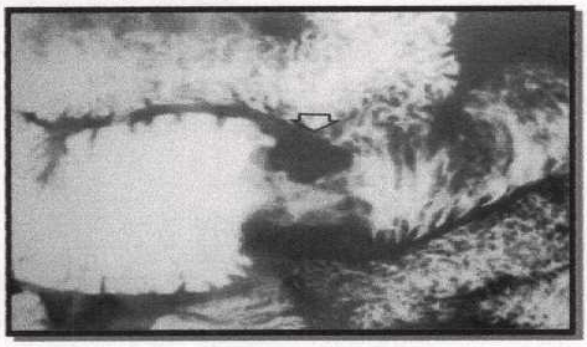


Fig 52. Metastasis. Adenocarcinoma of the lung metastasising to the jejunum (arrow) ***(Coated from Eisenberg 2004).***

Blood borne metastases to the small intestine from extra-abdominal sites are uncommon. The most common metastases are from malignant

melanomas and primary carcinoma of the breast, lung, kidney and genital tract. The appearance of metastatic melanoma is characteristic on barium examination the multiple submucosal polypoid lesions frequently have central ulceration giving a 'bulls-eye' or target appearance to the lesions. When melanoma deposits are multiple they may be confined to a segment of intestine within the field of a specific arterial distribution or they may be widespread in the intestine. They tend to develop on the anti-mesenteric border and when they are confined to a particular intestinal segment are about the same size. Metastatic melanomas may present as predominantly cavitating lesions ***(Willis et al., 1993).***

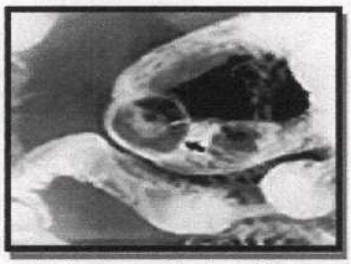


Fig. 53. Target lesion. A well-circumscribed radiolucent filling defect (*black arrow*) is seen in the barium pool. Centrally, an irregularly shaped barium-filled ulcer is seen. This lesion was metastatic melanoma ***(Coated from Rubesin 2003).***

- **Mechanical small-intestinal obstruction:**

The diagnosis of small-intestinal obstruction can be made on plain abdominal radiographs in 60-70% of patients. The distal ileum is the site of small-intestinal obstruction in most patients with normal or equivocal plain abdominal radiographs ***(Gough., 1998).***

Fig 56. Mechanical small bowel obstruction. Small bowel metastasis from carcinoma of the lung. A markedly dilated small bowel with normal folds. An annular constricting lesion (arrow) is demonstrated as the cause of partial obstruction. Note the dramatic decrease in the calibre of the small intestine distal to the obstruction ***(Coated from Eisenberg 2004).***

Barium is safe to use in partial or complete small intestinal obstruction, it is superior to water-soluble contrast agents and produces fewer side effects. Enteroclysis is proving to be reliable for investigating suspected small-intestinal obstruction ***(Maglinte et al., 1994).***

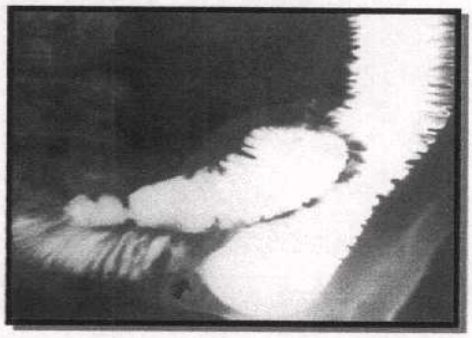


Fig 57. Mechanical small bowel obstruction. Stenotic lymphoma of the jejunum (arrow) ***(Coated from Eisenberg 2004).***

An acute transition in calibre between the distended loops proximal to the obstruction site and the collapsed loops distally is the most consistent sign of obstruction. A significant length of intestine proximal to an obstructive lesion is dilated in patients with chronic obstruction ***(Maglinte et al., 1994).***

Internal hernias may be identified as the cause of obstruction. In patients with partial, incomplete or intermittent obstruction enteroclysis is more reliable. Strangulation is indicated by the presence of ischaemic changes in the wall of the closed loop. Pneumatosis intestinalis may develop in advanced cases. Air in the intestinal wall and haemorrhagic mesenteric changes selectively involving the incarcerated intestinal loop are the most reliable CT findings of strangulation ***(Balthazar., 1994).***

- **Ischemia and infarction:**

On barium examination there is separation of the loops of intestine with oedema and marked thickening of the valvulae conniventes. In severe cases there may be ulceration and the entire mucosa may be completely effaced, with the intestine showing a smooth homogeneous configuration. The intestine usually returns to normal within 6 weeks, though strictures may develop and these may be multiple in severe cases. When ischaemia results from chronic obstruction to the arterial supply or venous return marked

persistent thickening of the valvulae conniventes is seen ***(Marshak et al., 1996).***

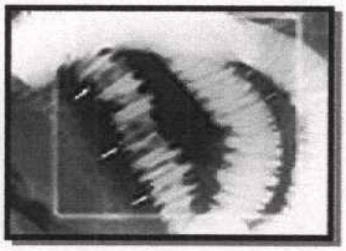


Fig. 58. Abnormal folds caused by ischemia. Thick, smooth, slightly undulating folds remain perpendicular to the luminal axis. Contrast these abnormal folds with the normal folds in the adjacent loop. This case demonstrates how folds in ischemia can be slightly lobulated and confused with an infiltrative lymphoma ***(Coated from Rubesin 2003).***

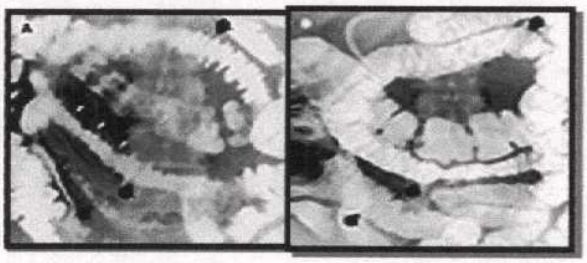


Fig. 59. "Stack of coins" caused by ischemia. (A) Three abnormal loops (*black arrows*) are present in the mid small bowel. Folds are smooth, thick, straight, and aligned perpendicular to the longitudinal axis. Where folds are markedly thickened they supposedly resemble a stack of coins (*white arrows*). (B) **Enteroclysis** performed 3 weeks later shows resolution of fold abnormality in the three loops (*arrows*) ***(Coated from Rubesin 2003).***

- **Intramural haemorrhage:**

Barium examination shows the location and nature of the changes in the small intestine, which extend over a variable length. The thickened valvulae conniventes may result in a 'picket fence' or 'stacked coin' appearance particularly in haemophilia. Sometimes there is narrowing of the lumen, a scalloped contour and complete effacement of the valvulae conniventes. Large submucosal haematomas may cause single or multiple smooth rounded concentric filling defects in a short segment of intestine ***(Nolan et al., 2001).***

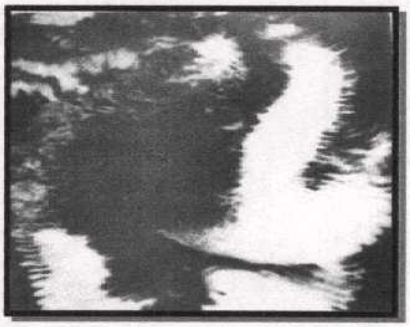


Fig 60. Haemorrhage into the wall of the small bowel. The symmetric, spike-like configuration mimics a stack of coins ***(Coated from Eisenberg 2004).***

- **Diverticulae and blind loops:**

  - **Jejunal diverticulosis:**

Jejunal diverticula are shown on barium studies as large out-pouching from the jejunum, occasionally lobulated and frequently multiple. An upright view shows fluid levels of barium in the diverticula ***(Nolan et al., 2001).***

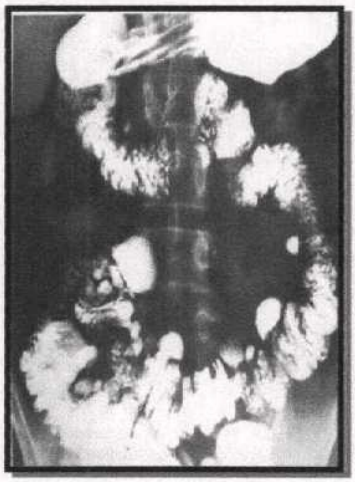


Fig 61. Jejunal diverticulosis ***(Coated from Eisenberg 2004).***

  - **Meckel's diverticulum:**

Radiologically the Meckel's diverticulum is seen as a blind-ending sac arising from the anti-mesenteric border of the ileum **(Kellett et al., 1997).**

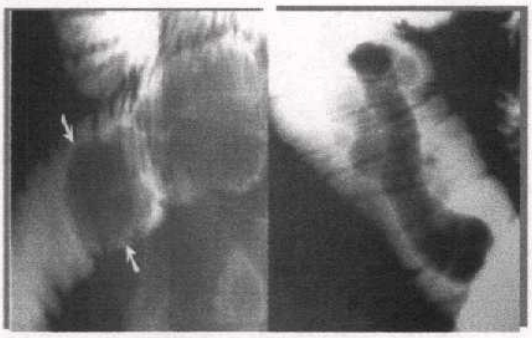


Fig 62. Inverted Meckel's and intussuscepted jejunal polyp. A. Initial examination of the small bowel demonstrates an intussuscepted polypoid mass in the distal jejunum (arrows). B. An inverted Meckel's diverticulum was identified in the terminal ileum ***(Coated from Eisenberg 2004).***

Sometimes a gastric rugal pattern is seen in the diverticulum". A tri-radiate pattern of mucosal folds or a triangular plateau is sometimes present at the base of the diverticulum". Occasionally the diverticulum is inverted and is seen as a filling defect similar to a pedunculated polyp, and it may become the apex of an intussusception ***(Ekberg., 1997).***

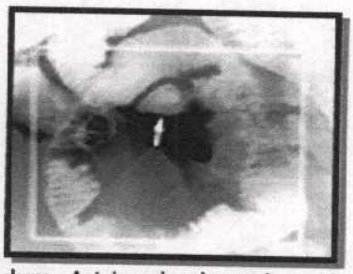


Fig. 63. Meckel's diverticulum. A triangle-shaped sac (*arrow*) arises in the distal ileum. The small bowel folds do not enter the sac. This image demonstrates that it is sometimes difficult to distinguish the mesenteric from the anti-mesenteric border. Meckel's diverticulum arises on the anti-mesenteric border of the distal ileum, but in this image appears to arise on the inner (mesenteric) border ***(Coated from Rubesin 2003).***

- **Ileal diverticulae:**

Acquired diverticula of the ileum are relatively rare, unlike diverticula in the jejunum. They are usually small, few in number, and are located on the mesenteric border of the terminal ileum ***(Garrett et al., 1999).***

- **Blind loops:**

Barium studies show the blind pouch as a medium sized or large collection of barium. Numerous filling defects, representing retained food particles, are normally present in the barium-filled pouch ***(Nolan et al., 2001).***

- **Neuromuscular disorders:**

Progressive systemic sclerosis, visceral myopathies and visceral neuropathies can be grouped together as neuromuscular disorders. Barium examination shows dilatation of the duodenum and jejunum, diminished peristalsis, decreased motility and delayed transit. Sacculations, also known as pseudo-diverticula, are seen frequently as large, broad-based out-pouching with a somewhat squared contour ***(Rohrmann et al., 1984).***

Similar appearances may be seen in visceral myopathy although pseudo-diverticula are not a feature of visceral neuropathy. A characteristic sign of progressive systemic sclerosis is an increased number of mucosal folds, resulting in the "wire spring' appearance. Jejunal diverticulosis may result from neuromuscular disorders ***(Bluestone et al., 1999).***

- **Nodular lymphoid hyperplasia and immunoglobulin deficiency:**

Nodular lymphoid hyperplasia is frequently seen in the terminal ileum and colon of children and young adults and is considered to be a normal finding

with no pathological significance. In older people nodular lymphoid hyperplasia is an abnormal finding. The lymphoid nodules are multiple, small, discrete round 1-3 mm in diameter nodular filling defects. The nodules are seen throughout the small intestine in most patients with immunoglobulin deficiency, increasing in number from the proximal to the distal end ***(Morson et al., 1990).***

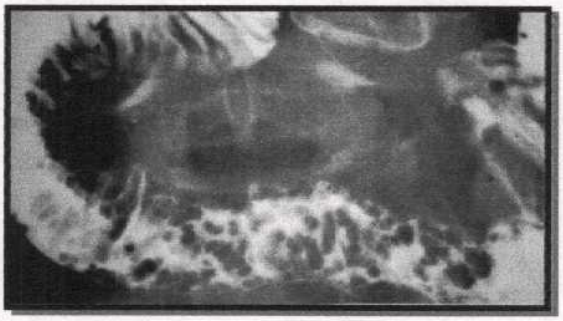


Fig 64. Nodular lymphoid hyperplasia. Large filling defects reflecting multiple polypoid masses ***(Coated from Eisenberg 2004).***

- **Intestinal lymphangiectasia:**

Barium examination shows uniformly thickened, closely set and parallel valvulae conniventes throughout the jejunum and ileum ***(Nolan et al., 2001).***

- **Amyloidosis:**

The radiological appearances vary from symmetrical thickening to effacement of the valvulae conniventes. Large deposits of amyloid may form intraluminal masses in the barium-filled small intestine. Diminished motility and atrophy of the valvulae may result from amyloid deposited throughout the layers of the intestinal wall and the lumen of the intestine may become dilated ***(Seliger et al., 1981).***

- **Acquired immune deficiency syndrome (AIDS):**

On the barium examination there is thickening, sometimes with nodularity, of the valvulae conniventes in the proximal small intestine ***(Nolan et al., 2001).***

- **Graft-versus-host disease:**

Radiological examination of the gastrointestinal tract reveals three distinct phases. The first is the acute stage 4-15 days after the onset of gastrointestinal symptoms and consists of simultaneous and uniform

thickening or flattening of the mucosal folds, thickening of the intestinal wall, rapid transit and excess intraluminal fluid. Ribbon-like narrowing of the lumen and thickened walls may be seen extending throughout most of the jejunum and ileum. Examination during the second, subacute phase, 13-96 days after the onset of gastrointestinal symptoms shows similar changes to the acute phase, often with a striking segmental distribution. The third or resolution phase shows improvement with no abnormality or effacement of mucosal folds, but with mural thickening confined to the terminal ileum ***(Fisk et al., 1989).***

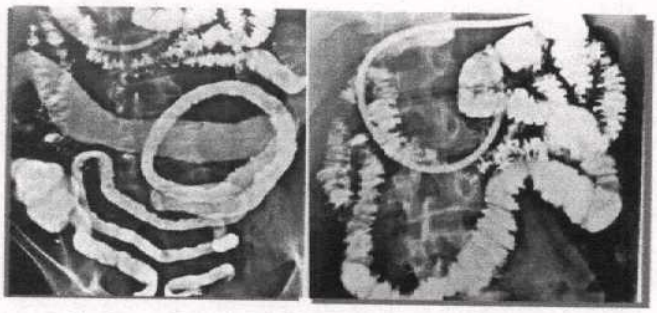


Fig 65. graft versus host disease. A. separation of ribbon-like ileal loops with loss of mucosal markings. B. oedematous pattern pf jejunal folds ***(Coated from Eisenberg 2004).***

- **Endometriosis:**

On barium examination a localized stricture or submucosal filling defects are seen encroaching on the lumen of the terminal ileum ***(Nolan et al., 2001).***

On the other hand, ***Stephen Rubesin 2003***, and ***Ronald Eisenberg 2004***, depend in their classification on the radiological changes through which a list of differential diagnosis could aid in a step-by-step manner to reach a rather accurate diagnosis. The ***Ronald*** classification is an elaborate one and is as follows:

- **Small bowel obstruction:**

*** Causes of small bowel obstruction:**

- Extrinsic bowel lesions
  - Adhesions
    - -Previous surgery -Previous peritonitis
  - Hernias
    - -External -Internal
  - Extrinsic masses
    - -Neoplasm
- Luminal occlusion
  - -Tumour -Gallstone -Enterolith
  - -Foreign body -Intussusception
  - -Meconium ileus
- Intrinsic lesions of the bowel wall
  - Strictures
    - -Neoplastic -Inflammatory
    - -Chemical -Anastomotic
    - -Radiation-induced
  - Amyloid
  - Vascular insufficiency
    - -Arterial occlusion -Venous occlusion
  - Congenital atresia or stenosis
    - -Jejunal -ileal

- **Adynamic ileus**
  - Surgical procedure
  - Peritonitis
  - Medication
  - Electrolyte imbalance
  - Metabolic disorder
  - Abdominal trauma
  - Retro-peritoneal haemorrhage
  - Gram-negative sepsis/shock
  - Acute chest disease (pneumonia, myocardial infarction, congestive heart failure)
  - Mesenteric vascular occlusion

- **Adynamic ileus simulating mechanical obstruction:**
  - Pelvic surgery

- Pancreatitis
- Acute intermittent porphyria

- Neonatal adynamic ileus
  -Systemic -Chemical/hormonal -Abdominal

- **Dilatation with normal folds:**

  - Mechanical obstruction
  - Adynamic ileus
  - Vagotomy (surgical or chemical)
  - Sprue
  - Lymphoma
  - Connective tissue disease
    -Scleroderma
  - Diabetes with hypokalemia
  - Lactase deficiency
  - Vascular insufficiency
    -Mesenteric ischemia -S.L.E
    - Amyloidosis
  - Chagas disease

- **Dilatation with thickened mucosal folds:**
  - Zollinger-Ellison syndrome
  - Vascular insufficiency states
  - Diseases affecting the bowel wall and mesentery
    -Metastases -Crohn's disease
    -Tuberculosis -Radiation enteritis
  - Infectious enteritis
  - Amyloidosis
  - Lymphoma
  - Hypoalbuminemia
- **Regular thickening of small bowel folds:**

  - Haemorrhage into the bowel wall
  - Thromboangiitis obliterans (Buerger's disease)
  - Leukaemia
  - Multiple myeloma
  - Lymphoma
  - Metastatic carcinoma
  - Hypofibrinogenemia/circulating anticoagulants
  - Intestinal oedema
    -Hypoproteinemia -Cirrhosis
  - Nephrotic syndrome
  - Protein-losing enteropathy
  - Lymphangiitis secondary to radiation damage
  - Fibrosis of the mesentery

-Angioneurotic oedema
- Intestinal lymphangiectasia
  -Primary -Secondary
- Esinophilic enteritis
- Amyloid vasculitis

- **Generalized,irregular,distorted small bowel folds:**
  - Whipple's disease
  - Lymphoma
  - Amyloidosis
  - Eosinophilic enteritis
  - Lymphangiectasia
  - Crohn's disease
  - Tuberculosis
  - Histoplasmosis
  - Strongyloidiasis
  - *Yersinia enterocolitica*
  - Typhoid fever
  - Other infections
    -Campylobacter jejuni *-Shigella*
    -Escherichia coli -Anisakiasis

- **Solitary filling defects in the jejunum and ileum:**
  - Benign neoplasms
    -Leiomyoma -Adenoma
    -Lipoma -Hemangioma
    -Neurofibroma
    -Fibroma/lymphangioma/teratoma
  - Malignant neoplasms
    -Adenocarcinoma -Lymphoma
    - Leiomyosarcoma -Metastases
  - Neoplasms with variable malignant potential
    -Carcinoid tumour
  - Gallstone ileus
  - Inflammatory fibroid polyp
  - Pseudo-tumours
    -Parasitic (ascariasis, strongyliodiasis)
    -Inflammatory
  - Duplication cyst
  - Heterotropic gastric mucosa
  - Small bowel varix
  - Inverted Meckel's diverticulum
  - Foreign body

- **Multiple filling defects in the small bowel:**
  - Multiple polyps
    -Peutz-Jeghers syndrome

-Gardner's syndrome
-Disseminated gastrointestinal polyposis
-Generalized gastro intestinal juvenile polyposis
-Cronkhite-Canada syndrome
-Simple adenomatous polyps

- Hemangiomas
- Leiomyomas
- Lipomas
- Carcinoid tumours
- Neuromas
- Metastases (especially melanoma, breast carcinoma, lung carcinoma)
- Lymphoma
- Crohn's disease
- Nodular lymphoid hyperplasia
- Parasites
  - -Ascaris lumbricoides
  - -Strongyloides stercoralis
  - -Ancylostoma duodenale (Hookworm)
  - -Taenia solis (tapeworm)
- Gallstones
- Amyloidosis
- Varices
- Behcet's syndrome

♦ **Sand like lucencies:**

- Histoplasmosis
- Lymphoid hyperplasia
- Intestinal lymphangiectasia
- Lymphoma
- Whipple's disease
- Crohn's disease
- Yersinia enterocolitis
- Eosinophilic enteritis
- Amyloidosis
- Irradiation enteritis
- Protein-losing enteropathy
- Small bowel ischemia

♦ **Thickened small bowel folds with concomitant involvement of the stomach:**

- Lymphoma
- Crohn's disease
- Eosinophilic gastroenteritis
- Zollinger-Ellison syndrome
- Gastric varices with hypoproteinemia

- Amyloidosis
- Whipple's disease

- **Separation of small bowel loops:**
  - Processes that thicken or infiltrate the bowel wall or mesentery
    - -Crohn's disease -Tuberculosis
    - -Intestinal haemorrhage
    - -Mesenteric vascular occlusion
    - -Whipple's disease -Amyloidosis
    - -Lymphoma
    - -Primary carcinoma of the small bowel
    - -Radiation-induced enteritis
    - -Carcinoid tumour -Neurofibromatosis
  - Ascites
  - Neoplasms
    - -Primary tumours of the peritoneum
    - -Primary tumours of the mesentery
    - -Metastases (peritoneal carcinomatosis)
  - Intra-peritoneal abscess
  - Retractile mesenteritis
  - Graft versus host disease
- **Small bowel diverticula and pseudo-diverticula:**
  - True diverticula
    - -Duodenal -Jejunal -Meckel's -Ileal
  - Pseudo-diverticula
    - -Intra-luminal diverticula -Scleroderma
    - -Crohn's disease -Lymphoma
- **Abnormalities of the ileoceacal valve:**
  - Lipomatosis (fatty infiltration)
  - Neoplasms
    - *Benign tumours
      - -Lipoma -Adenomatous polyp
      - -Villous adenoma
    - *Tumours of intermediate potential
      - -Carcinoid tumour
    - *Malignant tumours
      - -Adenocarcinoma -Lymphoma
  - Inflammatory disorders
    - -Crohn's disease -Ulcerative colitis
    - -Tuberculosis -Amebiasis
    - -Typhoid fever -Anisakiasis
  - Prolapse
  - Intussusception
  - Lymphoid hyperplasia

(Eisenberg et al., 2004).

❖ General Considerations:

Enteroclysis (small bowel enema) is a radiographic examination technique for the small intestine whereby the patient receives the contrast fluid via an infusion directly in the distal part of the duodenum. This technique is arguably the ideal method for investigating the small intestine; however, some consider it as an invasive and time-consuming method (***Miller et al., 2000).***

On the other hand, it results in better radiological assessment for the small bowel via a rapidly infused large continuous column of contrast directly into the jejunum, avoiding segmentation of the barium and without giving much time for flocculation to occur ***(Maglinte et al., 1999)***.

❖ Patient Preparation:

The patient should go without food for at least 8 to 12 hours before the examination as food remnants in the ileum may also seriously retard transit. Previous experiences have shown that a full ceacum also seriously retards transit through the distal half of the ileum. This is particularly true if there is hypomotility of the small intestine or inadequate closure of the ileocecal value as occurs. So, the colon, especially the right half, preferably is cleansed as for a colon examination ***(Beightol et al.,2000).***

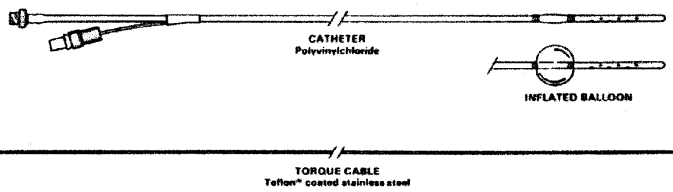
The procedure for infants is different; it is sufficient to give the last feeding at least 4 hours before the examination and to enhance gastric emptying by turning the baby on his right side. A sedative should be given because it is otherwise often impossible to examine the child at all ***(Pesquera .,1999).***

❖ Duodenal Intubation:

Two types of tube sets are used:

* **Maglinte Enteroclysis Catheter Set :**

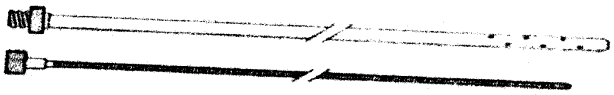
Having a balloon to prevent reflux of contrast medium.



CATHETER		TORQUE CABLE		
French Size	**Length**	**Diameter**	**Length**	**Tip**
13.0	155cm	1.65 mm	175 cm	angled

(Gianturco ., 1997).

* **Bilbao-Dotter Hypotonic Duodenography Set :**



CATHETER			TORQUE CABLE	
French Size	**Length**	**Side Ports**	**Diameter**	**Length**
12.0	145cm	6	1.65 mm	155 cm

(Bilbao et al., 1997).

- **Principles Of Intubation:**

In the upper gastro-intestinal tract there are four major bends to negotiate:

1. Nasopharynx: straight back, then down

2.Cardia: a sharp left

3. Mid-stomach: swings right and forward over the spine

4. Cap: up, back and down.

- **Reduce Friction:**

Bends in the route increase friction and reduce control over the tube.

1. Do a "lube job" using viscous lidocaine in nose and silicone spray (or mineral oil) on the tube and torque cable.

2. Straighten out the bends.

- **Intubation Method:**

1. Thoroughly lubricate (dripping wet) tube and torque cable with silicone gel.

2. Inject viscous lidocaine 2% into patient's nostril and have him "snuff" until his nasopharynx fills up.

3. With the patient in erect or semi-erect positions, pass a soft plastic duodenal tube through the nose to the antrum (this position avoid coiling).

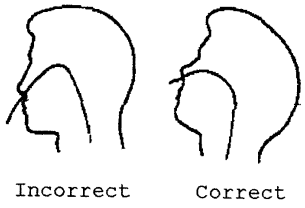


Figure (33) ***(Coated from Herlinger ., 1999)***

4. Now turn him steeply into his right side (almost into prone oblique and, we may inject a little barium to show anatomy), and insert a flexible torque cable to stiffen and control the tube. With the aid of fluoroscopy, pass the tube and torque cable to the duodenal cap.

5. Turn him to the left supine oblique. Gradually withdraw the torque cable while advancing the flexible tube.

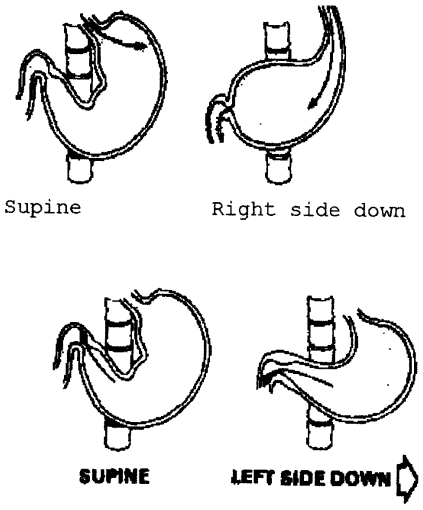


Figure (34) ***(Coated from Herlinger ., 1999)***

6. If suspicious about positioning the catheter within the duodenum, so use fluoroscopy with the patient in the lateral position. If catheter passes

posteriorly from the stomach toward the spinal column, so it is almost certainly within the duodenum, or inject a small amount of barium.

- **Average Time:**

After a little practice five minutes.

- **Failure Rate:**

Virtually nil.

- **Difficulties:**

Nearly always relate to:

* Inadequate visualization of anatomy.

* Illogical positioning of patient.

* Damaged equipment or un-lubricated tube and torque cable, etc ***(Sellink ., 1998).***

TROUBLESHOOTING CHART

	Hang-up	Cure
Nasopharynx	- Sore nose, tube sticks	Probably deviated septum or swollen mucosa. Decongest(1/4%neosynephrine nasal spray (2% viscous lidocaine).
	- Can't turn corner from nasal cavity to nasopharynx	Extend the head. Turn the head to lateral view and use fluoroscope. Push down, not up!
Oropharynx	-Patient gags	Viscous lidocaine or cetacaine spray in back of throat.
	- Tube pops out of mouth or goes into trachea	Turn head to side. Use the torque cable, fluoroscopy and rapid water drinking.
Cardia	Tube coils in fundus	(Oesophagus enters obliquely directing tube to left). Turn patient to right lateral, right prone oblique, or upright, leaning forward. Put a bend in the tip of the torque cable. Empty the stomach.
Pylorus	Tube won't go through	Turn patient to left supine oblique or right lateral. Visualize anatomy with barium. Line up tube and pylorus using gravity, breathing & manual palpation. Push tube. Use the torque cable.
Apex of Bulb	Sticks in bulb won't go down the duodenum	Turn patient to left lateral, which straightens the flexure. Visualize the anatomy, push the tube. Back out the torque cable, change its tip curve to suit.
Ligament of Treitz	Tube won't pass the duodenal jejunal flexure	Try same manoeuvres as for bulb.

(Frische et al., 1998).

Characteristics of the contrast medium:

A good contrast fluid must meet numerous requirements. The contrast medium should not foam, because foam can cause a misleading pattern simulating swollen villi, as found in some diseases. For the examination of the small intestine it is important also that the contrast medium be stable (i.e., that the diverse digestive juices found throughout the intestine do not cause flocculation). A thin, fluid contrast medium generally produces sharper images and permits the rate of flow of the infusion to be regulated more accurately ***(Ott et al., 1997).***

For routine procedures, a creamy viscosity is preferable because good adhesion and sharply defined double contrast views cannot otherwise be obtained. The best choice is a viscosity that gives a rate of flow from the infusion system of 100 ml/min when the infusion bag is in the highest position ***(Thoeni et al., 1996).***

The temperature of the contrast medium is an important factor for optimal results with the enteroclysis technique. Cold contrast fluid enhances peristalsis. With enteroclysis, however, the temperature of the contrast medium increases 5° C as it passes through the infusion system ***(Fraser et al., 1998).***

Among the diverse factors that can cause an abnormal rate of flow, the viscosity of the medium is the most important. The viscosity in turn is highly dependent on the temperature of the contrast medium. The only practical way to keep this temperature fairly constant is to administer the contrast medium at room temperature ***(Herlinger ., 1998).***

Another important factor is the specific gravity, or density, of the contrast medium. The specific gravity of the contrast fluid should never drop below 1.15, because flocculation increases with further dilution ***(Kelvin et 1998).***

I) Single Contrast Enteroclysis

- **Amount Of The Contrast Medium:**

The average amount of contrast medium required at the optimum rate of flow of 75 ml/min is 700 ml. This means that in 15% of cases more than 1 litter is needed and thus that in 85% of cases it is sufficient to prepare 1 litter, which in certain instances and diseases could be increased up to 1500 ml of contrast medium, or even up to 2000 to 2500 ml as in patients with ileus, regardless of whether it is paralytic or caused by a stenotic process ***(Ekberg ., 1997).***

- **Rate Of Flow Of The Contrast Medium:**

Continuous attention to and maintenance of the correct rate of flow is probably the most important and at the same time the most neglected factor in the examination technique. The 75 ml/min- up to 100 ml/min are the most favourable rates. The rate of flow through the infusion system should be checked regularly with a stopwatch and can be adjusted if necessary by hanging the infusion bag higher or lower ***(Gershon et al., 1999).***

When the rate of flow is 75 ml/min, an average amount of almost 700 ml of contrast medium is required to reach the ceacum and to achieve the best evaluation of motility in the shortest possible examination time. When the rate of flow exceeds 100 ml/min, a large segment of the intestine is stretched too much and too quickly. Reflex atony and a loss of peristalsis develop, and motility can no longer be evaluated. A large amount of contrast fluid is then required to reach the ceacum, and reflux into the stomach is common. If the contrast fluid is administered too slowly (50 ml/min or less), filling of the intestine is poor and the mucosal pattern is as disorderly as in conventional transit examinations, furthermore, this will prolong the examination time ***(Oudkerk ., 1998).***

As a result of the forced administration of fluid and the greater degree of filling with the enteroclysis examination technique, disturbed motility, tone or

both, are much more easily recognized than under so-called physiologic conditions. If motility is normal, the patient can easily tolerate the standard forced flow of 75 ml/min ***(Miller ., 1999).***

II) Double Contrast Enteroclysis

Double Contrast Agents :

Water is unsuitable as a double contrast agent because it shows high diffusivity with barium suspensions, rapidly washes the barium coating from the mucosa, and causes an early degradation of the barium suspension, air is also described as a double contrast agent. However, methylcellulose considered a better agent ***(Ekberg ., 2000).***

❖ Air Contrast:

Pirbram & kleiber first described this technique at 1937. If during a routine examination a mass of ileal loops in the pelvis cannot be reached by compression, then it may help to pump air (about 1 litter) through the tube into the small bowel. The patient himself best performs this intermittent air insufflation, with careful observation for signs of pain. The air causes a pronounced local stretching of the jejunum and in cases of normal peristalsis a subsequent extremely fast rush distally. Compression should not be applied until the air has reached the distal ileum, which usually takes 1 minute ***(Fournier ., 1999).***

❖ Water infusion:

The total amount infused to a maximum of 1000 ml, and the rate of flow not more than 150 ml/ min at a temperature of about 30° C. This usually means that the water bag must be suspended only about 40 cm above the examination table ***(Friedman et al ., 1998).***

The administration of water after the barium suspension may be indicated for the following reasons:

1. To obtain a better degree of filling of the distal ileum

2. To clarify the anatomy in the ileocecal region by making the jejunum more transparent.
3. When the contrast fluid dose exceeds 1500 ml, as in the case of an ileus or severe hypomotility
4. To obtain useful radiographs of the colon if for some reason a rectal enema is not possible
5. To cleanse the small intestine because the patient must undergo surgery as soon as possible ***(Gershon et al., 1999).***

❖ **Methyl cellulose:**

In the form of a 0.5% solution has significant advantages over water. It can propel barium toward the colon, it shows a low diffusivity with compatible barium suspensions, and it usually causes a significant reduction of small bowel motor activity (except in the distal ileum). Its amount varies up to 2 litters at a rate that produces distension and trans-radiancy without causing reflux into the stomach. The injection is stopped only when the entire small bowel to the ileocecal valve has become sufficiently distended and rendered radiolucent. An intravenous injection of 0.5 units of glucagon may be administered at this stage to produce relaxation and better distension of the terminal ileum. If barium accumulates in the sigmoid and rectum before full transradiancy of the small bowel is attained, obscured low-lying loops of ileum become visible again after colon evacuation ***(Herlinger ., 1998).***

III) Infant Enteroclysis

For infants, the rate of flow should be 30 to 40 ml/min, which is relatively high and doubtless will result in an abundant reflux into the stomach. This high rate of flow, as well as a relatively large dose of contrast fluid, is required because of the marked tendency toward flocculation in infants. Because an interruption of the examination would therefore lead to failure within 2 or 3 minutes, extra-contrast medium should be prepared before-hand. The colon is reached within 4 minutes and as soon as the ceacum has

been reached so that the entire intestine can be visualized in a well filled state and good compression spot films can be taken ***(Herlinger ., 1999).***

EXPOSURES AND FILMING

Disturbed intestinal motility is a symptom that can be observed in about 1% of patients, and it accounts for about 10% of pathologic findings; it is best evaluated with early exposures when, as a rule, the ileum has not yet been filled ***(Kobayashi et al., 2001).***

It is preferable to obtain spot films of the ileum in the pelvis while it is filling because it is much more difficult in a later stage. Exposures of the distal ileum should be obtained after these loops have been flushed clean and the ceacum therefore is well filled. It is a mistake to take compression spot films of the distal ileum and not of the jejunum, because many abnormalities are encountered in the rest of the small bowel as in the distal ileum. A good approach with the minimum number of exposures is as follows:

1) After 300 ml of contrast medium has been administered:
- **a. One survey anteroposterior film of the jejunum**
- **b. One survey oblique film of the jejunum**

2) When the ileal loops in the pelvis begin to fill:
- **a. Four spot films of the ileum**
- **b. Four spot films of the jejunum**

3) When the ceacum is well filled:
- **a. Four spot films of the distal ileum**
- **b. One survey film of the entire intestine**

4) If more than 700 ml of contrast fluid is required to reach the ceacum, then the first survey film is taken after 700 ml has been administered and the second after the ceacum is well filled *(Kobayashi ., 2000).*

Flocculation of the barium suspension in infants develops almost immediately after the contrast infusion is terminated, and thus all exposures should be taken while the infusion is running or immediately afterward. Compression should be applied with the utmost care. An infant can be examined only in the supine position, preferably immobilized ***(Sanders et al., 1999).***

Until recently, the small intestine was the only region of the digestive tract which could not be examined endoscopically. This was due to in part to the anatomy of the small intestine whose multiple unsupported loops precluded deep intubation using conventional instruments and techniques, and also to differences amongst clinician and experts in endoscopy as to the perceived need for endoscopic examination of the jejunum and ileum ***(Klaus et al., 2002)***.

The standard endoscopic examination, esophago-gastroduodonoscopy (EGD) and colonoscopy, visualize only limited areas of the small intestine. Upper endoscopy reaches the junction of the second and third portions of the duodenum, and the terminal ileum can be intubated for up to 30 cm at colonoscopy. Endoscopic evaluation of the distal duodenum and large areas of the jejunum and ileum has been termed enteroscopy. At present, several methods are available: push enteroscopy, sond enteroscopy, intra-operative enteroscopy, as well as the rope-way technique now largely abandoned, and the investigational technique of endostomy ***(Roy et al., 2002)***.

The first evaluations of protype small intestinal endoscopes were published in the mid-1970s. Today special techniques using purpose designed instruments allow high quality examination of the whole small intestine ***(Lewis et al., 2000)***.

There are two commonly used techniques of endoscopic examination of the small bowel; ***Sond*** and ***Push enteroscopy***. These depend upon purpose designed instruments which enable examination of different areas of the small intestine. Facilities for simultaneous radiological screening are essential for safe and successful sond enteroscopy and can be helpful to the less experienced endoscopists during push enteroscopy. Preparation and sedation for enteroscopy are essentially, but as the procedure may be prolonged and sometimes uncomfortable, higher doses of sedation and the use of analgesics may be required ***(Gilbert et al., 2001)***.

○ **Sond Enteroscopy :**

Is highly flexible, it is designed to negotiate the convoluted loops of the distal small bowel. It has 2 channels, one for insufflation of air or water from the tip and the second for inflation of a balloon covering the distal 3 cm of the instrument. Sond enteroscopy was the first method used in clinician practice and was pivotal in the development of small bowel endoscopy ***(Tada et al., 2000)***.

Sond enteroscopy differs from conventional gastrointestinal endoscopic techniques in three respects. Firstly, the enteroscopy is not advanced by the endoscopists but relies on traction by peristalsis to allow deep intubation of the ileum. Secondly, the instrument is introduced through the nose and is advanced in stages by the patient or an assistant. Finally, examination of the bowel occurs only during withdrawal of the instrument with the balloon in the deflated sate ***(Gostout et al., 2000)***.

A major problem with the sond technique is the time taken to achieve deep intubation of the small bowel. This period can be shortened by helping the enteroscope through the pylorus using a " piggy back " technique, were a string on the distal tip on the enteroscope is grasped by biopsy forceps from a second conventional endoscopy passed through the mouth a long the side of the sond. The tip of the enteroscope is manoeuvred into the duodenum using the biopsy forceps before inflation of the distal balloon. The second endoscopy is then withdrawn even with the modified technique the whole procedure may take 6-8 Hrs. Sond enteroscopy Is therefore normally reserved for occasion where examination of the ileum is felt to be essential for patient management. As there is no biopsy channel, it is not possible to obtain specimen for pathological examination, and the absence of a steering mechanism for tip deflation may result in incomplete mucosal inspection ***(Lopez et al., 2001)***.

○ **Push Enteroscopy :**

The push enteroscopy is a mush more familiar instrument having a biopsy-therapeutic channel and a fully steerable tip. Typical video push enteroscopy

with a special flexible distal section facilitates passage around bends in unsupported loops of small bowel. Successful push enteroscopy depends on the ability to propel the instrument into the small bowel by direct pressure. A potential problem is looping in the stomach. To overcome this, a stiffing over tube is back loaded onto the shaft before intubation ***(Foutch et al., 2000)***.

Whilst, sond enteroscopy allows examination of the entire small intestine the push enteroscopy can only reach the distal jejunum or at best the proximal ileum. On the other hand, image quality of narrow sond fibres enteroscopies is poor when compared with that obtained with the latest push video enteroscopies ***(Klaus et al., 2002)***.

- **Intra-Operative Enteroscopy :**

Because sond enteroscopy is not widely available, intra-operative enteroscopy remains the most common form of total small bowel endoscopic examination. Colonoscopes are routinely employed in this examination, although a push enteroscope may also be used. Use of a sond enteroscope has also been reported. Access to the small intestine may be via the mouth, the colon, or an enterostomy. The use of video endoscopes allows both the surgeon and the endoscopist to see the intra-luminal views ***(Lopez et al., 2001)***.

- **Investigational Techniques of Enteroscopy :**

These include the so called rope- way method, endostomy, and laparoscopy - assisted enteroscopy ***(Askin et al., 1996)***.

INTESTINAL BIOPSY

Most lesions of the gastrointestinal tract can be recognized by their endoscopic appearance. A clinician's suspicion about the nature of a lesion usually can be confirmed by obtaining endoscopic biopsies and brush cytology specimens. The use of these two sampling technique, alone or together, results in correct identification of approximately 95% of malignant lesions. A small proportion of tumours remain undiagnosed by these conventional techniques, because only surface cells or tissues are sampled. Lesions that are primarily infiltrative, such as recurrent tumours, and less common histologic types such as lymphomas and sarcomas, are difficult to diagnose from standard biopsy or brush cytology specimens ***(Giancarlo et al., 2000).***

When used in combination, these techniques give false-negative results for 5 % of the lesions, but this percentage increases to as high as 50% for infiltrative or stenotic lesions, malignancies with necrotic surfaces, and submucosal tumours such as lymphomas and sarcomas ***(Michael et al., 2000).***

Multiple endoscopic biopsy specimens are often inadequate for a histologic diagnosis because of insufficient tissue depth and the small size of these samples. Techniques for obtaining biopsies of submucosal lesions are difficult. These methods include aspiration needle biopsy and guillotine needle biopsy ***(Parker et al.,2001).***

- **Aspiration Needle Biopsy :**

The availability of flexible needles for injecting oesophageal varices raised the possibility that needle aspiration cytology could be applied to gastrointestinal lesions makes it possible to obtain samples from lesions lying deep to necrotic debris or normal mucosa that are difficult to diagnose by conventional sampling methods ***(Barkin et al.,2000).***

A number of investigators have advocated endoscopic aspiration cytology as a way of increasing diagnostic yield when endoscopic biopsies and brush

cytology specimens are obtained in the upper gastrointestinal tract. The combination of forceps biopsy and brush cytology gave an accuracy of 93.5%, and the addition of fine –needle aspiration cytology increased the yield to 100 % ***(Kochhar et al., 2000).***

- **Guillotine Needle Biopsy:**

This bioptic needle is a unique flexible needle designed for use with endoscopes that have accessory channels of standard diameters ***(Caletti et al., 2000).***

This study was conducted on 50 patients referred from the inpatient departments and outpatient clinics of medicine and surgery to the radiology departments of Theodore Bilharz Research Institute, Cairo University and a radiology center.

They were 30 males and 20 females, their age ranged between 22 and 50 years. The predominant clinical presentations were diarrhoea, loss of body weight, abdominal colic and distension.

The cases were submitted to the following:

- Full clinical examinations.
- Basic laboratory investigations.
- Radiological studies:
  - *Plain X-ray examination of the abdomen (erect & supine views)*
  - *Enteroclysis (small bowel enema).*
  - *Barium enema (3 cases).*
  - *Barium meal-follow through (6 cases).*
  - *Fistulography (2 cases).*
  - *Chest X-ray examination (8 Cases).*
  - *Ultrasonography (24 cases).*
  - *CT scan (23 cases).*
  - *Angiography (1 case)*
  - *Bone scan (4 cases).*
- Enteroscopy (26 cases).
- Colonoscopy (10 cases).
- Biopsy & histopathology (28 cases).
- Surgical interference (13 cases).

- **Clinical examinations:**

- Full history taken for each case laying stress on; diarrhoea, abdominal pain, fever and vomiting.
- Clinical examination:
  - General for: wasting, anaemia, enlarged lymph glands, cardiac, pulmonary abnormalities, mal-nutrition or hypo-vitaminosis signs.
  - Local for: Abdominal tenderness, abdominal masses or enlargement of liver and spleen. Ascites was also searched for.

- **Laboratory investigations:**

  - Stool examination (All cases).
  - Sputum analysis (4 cases).

    Early morning samples for 3 consecutive days are examined microscopically after staining with Ziehl-Nielsen stain.

  - Tuberculin test (2 cases).
  - C.B.C. (All cases).
  - Renal & Liver functions (All cases).

- **Radiological examinations:**

All cases were submitted to the following radiological examinations:

I. Plain x-ray of the abdomen

To show soft tissue tumefaction, calcifications or signs of intestinal obstruction.

II. Small bowel enema

The apparatus used was Toshiba-DBA-300/80N with image intensifier, closed circuit television, tilting table and an EPS unit with a Kodak EKTA scan 1120 laser digital camera.

The factors used differed according to the built of the patient, with an average of 100 mAS, and 80 KV.

A) Patient preparation:

The patient had nothing to eat or drink for eight hours before the examination (fasting overnight).

B) Pre-medication:

The fasting patients were given 20 mg metoclopramide orally 10-15 minutes prior to the examination to prevent vomiting, relax the pylorus and promote the onward flow of the contrast material injected, eliminating the peristaltic wave transmission effect on the barium column.

C) Contrast media:

-The barium used for enteroclysis examination was Pronto-bario (barium sulphate) H.D 250% w/v suspension which has the advantages of being flavoured, more readily soluble having a mucus resistance flocculation, and giving a better delineation of the mucosal pattern. The average quantity used for each patient was 200-300 ml of 30% w/v of the barium (till reaching the proximal ileum), followed by about 800-1000 cc of methylcellulose. The barium was infused at a slow rate of about 75 ml/minute to ensure better delineation of the bowel loops.

-Methylcellulose 0.5 percent solution was used as a radiolucent agent producing the double contrast effect, and was prepared as follows:

Few ccs of boiling water were added to 10 gm of methylcellulose powder and mixed well to make a paste. Grind ice was then added to the paste and mixed thoroughly till it dissolved completely. Ice-cold water was then added up to 2000 ccs to make 0.5% solution. The solution was then filtered with gauze to take out any un-dissolved particles

C) Intubation & filming:

- The jejunal tube; was 12F Balbao-Dotter hypotonic duodenography set, 145 cm long, has six sided-holes within 5 cm of its tip, with a long 155 cm stainless-steel guide wire.

- Xylocaine spray and gel were used through the patient's nostrils and applied generously on the catheter tip, respectively. With the patient in the sitting position with his neck flexed, the tube was passed trans-nasally assisted by the patient swallowing and the presence of the guide wire within (not reaching the tip of the tube) until it reached the gastric fundus.

- Then the patient was asked to lie on his right side to allow the tube to slide on the greater curvature of the stomach thus preventing tube coiling. This position also put the duodenal cap in the dependant position so by gravity the tube will be directed toward it.

- Once the tube was within the pyloric canal the patient elevated his right side, helping to introduce the tip of the tube through the duodenal cap. Meanwhile, the guide was pulled-up from the tube and never allowed to enter the duodenum.

- The tube was pushed through the different duodenal segments, till reaching the very proximal part of the jejunum, at the duodeno-jejunal junction where the ligament of Treitz lies. To ensure the position of the tube within the duodenal cap & exclude its being coiled upon itself in the gastric pylorus, the patient was put in the true lateral position if the tube was directed posteriorly toward the vertebral column, so it was passing through the duodenum and this was better than delineating the way with some barium.

- The procedure was done under fluoroscopic control. Once the tube reached the proximal jejunal loop, it was fixed in place with a

plaster to the side of the face to prevent slipping-out during injection.

- Barium & methylcellulose injection through the tube in the upper jejunum was done under intermittent fluoroscopic control to be sure that the contrast was not refluxing in the stomach.

- Consecutive spot-films with compression were taken to show the jejunal loops gradually. This allowed the whole of the small bowel to be examined, minimizing difficulties caused by overlapping loops. At the end of the injection, with the patient supine and in different positions and degrees of obliquity, the small bowel was carefully examined under fluoroscopy, especially the ileum, before being masked by the barium filled colon, and spot films of the ileal loops and terminal ileum as well as full size over-couch films for the abdomen in supine & prone positions were taken to show the ileo-ceacal region and overall view of the small gut respectively. The examinations were usually completed within 30-40 minutes.

- Some difficulties occur during the enteroclysis examinations, as follows:

(1) Some patients found it difficult to tolerate the intubation, but with the use of anaesthetic gel & spray as well as assuring the patient we could overcome this difficulty.

(2) Coiling of the tube within the stomach was occasionally observed, this was corrected by;

(a) Splinting the tube by the guide wire.

(b) External support of the tube in the gastric body by applying external pressure on the left hypochondrium with the gloved hand.

(3) Failure of the tube to pass into the pyloric canal. Changing the patient's position and gentle introduction had

often solved this problem as forcible manoeuvring may cause mucosal injury.

(4) Reflux of contrast material into the stomach due to very rapid injection, this was worked-out by slowing the rate of injection and turning the patient into the right lateral position.

(5) Vomiting; when the reflux was established & sometimes lead to failure of the examination.

(6) Insufficient loop distension and flocculation of the contrast material due to slow rate of injection. This should be avoided by increasing the rate of injection.

III. Other different radiological studies

These include plain x-ray examination of the abdomen and chest, barium enema, barium meal follow-through, fistulography, and selective superior mesenteric angiography. These studies are done using Toshiba-DBA-300/80N apparatus with image intensifier, closed circuit television, tilting table and an EPS unit with a Kodak EKTA scan 1120 laser digital camera.

IV. Ultrasonography examination

Abdominal and pelvic examinations were conducted for 23 cases using a general electric (GE) logic 500, pro-series apparatus with curvilinear probes (2.5-4 MHz), B-mode colour duplex and pulsed doppler.

V. CT scan of the abdomen & pelvis

Post oral & I.V contrast CT studies of the abdomen and pelvis were done for 23 cases, using Toshiba whole body X-ray-CT scanner Xpress / SX, TSX-011A/7 series- solid state detector. CT guided percutenous needle biopsies

using 18G-20 cm true-cut needle biopsy set were done for 6 cases, and the specimens were send for histo-pathological assessment.

VI. Enteroscopy

Enteroscopy was done for 26 cases using a Pentax video-enteroscopy VSB-3440 series (210 cm length) with a flexible biopsy forceps, connected to a video processor unit.

VII. Bone scan

Whole body scan was done for 4 cases, using a large field of view dual head gamma camera (Toshiba), after I.V injection of 20 mci of Tc^{99m} – MDP (methylene diphosphonate),with oral hydration for 2 hrs using 2 litres of fluid followed by complete urinary bladder evacuation before imaging.

VIII. Histopathology

The specimens obtained whether by enteroscopy (16), colonoscopy (10), CT guided (2) or sent after operative intervention (4) were examined under Zeiss light microscopy (LM) with an attached digital camera to obtain snap-shot views.

Our study population was 50 patients, consisted of 30 males and 20 females, their age ranged between 22 and 50 years, with a mean age of 38.1 ± 7.3 years.

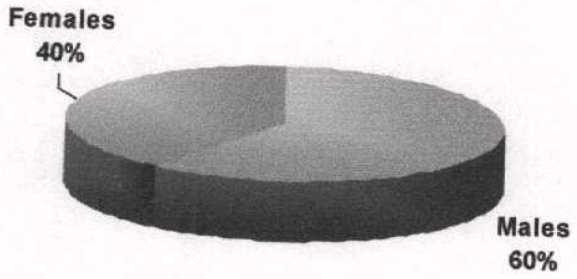


Chart 1: Male: Female prevalence in the study

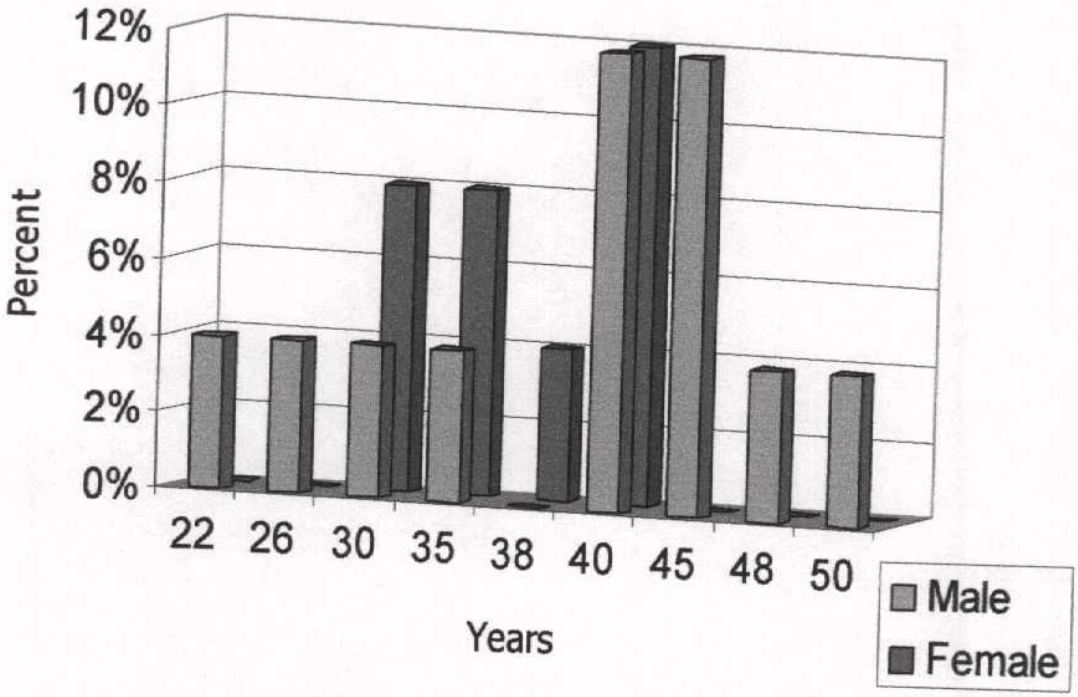


Chart 2: Age range with Male / Female ratio

The indications for which the examinations were done are demonstrated in the following table and corresponding figure:

Indications for exam	Total		Males		Females	
	No.	%	No.	%	No.	%
Diarrhoea	40	80%	22	55%	18	45%
Weight loss	34	68%	18	53%	16	47%
Abdominal pain	42	84%	26	62%	16	38%
Abdominal distension	18	36%	12	67%	6	33%
Fever	6	12%	4	67%	2	33%
Bleeding per rectum	1	2%	0		1	16%

Table 1: Indications for the examination

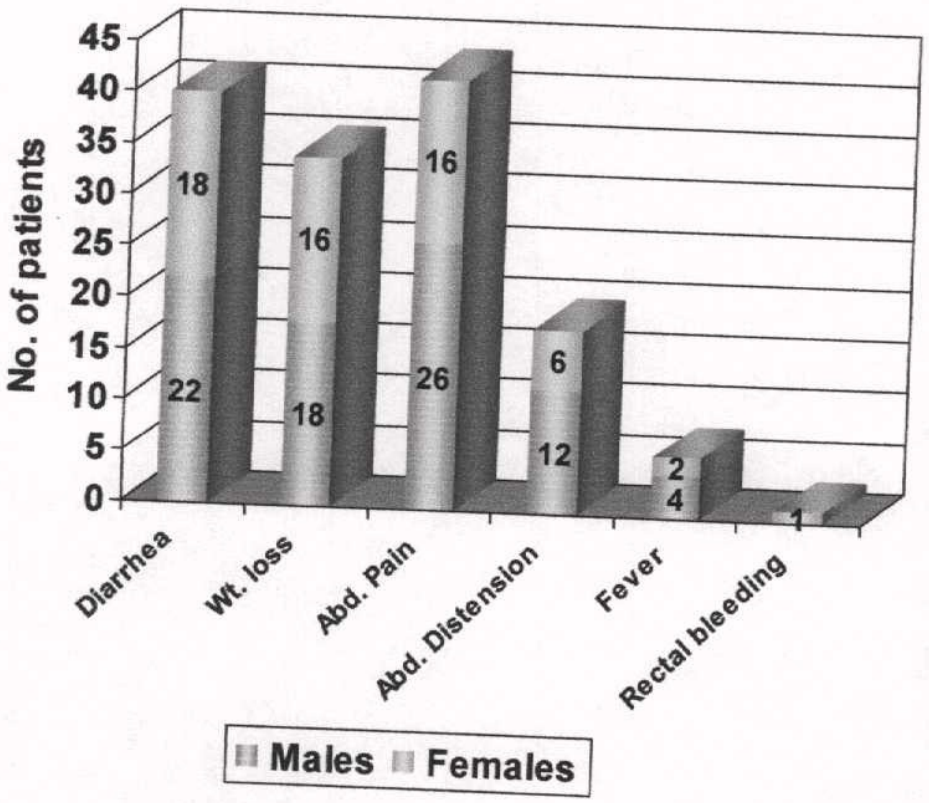


Chart 3: Indications for the enteroclysis examination in the study population

38 patients of our conducted study were either pathologically or operatively proven (76%). Two cases (4%) were suspected to have small intestinal loops infiltration by an invasive ovarian carcinoma using another modality, while enteroclysis declined this (our results was confirmed operatively). On the other hand, there were four cases (8%) of post-radiotherapy enteric changes having no definite criteria by enteroclysis, and was diagnosed by previous clinical data of receiving radio-therapeutic treatment. Our study was non-specific with two cases (4%).

Failed jejunal intubation had occurred with one patient that refused the procedure. Our study was negative in one patient suffering from obscure rectal bleeding, proved by angiography to have a ceacal vascular malformation.

We classified our patients for more detailed analysis according to the type of abnormality into:

1. Post-therapeutic complications.
2. Inflammatory diseases.
3. Neoplastic disorders.
4. Obstructive disorders.
5. Others.

The following table and chart show the different types of abnormalities encountered in the study and their percentages and their sex prevalence:

Types of abnormalities	Total		Males		Females	
	No.	%	No.	%	No.	%
Post-therapeutic complications	6	12%	4	67%	2	33%
Inflammatory	11	22%	6	55%	5	45%
Neoplastic	5	10%	3	60%	2	40%
Obstructive	12	24%	4	33%	8	67%
Others	6	12%	2	33%	4	67%

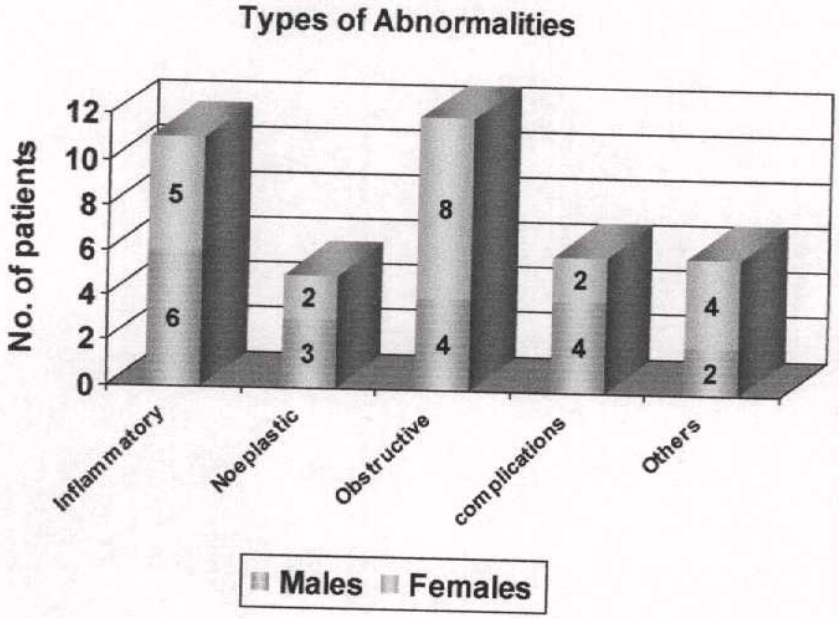


Table 2 & Chart 4: Types of abnormalities encountered in the study

For more detailed analysis we further subdivided the abnormalities into the definite abnormalities encountered in the study:

Definite abnormalities	Total		Males		Females	
	No.	%	No.	%	No.	%
Crohn's	5	10%	2	40%	3	60%
Intestinal obstruction (adhesive band)	4	8%	0	0%	4	100%
Intussusception	2	4%	2	100%	0	0%
Chronic radiation enteritis	4	8%	2	50%	2	50%
Post operative jejunal stricture	2	4%	2	100%	0	0%
Ileo-caecal TB	4	8%	2	50%	2	50%
Lymphoma	4	8%	2	50%	2	50%
Malabsorption	2	4%	2	100%	0	0%
Displacement	2	4%	0	0%	2	100%
Ileo-colic fistula	2	4%	0	0%	2	100%
Jejuno-ilial fistula	2	4%	2	100%	0	0%
Carcinoid	1	2%	1	100%	0	0%
Adhesions	4	8%	0	0%	4	100%
Non-specific enterocolitis	2	4%	2	100%	0	0%

Table 3: Further subdivision of the study abnormalities

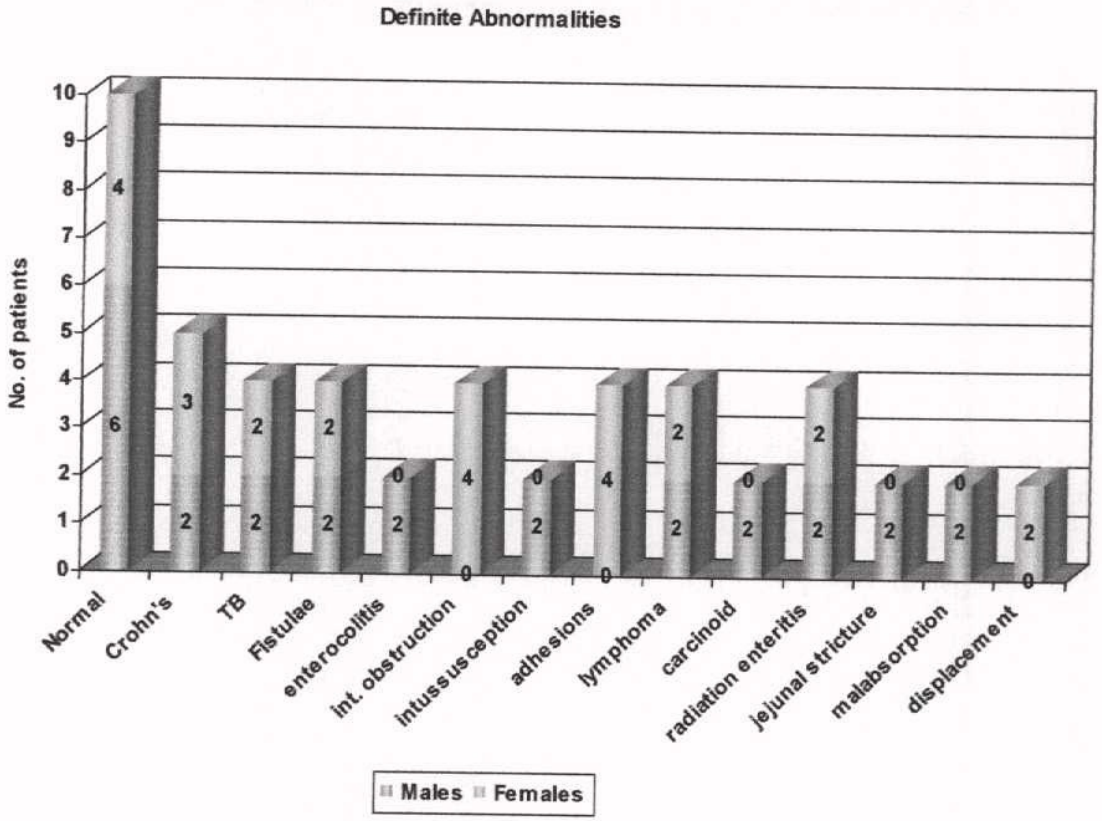


Chart 5: Definite abnormalities encountered in the study

The encountered abnormalities in our study were plotted in the following chart:

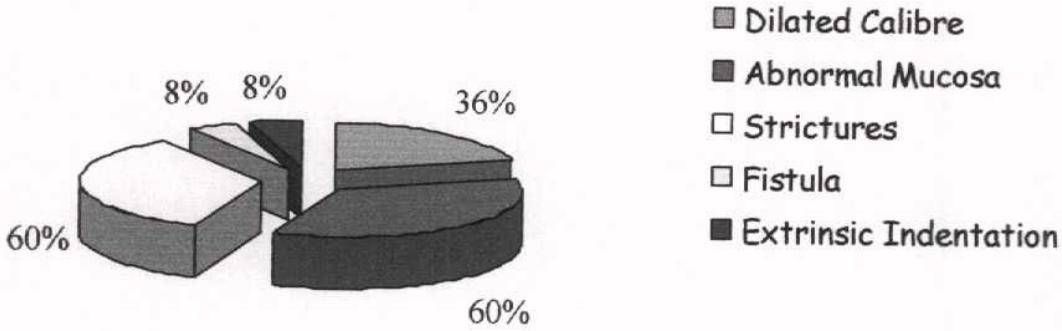


Chart 6: The percentage of the enteroclysis detected abnormalities

The following tables & charts show the sensitivity, specificity, +ve and –ve predictive values of the enteroclysis technique itself and its different findings seen in this study:

	Enteroclysis Findings				
	Dilatation	Mucosal pattern	Strictures	Fistulae	Extrinsic indentation
Sensitivity	82%	85%	85%	80%	83%
Specificity	90%	90%	92%	83%	87%
Positive predictive value	87%	95%	95%	85%	85%
Negative predictive value	92%	95%	93%	90%	90%

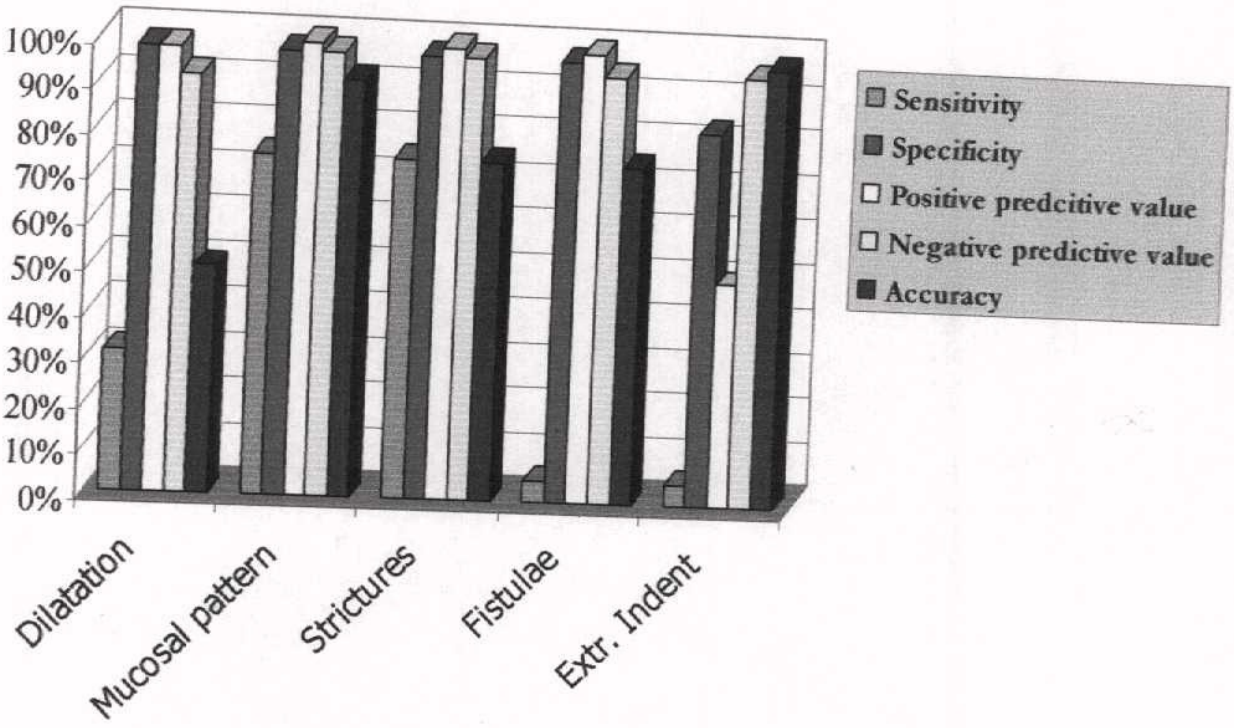


Table 4 & Chart 7: Different statistical analysis of the enteroclysis findings

The Enteroclysis Technique Statistics	
Sensitivity	84%
Specificity	89%
Positive Predictive Value	93 %
Negative Predictive Value	90%

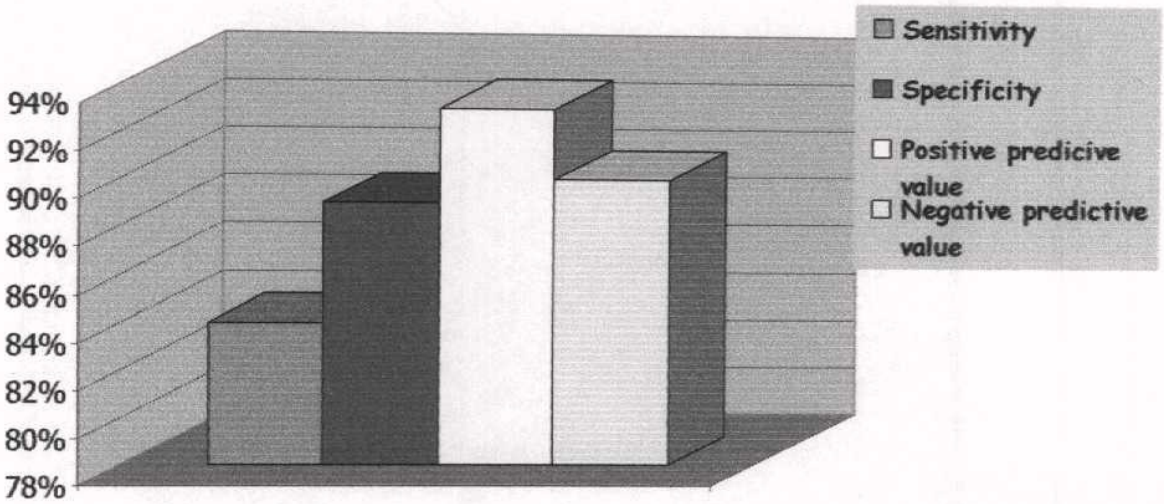


Table 5 & Chart 8: Different statistical analysis of the enteroclysis technique

Case No.1

- **Clinical presentation:**

- A 30 years old female patient, presented with diarrhoea, weight loss, and abdominal colic.

- **Laboratory findings:**

- Stool analysis: Pus cells.

- **Enteroclysis findings:**

- Non-uniform alternating areas of luminal narrowing and saccular dilatation were seen associated with disrupted mucosal outlining.

- The terminal ileum was narrowed showing multiple hairline (fissure) ulcerative projections.

- **Other radiological examinations & findings:**

- Abdominal& pelvic ultrasonography: Normal.

- **Enteroscopic findings:**

- Severe jejunal ulcerations.

- **Histopathological findings:**

- Epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall, confirming the diagnosis.

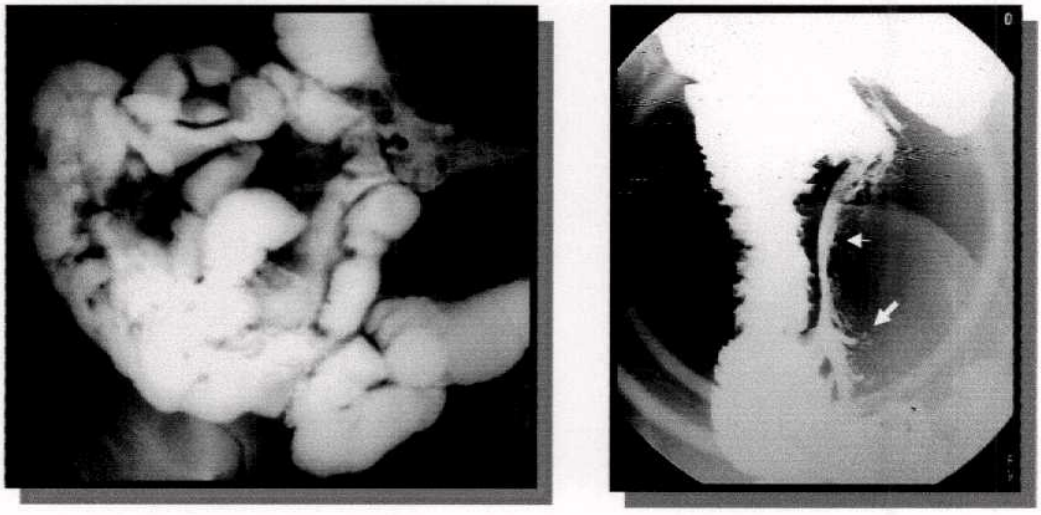
- **Diagnosis:**

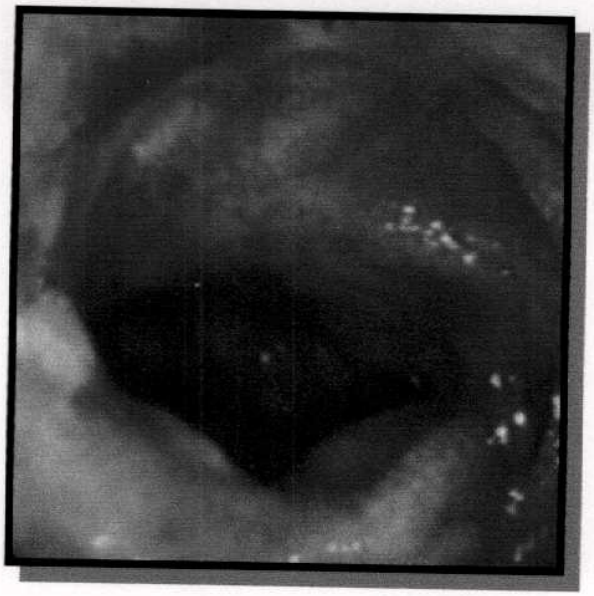
Crohn's disease

- Alternating luminal narrowing and dilatation.

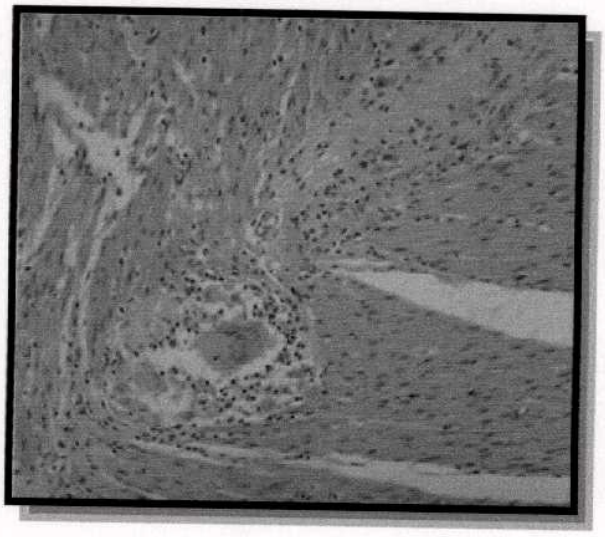
- Disrupted mucosal outlining.

- Narrowed terminal ileum showing multiple ulcerations (short arrows).





- Enteroscopy revealed severe jejunal ulcerations.



- Pathological examination of tissue biopsy revealed epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall (Hematoxylin and eosin stain X200) confirming the diagnosis.

Case No.2

- **Clinical presentation:**

- A 40 years old male patient, presented with diarrhoea, weight loss, abdominal colic & low grade fever, and multiple coetaneous sinus openings.

- **Laboratory findings:**

- Stool analysis: Blood cells.

- **Other radiological examinations & findings:**

- Fistulography examination resulted in opacification of variable length fistulous tracks, however could not totally exclude the presence or absence of a communication to hollow organ.

- Barium enema showed normal non-contracted distensible ceacum.

- U.S examination of the terminal ileum & ileo-caecal region revealed marked thickening of the examined bowel segments showing eccentric lumen and loss of normal layer differentiation of the bowel wall, minimal peri-caecal fluid, and marked increased vascularity.

- **Enteroclysis findings:**

- The distal portion of the ileum as well as the ileo-ceacal junction showed non-uniform stenotic segment with consequent relative proximal dilatation.

- Multiple barium filled linear fistulous tracts predominantly originating from the terminal ileum, through which barium was extruded on the skin (washed-out during filming).

- **Colonoscopic findings:**

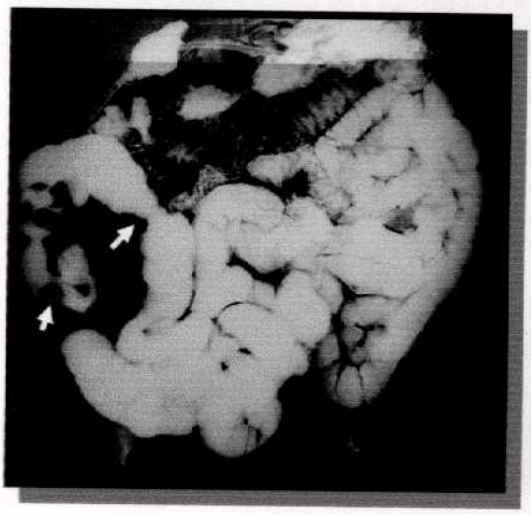
- Confirmed the presence of fistulous openings, and tissue biopsy was obtained for Histopathological assessment.

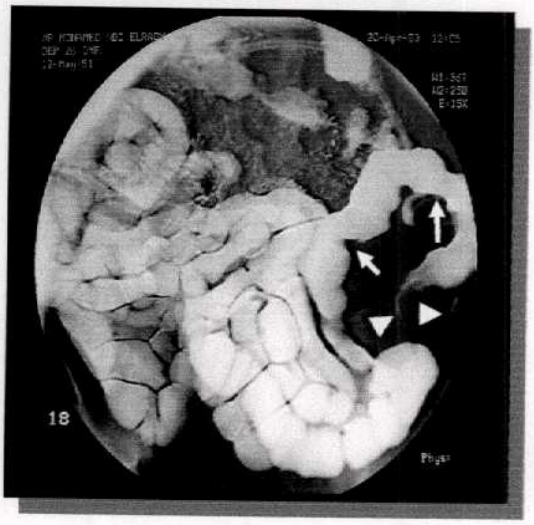
- **Histopathological findings:**

  - Histopathological examination of the tissue biopsy (from the ileum) showed epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall (Hematoxylin and eosin stain X200) proving the previous diagnosis.

- **Diagnosis:**

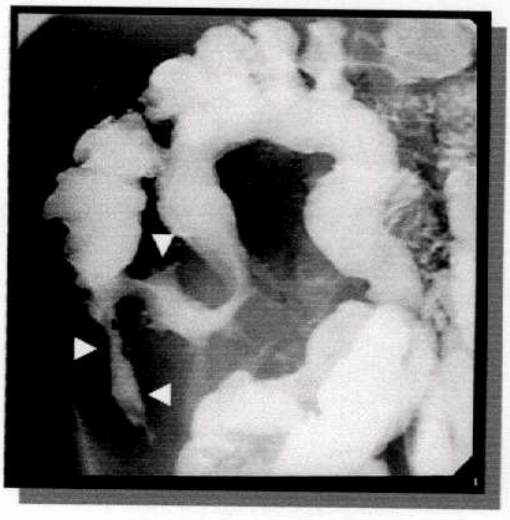
Complicated Crohn's disease

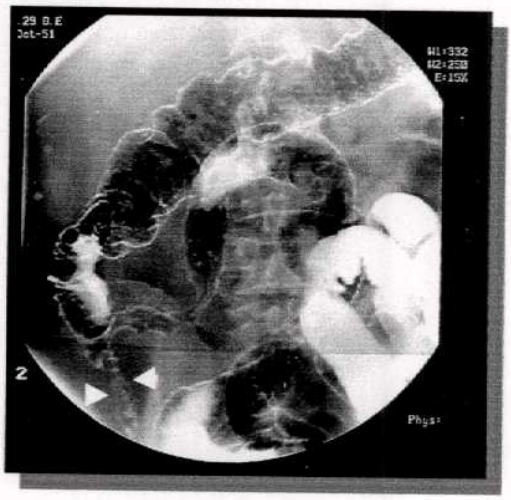




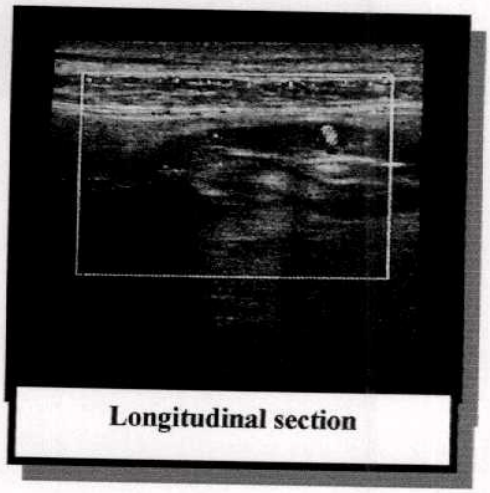
- Non-uniform stenotic segment at distal ileum & ileo-ceacal junction (arrows).

-Multiple terminal ileum barium filled linear fistulous tracts (arrow heads).



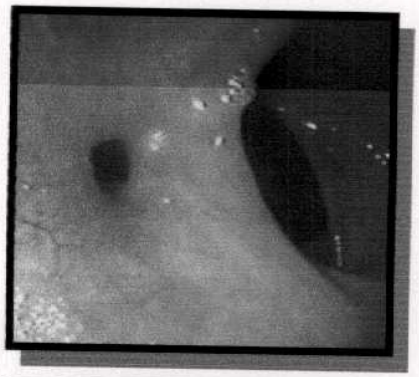


Transverse section



Longitudinal section

- Ultrasonographic doppler examination of the distal ileum and ileocecal region revealed:
  - Marked thickening of the examined bowel segments showing eccentric lumen and loss of normal layer differentiation of the bowel wall.
  - Minimal peri-caecal fluid.
  - Marked increased vascularity.



-Colonoscopy identifies the fistulous opening.

-Epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall.

Case No.3

Clinical presentation:

- A 30 years old female patient, presented with diarrhoea, weight loss, abdominal colic and distension.

- **Laboratory findings:**

- Stool analysis: Pus & Blood cells.

- **Enteroclysis findings:**

- Luminal contour changes with abnormal mucosal fold pattern and small barium outlined ulcerative projection, were noticed at the adjoining distal jejunum and proximal ileum.

- Irregular outline of the terminal ileum presenting linear and nodular filling defects. Tiny rounded barium filled ulcerative projections (arrows) were also noticed.

- **Other radiological investigations & findings:**

- CT examination of the abdomen and pelvis only raised the suspicion of distal ileal mural wall thickening.

- **Colonoscopic findings:**

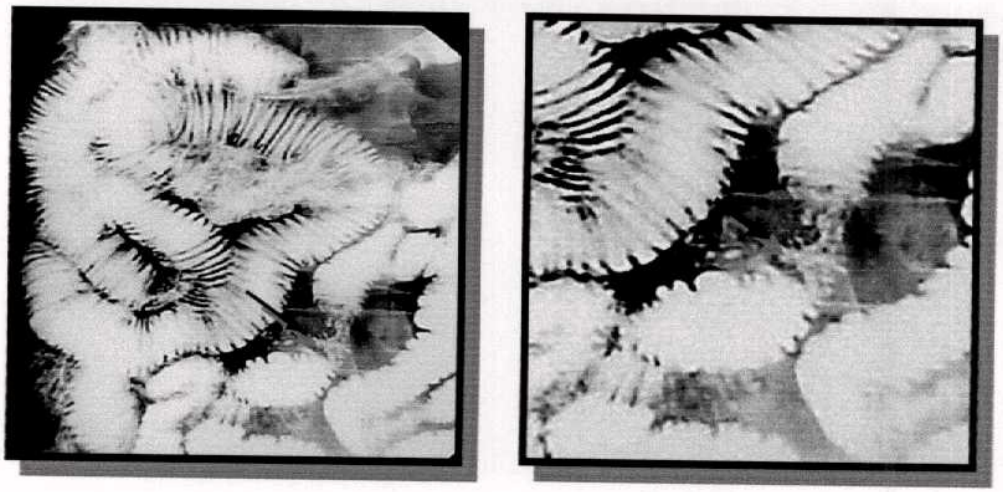
- Colonoscopy revealed denuded terminal ileum mucosa being covered with whitish necrotic tissue and surrounded by hyperaemic oedematous mucosa (aphthoid ulcer).

- **Histopathological findings:**

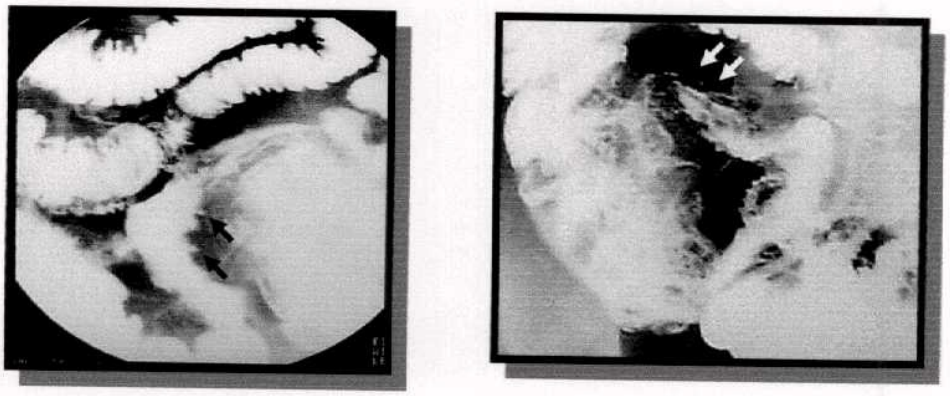
- Examination of the colonoscopic guided biopsy revealed epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall, confirming the diagnosis.

- **Diagnosis:**

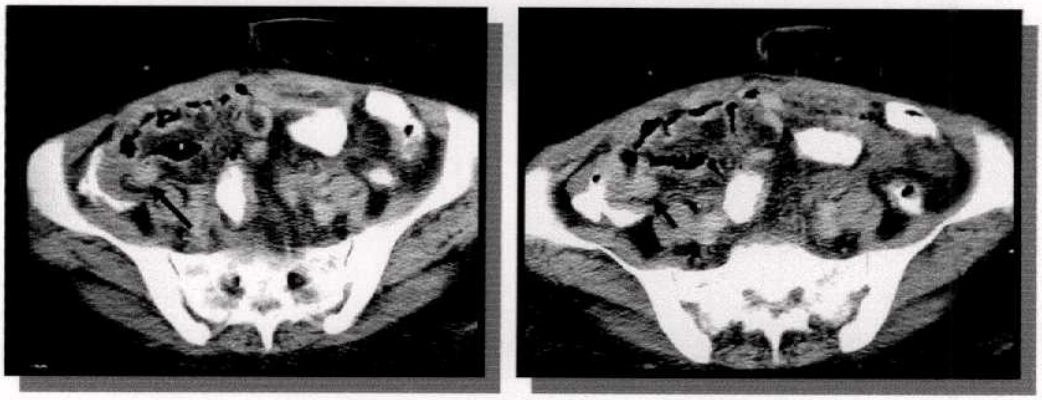
Crohn's disease



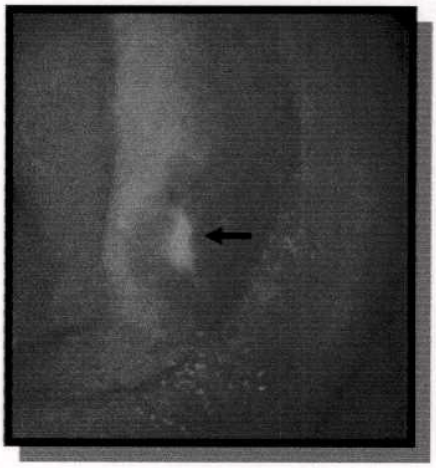
- Abnormal mucosal fold pattern with barium outlined ulcerative projection (black arrow).



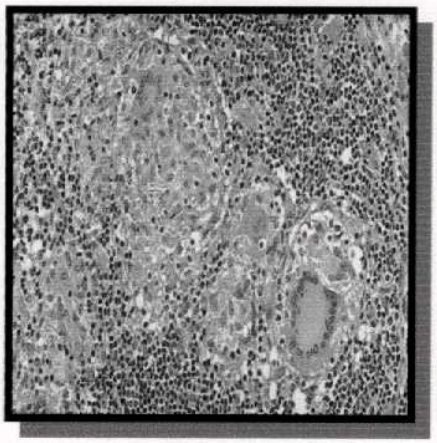
- Non-uniform terminal ileum mucosal outlining with multiple ulcerative projections (arrows).



- Subtle mural wall thickening at the ilea-ceacal region (arrows).



-Colonoscopy shows terminal ileum aphthoid ulcer.



- Histopathological examination of the biopsy showing epithelioid granuloma formed of epithelioid cells and multinucleated giant cell in the muscle wall (Hematoxylin and eosin stain X200).

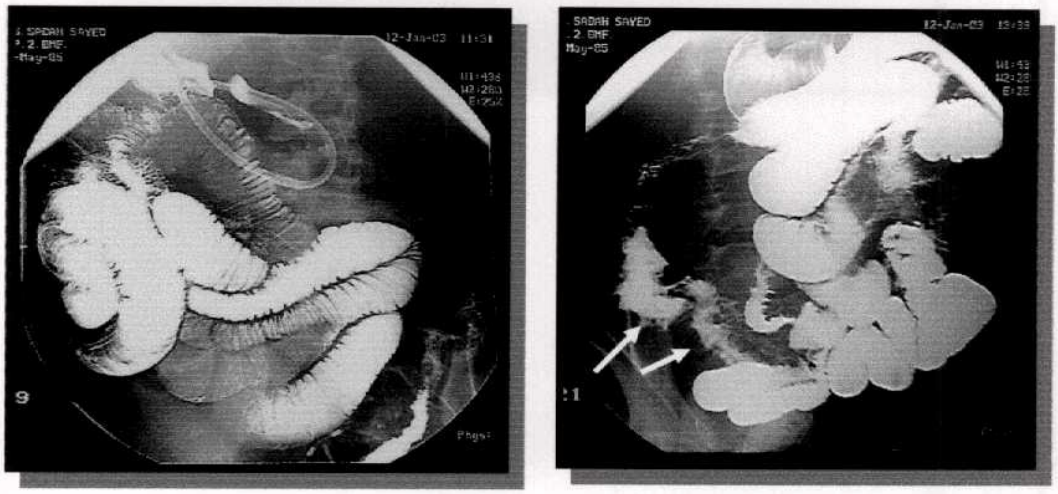
Case No.4

- **Clinical presentation:**
  - A 38 years old female patient, presented with diarrhoea, weight loss, and low grade fever.
- **Laboratory findings:**
  - Stool analysis: Non-specific.
  - Sputum: -ve
- **Enteroclysis findings:**
  - Bizarre shaped terminal ileum showing destructed mucosa, serrated outline, with intermingled linear and nodular filling defects.
  - Contracted non-distensible ceacum depicting an irregular outline.
- **Other radiological investigation & findings:**
  - Plain chest X-ray examination: Normal.
  - CT scan of the abdomen & pelvis raised the suspicion, yet could not confirm the presence of mural wall thickening at the ceacum and ileo-ceacal region.
- **Colonoscopic findings:**
  - A large ulcer in the terminal ileum covered by whitish necrotic tissue.
- **Histopathological findings:**

- Confirm the diagnosis.

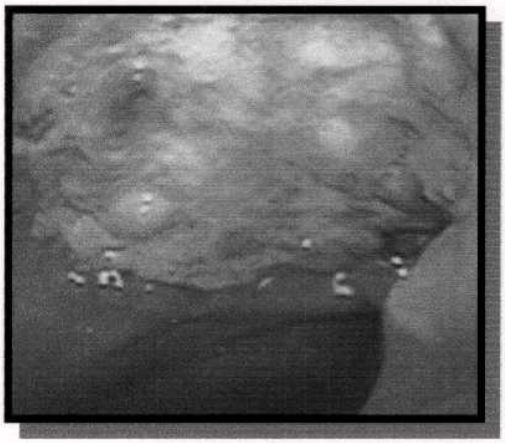
- **Diagnosis:**

Ileo-ceacal T.B

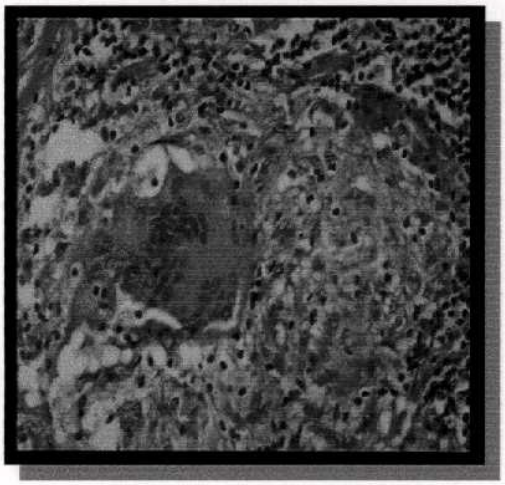


- The terminal ileum shows destructed mucosa with intermingled linear and nodular filling defects.
- Contracted non-distensible ceacum.

-Suspicious mural wall thickening of the ceacum and ileo-ceacal region.



-Colonoscopy revealed a large ulcer in the terminal ileum.



-Histopathological examination of the ileal biopsy shows tuberculous granuloma, formed of central caseation rimed by epithelioid cells with few Langhan's multinucleated giant cells.

Case No.5

- **Clinical presentation:**
  - A 45 years old male patient, presented with diarrhoea, abdominal colic & distension, weight loss, and low grade fever.
- **Laboratory findings:**
  - Stool analysis: Non-specific.
  - Sputum: -ve for tubercle bacilli.
- **Enteroclysis findings:**

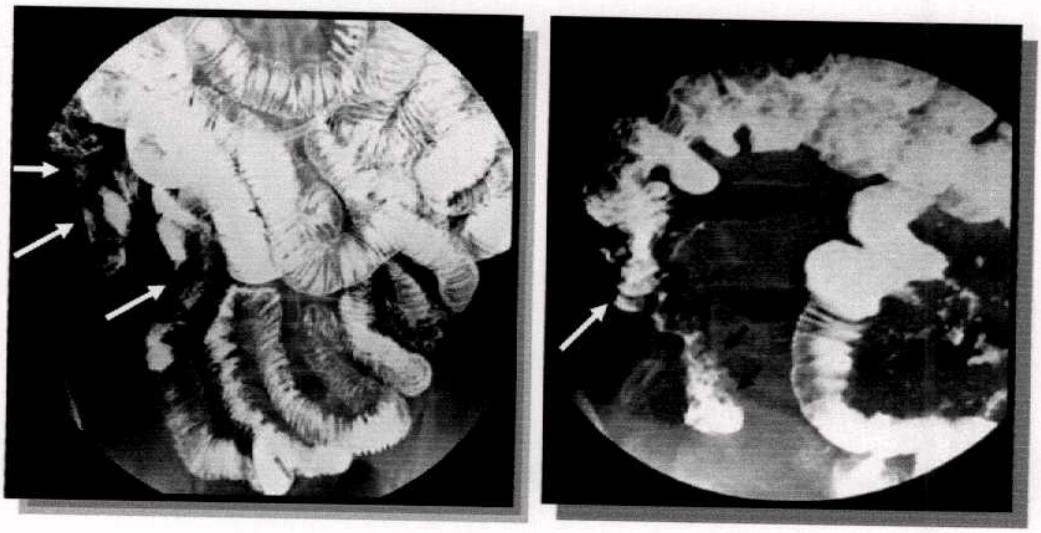
- Reduced distensibility of the distal ileal loops showing irregular contour, obliteration and distortion of the mucosal folds.
- Contacted pulled-up ceacum depicting irregular outline & distorted configuration, associated with multiple rather nodular filling defects within the terminal ileum.

- **Other radiological investigation & findings:**
  - Plain chest X-ray examination: Normal.
  - CT scan of the abdomen & pelvis showed doubtful mural wall thickening at the caecal region.
- **Colonoscopic findings:**
  - Caecal stricture with an ulcer on top.
- **Histopathological findings:**

- Examination of the colonscopic biopsy specimen confirmed the diagnosis.

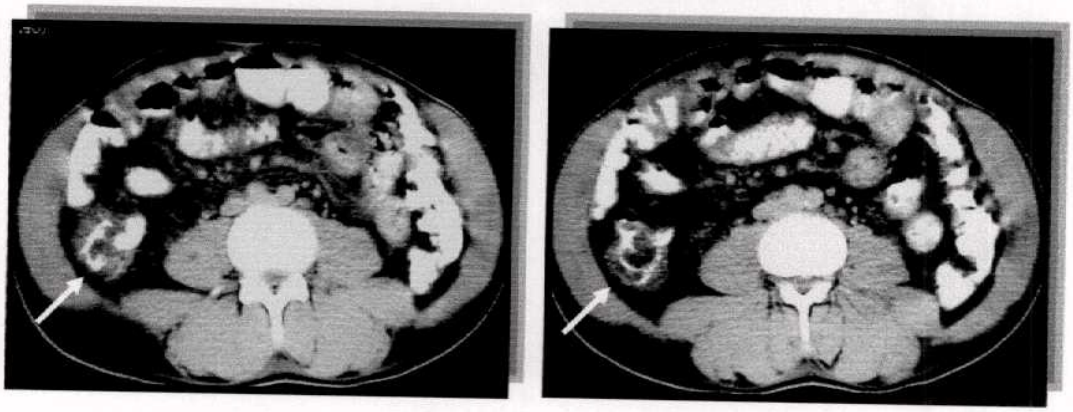
- **Diagnosis:**

Ileo-caecal T.B

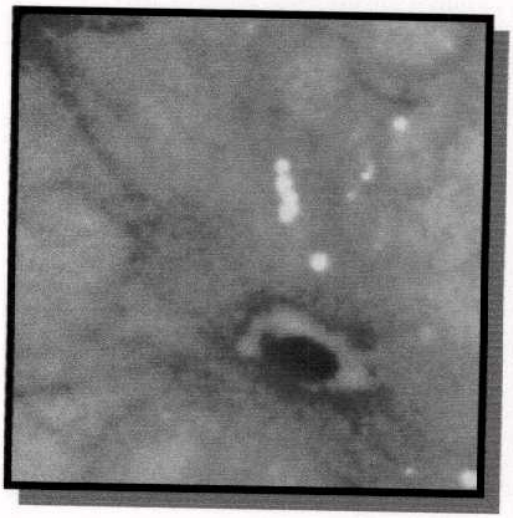


- Spastic distal ileal loops showing irregular contour, distorted mucosal folds.

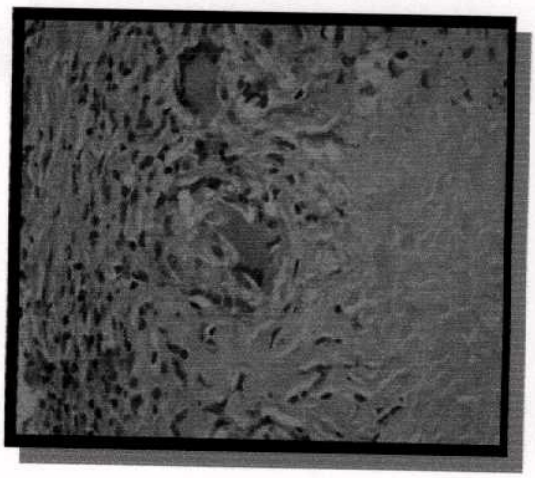
-Contacted ceacum (white arrows) with multiple rather nodular filling defects within the terminal ileum (black arrows).



-CT shows apprehensive mural wall thickening at the ceacal region (arrows).



-Colonoscopy revealed ceacal stricture with an ulcer on top.



- Tuberculous granuloma, formed of central caseation rimed by epithelioid cells with few Langhan's multinucleated giant cells coalescence of granulomas with caseation.

Case No.6

- **Clinical presentation:**
  - A 35 years old male patient, presented with vomiting and abdominal colic of acute onset.
- **Laboratory findings:**
  - Complete blood picture: Normal
- **Enteroclysis findings:**

- An area of concentric narrowing was noted at the proximal jejunum, preceded by a radio-lucent zone with consequent proximal dilatation.

- Free flow of the barium through the rest of the normal calibre small bowel was noticed.

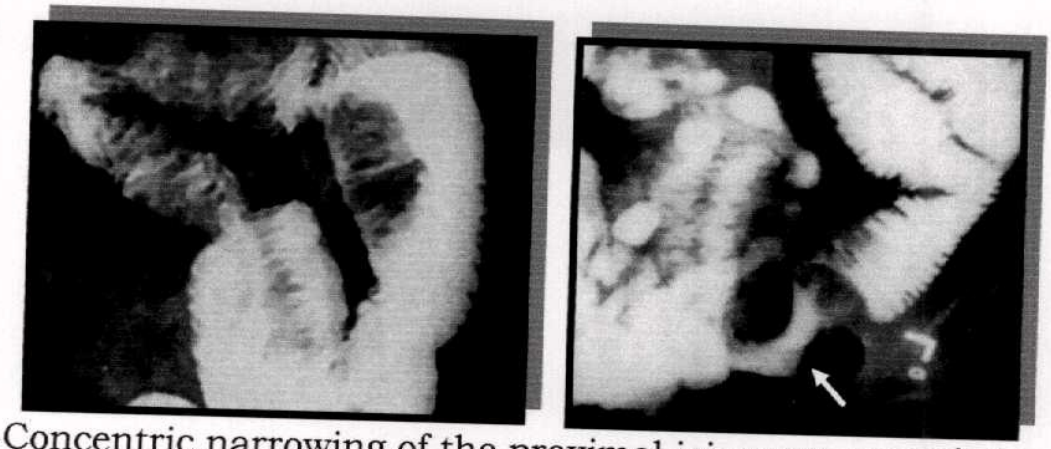
- **Other radiological investigation & findings:**
  - CT scan of the abdomen demonstrated focal mural wall thickening of the proximal jejunum, with traces of oral contrast through and after this segment.
  - Ultrasound examination was unremarkable.

- **Surgical intervention:**

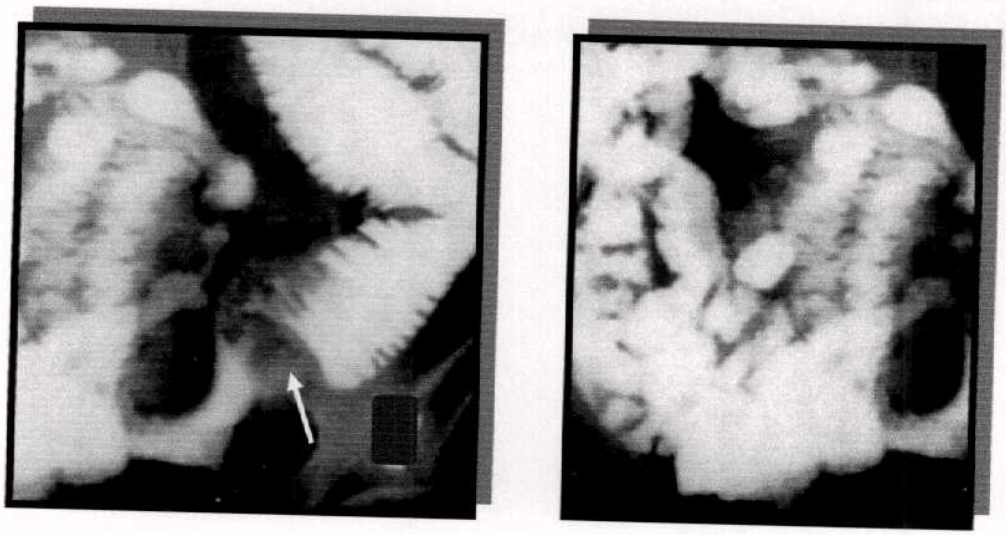
- Laparotomy confirmed the diagnosis and resection (of the non-viable segment) anastomosis was done after failed trials of reduction.

- **Diagnosis:**

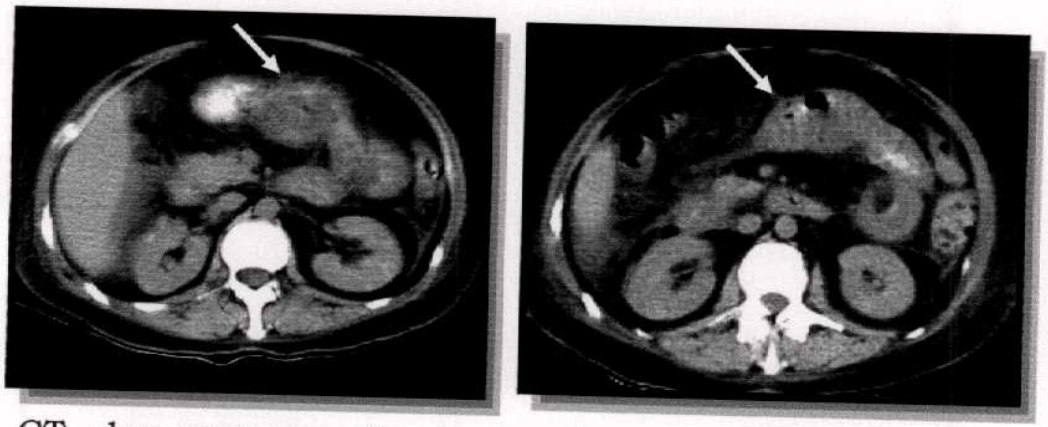
Intestinal Intussusception



-Concentric narrowing of the proximal jejunum, preceded by a radio-lucent zone with consequent proximal dilatation.



- Free flow of the barium through the rest of the small bowel loops.



- CT demonstrates focal mural wall thickening of the proximal jejunum, through which traces of gastrographin are seen.

Case No.7

- **Clinical presentation:**
  - A 40 years old male patient, presented by acute abdominal colic and distension, with a past history of previous abdominal surgical procedure.

- **Laboratory findings:**
  - Complete blood picture: Normal.

- **Enteroclysis findings:**

-Marked dilatation and kinking of the proximal small bowel.

-Focused spot films revealed distal jejunum obstruction terminating in a smooth pointed fashion. Regular slightly stretched mucosal outline, however, without distortion or destruction.

-Failure of the barium to opacify rest of the small bowel loops.

- **Other radiological examinations:**

- **Plain X-ray examination of the abdomen:** Dilated air filled bowel loops with air/fluid levels.

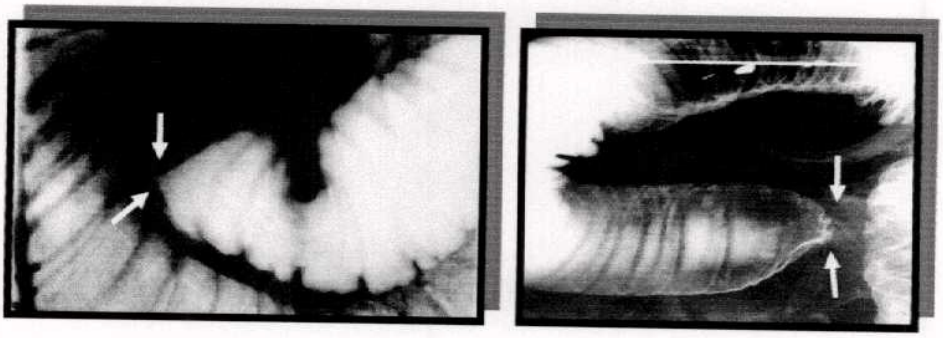
- **Operative intervention:**
  - Exploration confirmed the presence of adhesive bands, proximal bowel dilatation, and band resection was done.

- **Diagnosis:**

Intestinal obstruction

-Marked dilatation of the proximal small bowel.

-Non-opacified distal small bowel loops.



-Focused spot films smoothly tapered distal jejunum ending in a slickly pointed fashion.

-Stretched non-destructed mucosal pattern.

Case No.8

- **Clinical presentation:**
  - A 35 years old female patient, presented with acute abdominal colic and distension. Past history of multiple operative intervention.
- **Enteroclysis findings:**

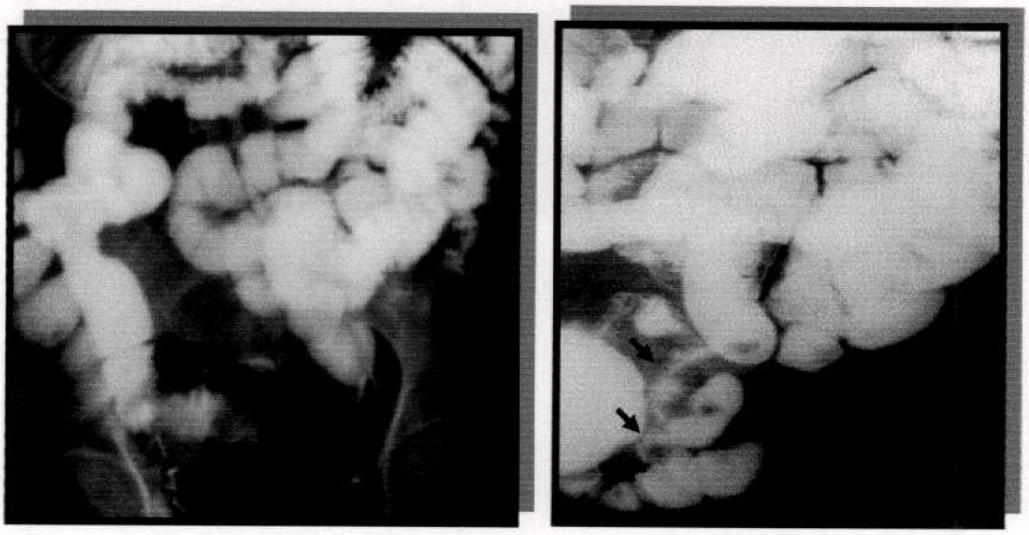
- There were multiple narrowed small bowel segments within the pelvic cavity near the visualised surgical staples, with proximal saccular dilatation.
- Focused spot views revealed one of the smoothly tapered narrowed distal ileal loops with relative proximal dilatation.

- **Other radiological investigation & findings:**
  - **Plain X-ray examination of the abdomen:** Dilated air filled bowel loops.
  - **CT scan of the abdomen & pelvis:** Revealed small bowel dilatation with no evident underlying cause.
  - **Abdominal & pelvic ultrasonography:** Showed bowel distension.

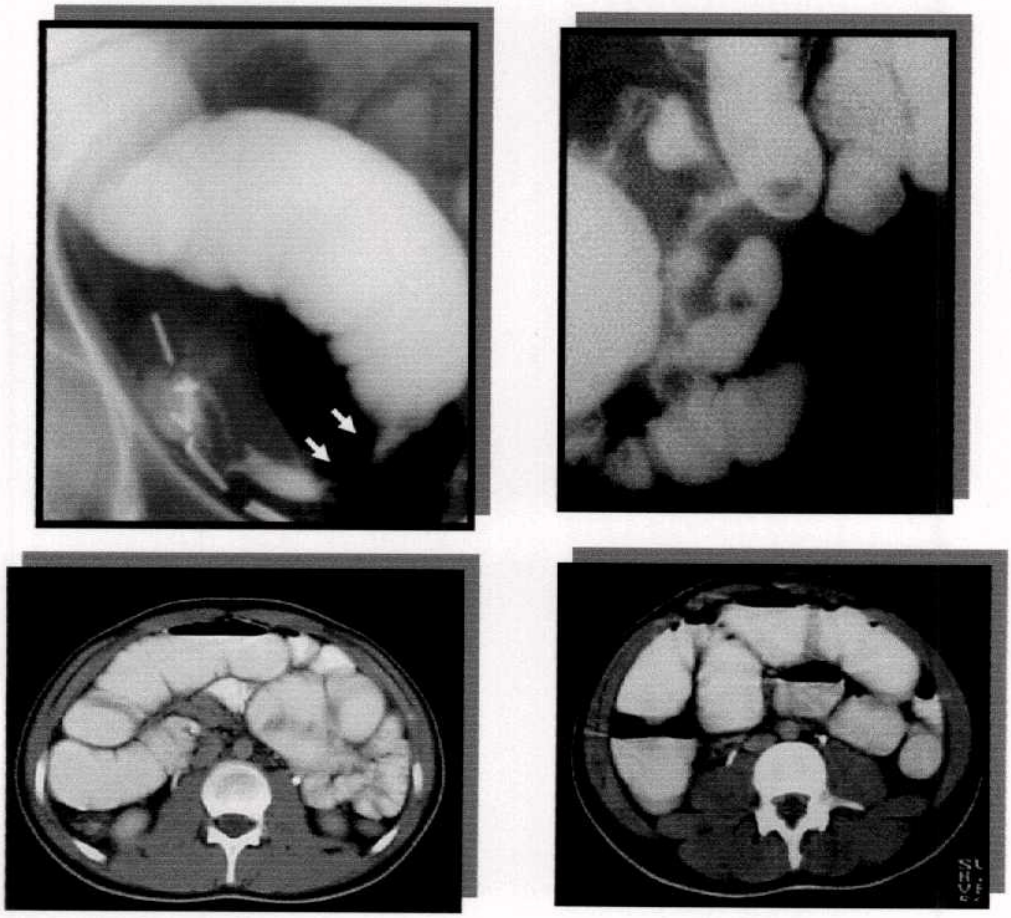
- **Operative intervention:**
  - Adhesive bands resection and resection anastomosis.

- **Diagnosis:**

Intestinal obstruction



- Multiple variable legth small bowel sements of persistant narrowing (arrows) with proveked saccular dialation.
- Focused spot views revealed a smoothly tapered narrowed distal ileal loops with consequent proximal dilatation.



- CT scan revealed diffuse small bowel dilatation.

Case No.9

- **Clinical presentation:**
  - A 48 years old male patient, presented with weight loss, abdominal colic and low grade fever. Palpation revealed painful abdominal swelling.
- **Laboratory findings:**
  - Stool analysis: Non-specific.
- **Enteroclysis findings:**

- Bizarre shaped alternating stenotic and dilated jejunal loops showing distorted mucosal fold pattern. An irregular shaped abrupt lumen interruption with lack of proper coating and distension of the distal bowel loops were noticed.

- Irregular shaped terminal ileum and ileo-ceacal junction.

- **Other radiological investigation & findings:**
  - **CT scan of the abdomen & pelvis** revealed extensive abdominal lymph nodal enlargement and at least two splenic hypodense focal lesions.
  - Small intestinal loops & mesenteric involvement and mural wall thickening could not be totally confirmed in the CT study.
  - **Ultrasound examination of the abdomen & pelvis** revealed retroperitoneal lymphadenopathy and splenic focal lesions
  - **Chest X-ray examination:** Normal.
- **Enteroscopy findings:**

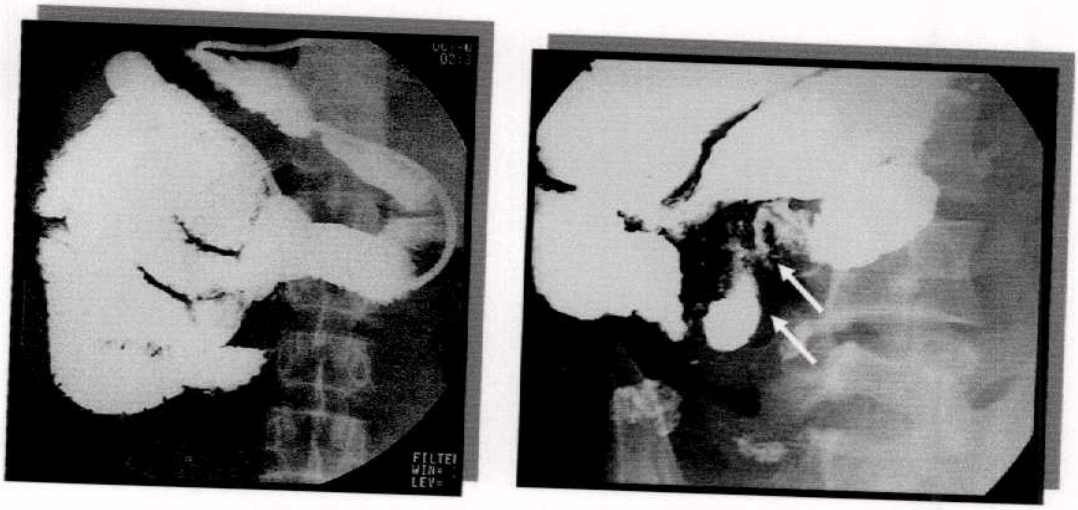
- Illustrated mucosal fold pattern distortion with multiple non-ulcerated polyps in the jejunum.

- **Histopathological findings:**

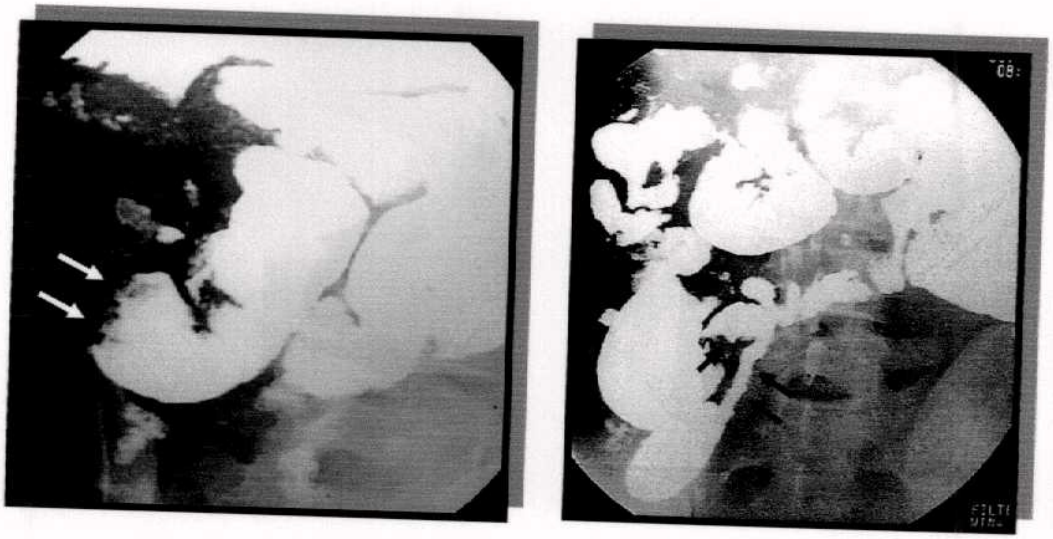
- Examining the enteroscopic & nodal biopsies confirmed the diagnosis of N.H.L

- **Diagnosis:**

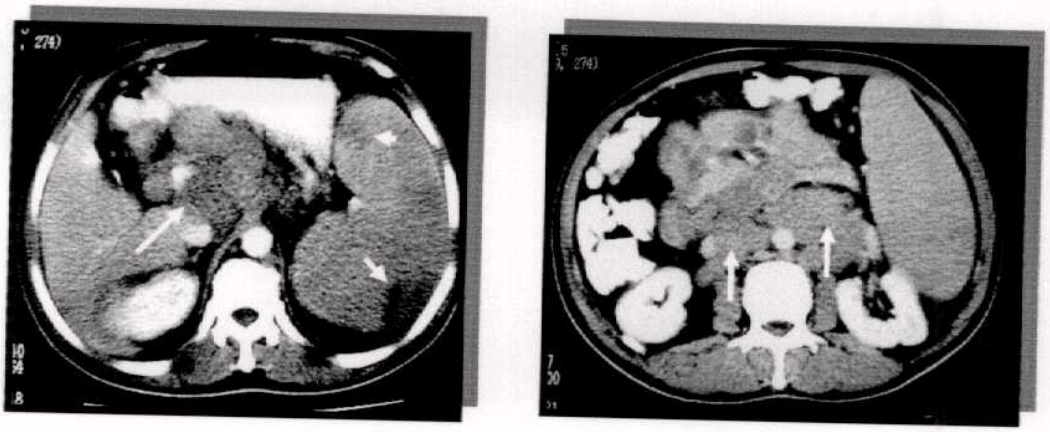
Non-Hodgkin's Lymphoma



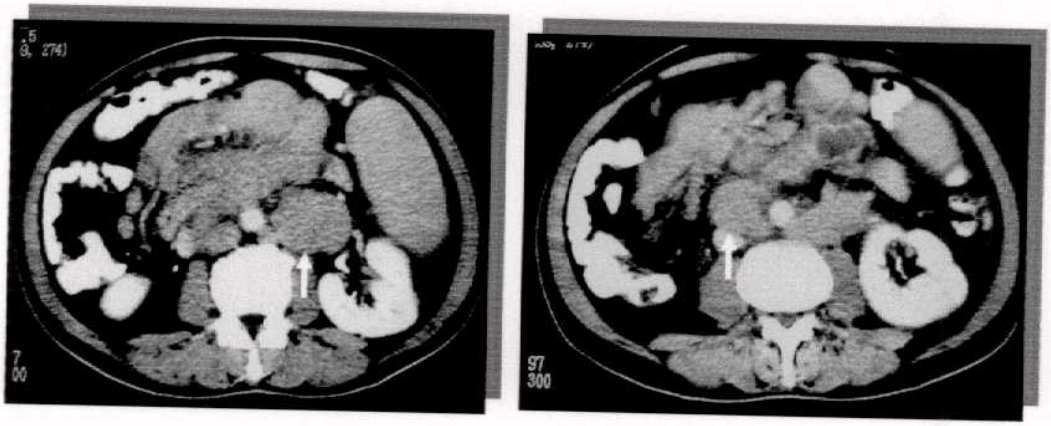
- Areas of stenosis and consequent proximal dilatation showing distorted mucosal fold pattern.



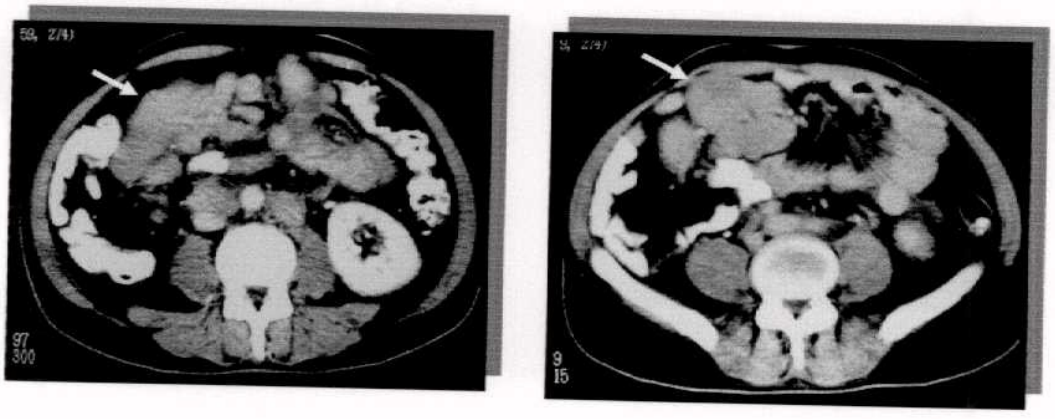
- Abrupt luminal interruption with non-uniform distension of the distal bowel loops.
- Spastic terminal ileum showing serrated outline(black arrows).

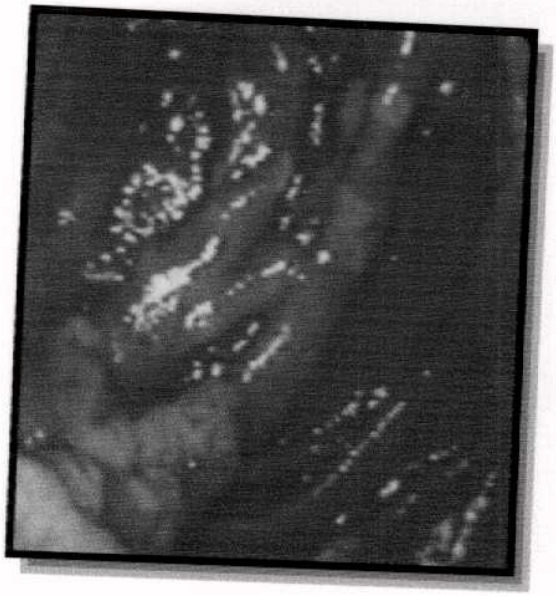


- Extensive abdominal lymph nodal enlargement (arrows) and two splenic focal lesions (short arrows).



- CT examination raises the suspicion of small intestinal loops infiltration.





- Enteroscopy illustrates multiple jejunal polypoid projections.

-Histopathological examination of biopsy specimen revealed large mucosal lymphoid follicle with expansion of the mantle zone lymphocytes and moderate lympho-epithelial infiltrate as well as focal villous atrophy.

Case No.10

- **Clinical presentation:**
  - A 40 years old female patient, presented with diarrhoea, weight loss, and abdominal colic.

Laboratory findings:

- Stool analysis: Blood cells.
- Blood picture: Normal.

- **Enteroclysis findings:**
  - Multiple wide spread variable sized nodular filling defects were seen scattered throughout the small bowel predominantly affecting the distal jejunum and proximal ileum.

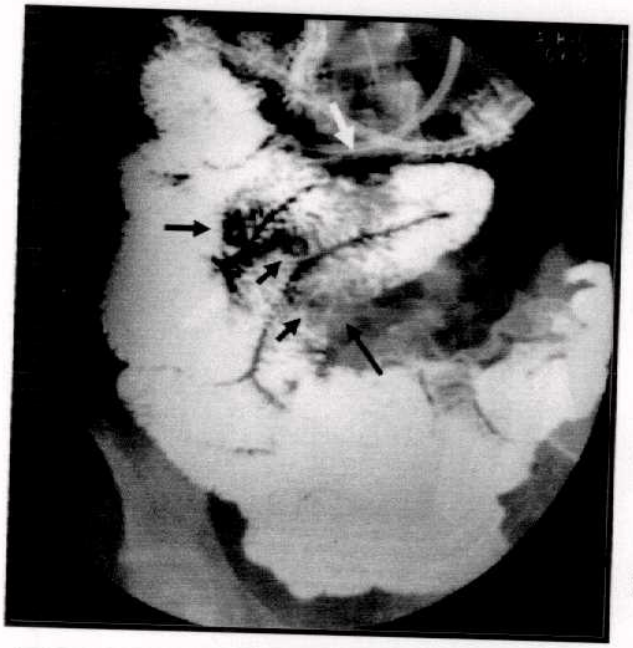
- **Other radiological investigation & findings:**
  - **Barium meal follow-through:** No definite abnormalities could be detected.
  - **Chest X-ray examination:** Normal.

- **Colonoscopy findings:**
  - Examination of the terminal ileum showed multiple sessile lymphomatous polyps.

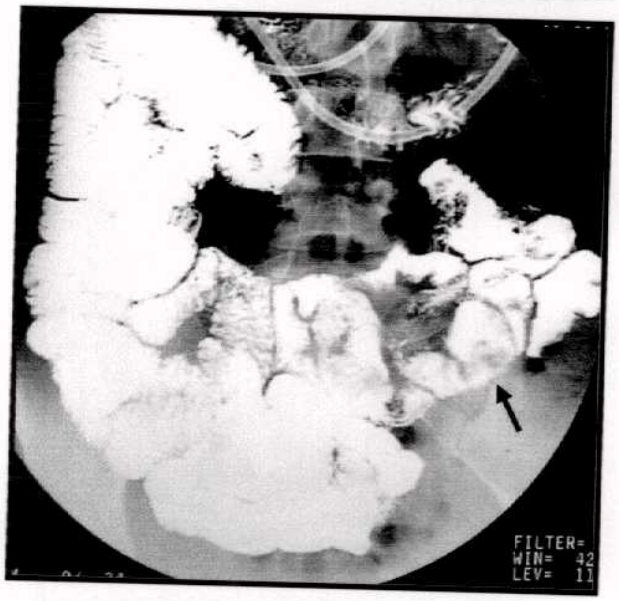
- **Histopathological findings:**
  - Large mucosal lymphoid follicle with expansion of the mantle zone lymphocytes and moderate lympho-epithelial infiltrate.

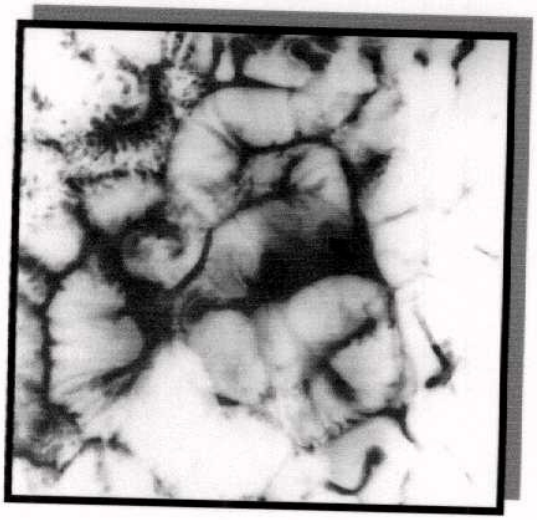
- **Diagnosis:**

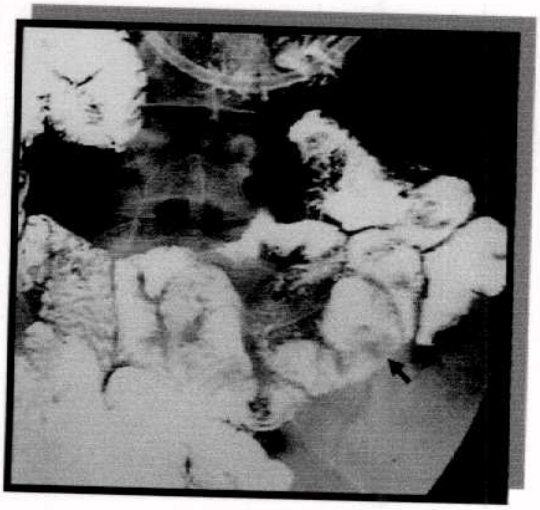
Non-Hodgkin's Lymphoma

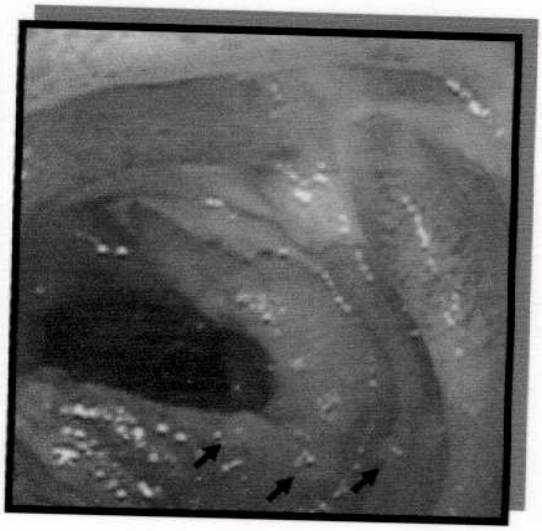


-Innumerable variable sized filling defects are seen scattered all-through the small intestine with predilection of the distal jejunum and proximal ileum (arrows).

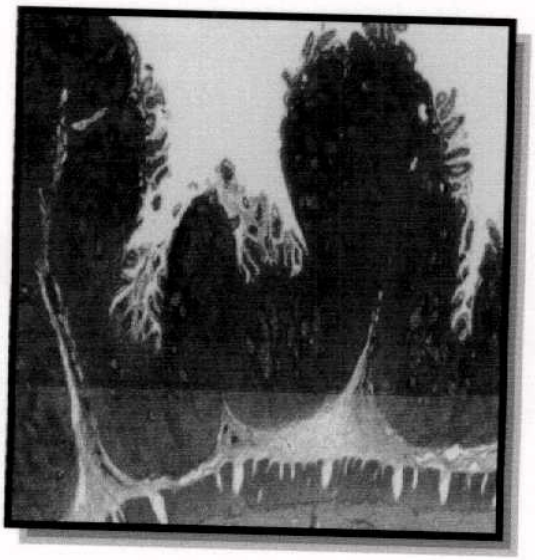








-Colonoscopy examination of the terminal ileum shows multiple sessile polyps (arrows).



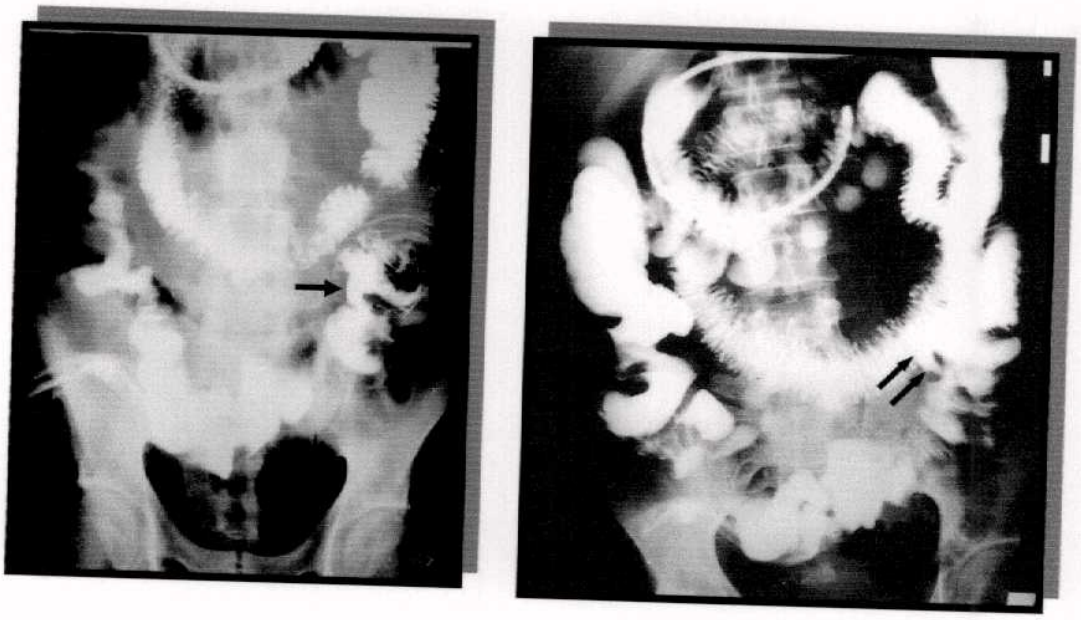
-Histopathological examination of the biopsy specimen shows large mucosal lymphoid follicle with expansion of the mantle zone lymphocytes and moderate lympho-epithelial infiltrate (Hematoxylin and eosin stain X100).

Case No.11

- **Clinical presentation:**
  - A 45 years old male patient presented with diarrhoea, weight loss, and abdominal distension. Past history of multiple small bowel loops resection (Known Crohn's disease).
- **Laboratory findings:**
  - Stool analysis: (++) Vegetable cells, starch & fat.
- **Enteroclysis findings:**

  - Rapid passage of the barium through the scanty jejunal loops to opacify the distal ileum and adjoining colon, due to the presence of a jejuno-ileal fistula.
- **Other radiological investigation & findings:**
  - **Barium follow-through examination:** Rapid passage of the barium through the remaining short small bowel segments reaching the colon, without identification of the underlying cause.
- **Operative intervention:**
  - Confirmed the diagnosis.
- **Diagnosis:**

Jejuno-ileal fistula



- Rapid passage of the barium through the scanty jejunal loops with opacification of a jejuno-ileal fistula (arrowed).

Case No.12

- **Clinical presentation:**

- A 40 years old female patient, presented with abdominal colic & distension and abnormal vaginal bleeding.

- **Laboratory findings:**

- Complete blood picture: Anaemia.

- **Other radiological examinations & findings:**

- CT scan of the abdomen& pelvis revealed huge pelvi-abdominal mass lesion of heterogeneous texture, showing hypodense areas of breaking down / cystic degeneration with secondary bilateral hydronephrosis. The bowel loops were seen deviated on either sides of this mass with high suspicion of possible bowel infiltration.

- **Enteroclysis findings:**

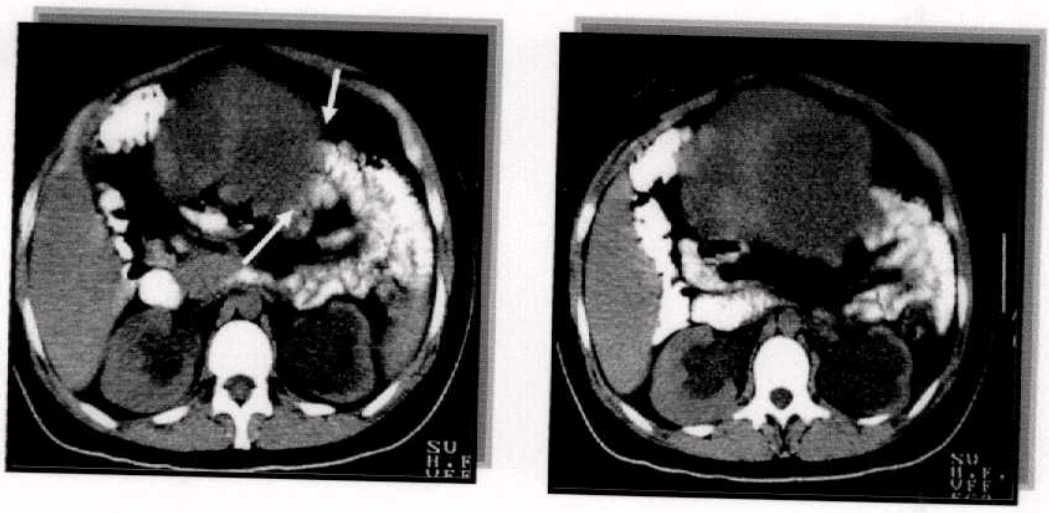
- Marked jejunal and ileal loops displacement, however, with no evidence of mucosal destruction, infiltration, wall invasion or actual luminal obstruction.

- **Surgery:**

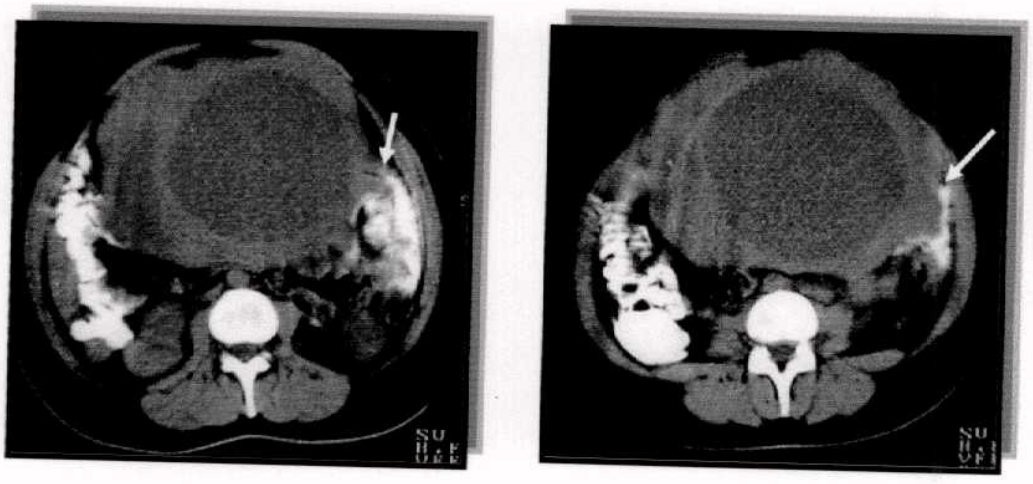
- Proved the non-invasion of the adjacent small intestinal loops.

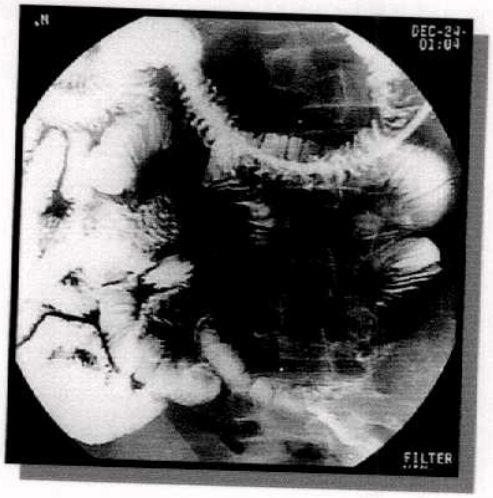
- **Diagnosis:**

Large ovarian papillary serous cystadenocarcinoma & bowel displacement

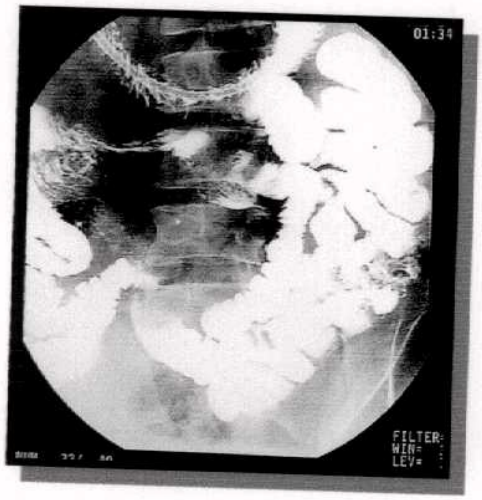


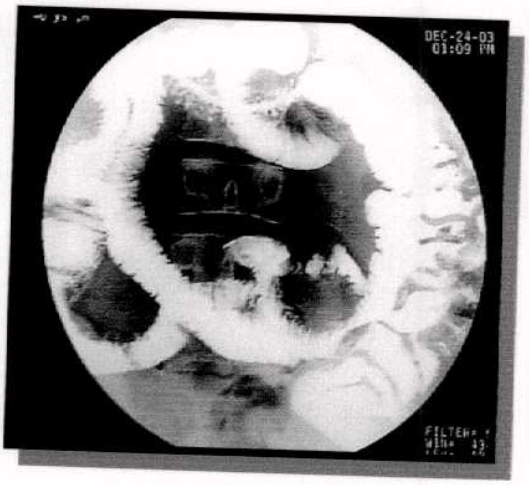
- Huge pelvi-abdominal mass with the adjacent intestinal loops are seen deviated on either sides of this mass showing high suspicion of possible bowel infiltration.





- The small bowel enema shows marked jejunal and ileal displacement, however, with no evident mucosal destruction, wall invasion or actual luminal obstruction.





Case No.13

- **Clinical presentation:**

- A 22 years old male patient, presented with flushing of the face, diarrhoea, and abdominal colic.

- **Laboratory findings:**

- Stool analysis: Non-specific.

- **Other radiological examinations & findings:**

- CT scan of the abdomen revealed multiple variable sized intensely enhancing focal lesions scattered all-through both hepatic lobes with the largest of them located at the medial segment of left hepatic lobe (arrows), from which a CT guided needle biopsy was taken.

- **Histopathological findings:**

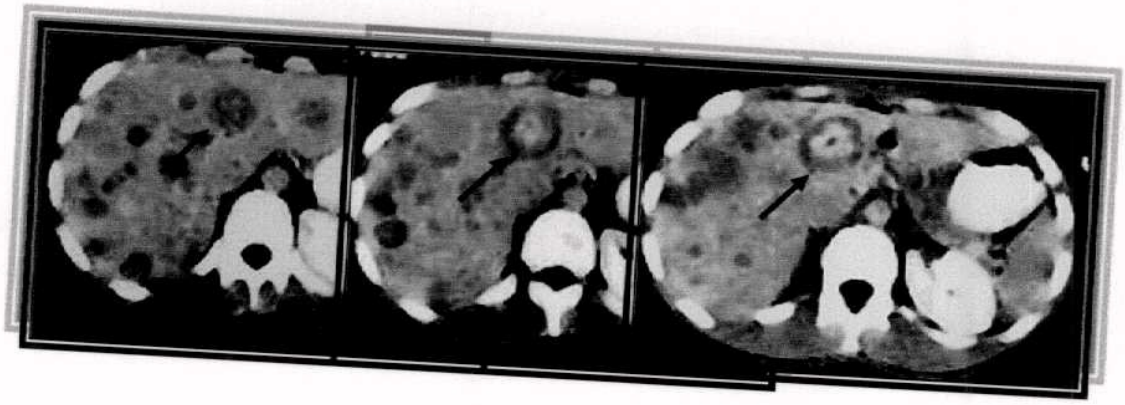
- Examination of the biopsed hepatic specimen confirmed the diagnosis of carcinoid tumour.

- **Enteroclysis findings:**

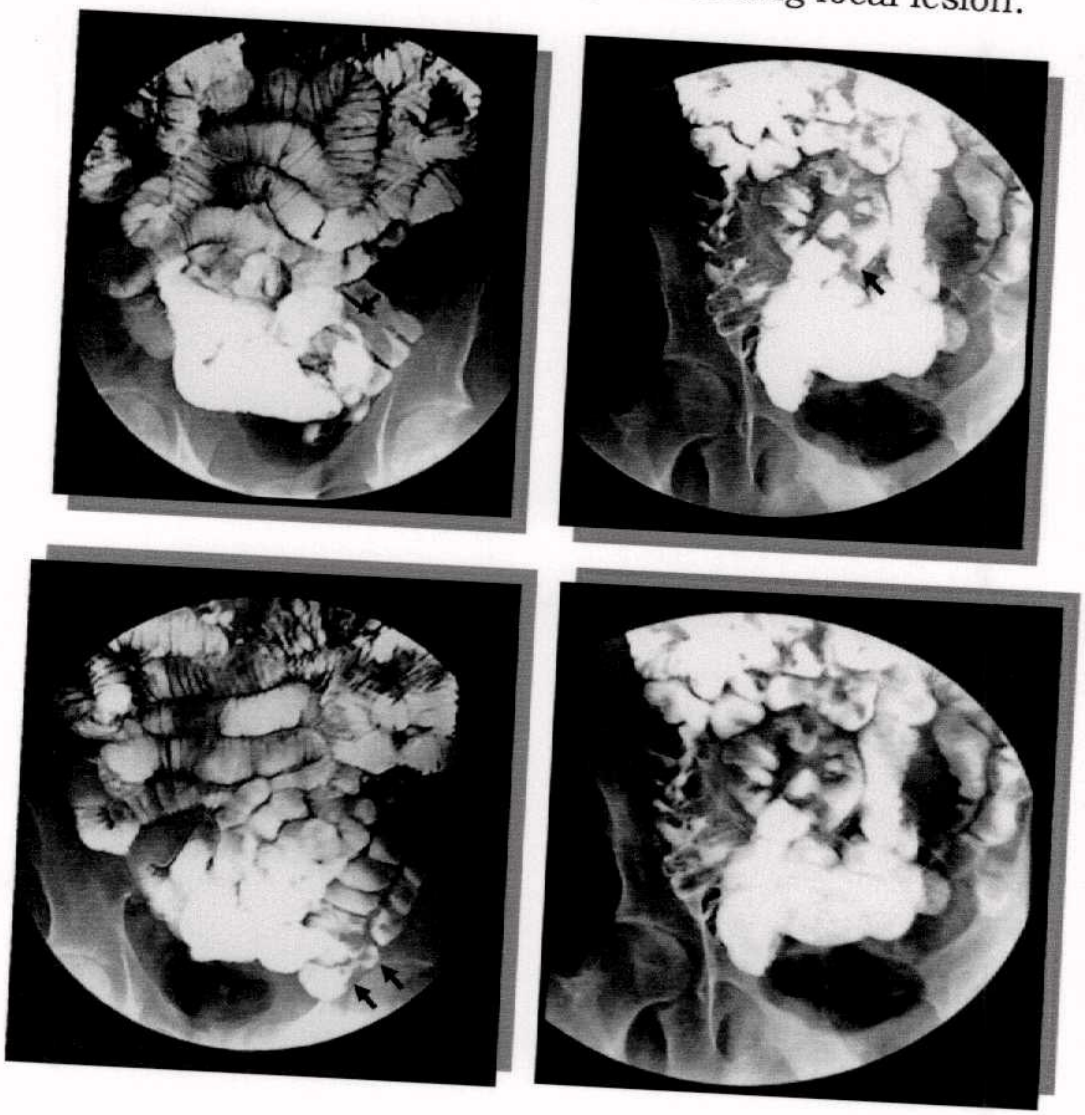
- Small bowel enema showed irregular non-uniform narrowing of the terminal ileum and ileo-ceacal region (arrows). Otherwise, the jejunum and rest of the ileum presented average calibre, normal distensibility and mucosal fold pattern.

- **Diagnosis:**

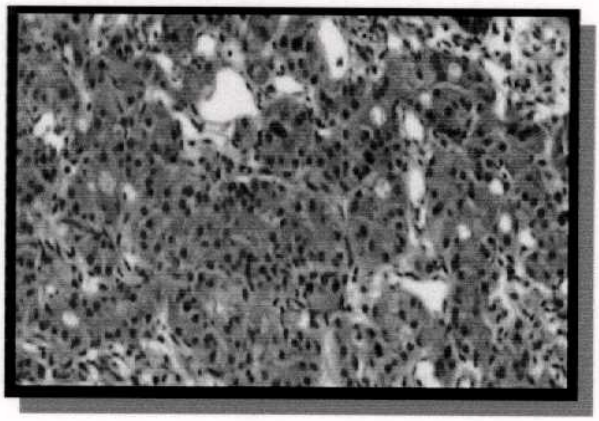
Metastasizing carcinoid tumour



-Left hepatic lobe intensely enhancing focal lesion.



- Terminal ileum narrowing (arrows).



-Histopathological examination shows groups of rounded cells with eosinophilic cytoplasm and small mono-morphic nuclei.

Case No.14

- **Clinical presentation:**

- A 30 years old female patient, presented with fresh bleeding per-rectum and melena.

- **Colonoscopy findings:**

- Normal appearance of the examined portions of the colon almost up to the hepatic flexure.

- **Enteroclysis findings:**

- Small barium enema examination revealed normal calibre of the jejunal & ileal loops depicting smooth outline and normal mucosal pattern, excluding the presence of any small intestinal abnormalities.

- **Other radiological examinations & findings:**

  - **Barium enema examination** revealed normal appearance of the different colonic segments.

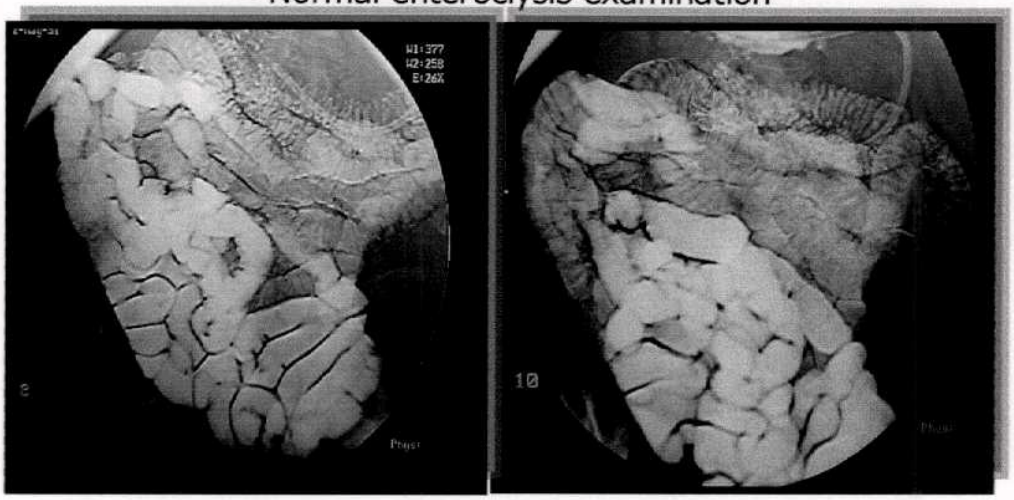
  - **Digital subtraction superior mesenteric angiography** showed prominent feeder artery originating from the right middle colic artery and ending in a punch of abnormal vessels.

    - Super-selective angiography resulted in opacification of abnormal vascular structures with early filling of the draining vein.
    - Injection of a gel foam chemo-embolization material resulted in occlusion of this vascular anomaly, judged by the post-chemo-embolization study.

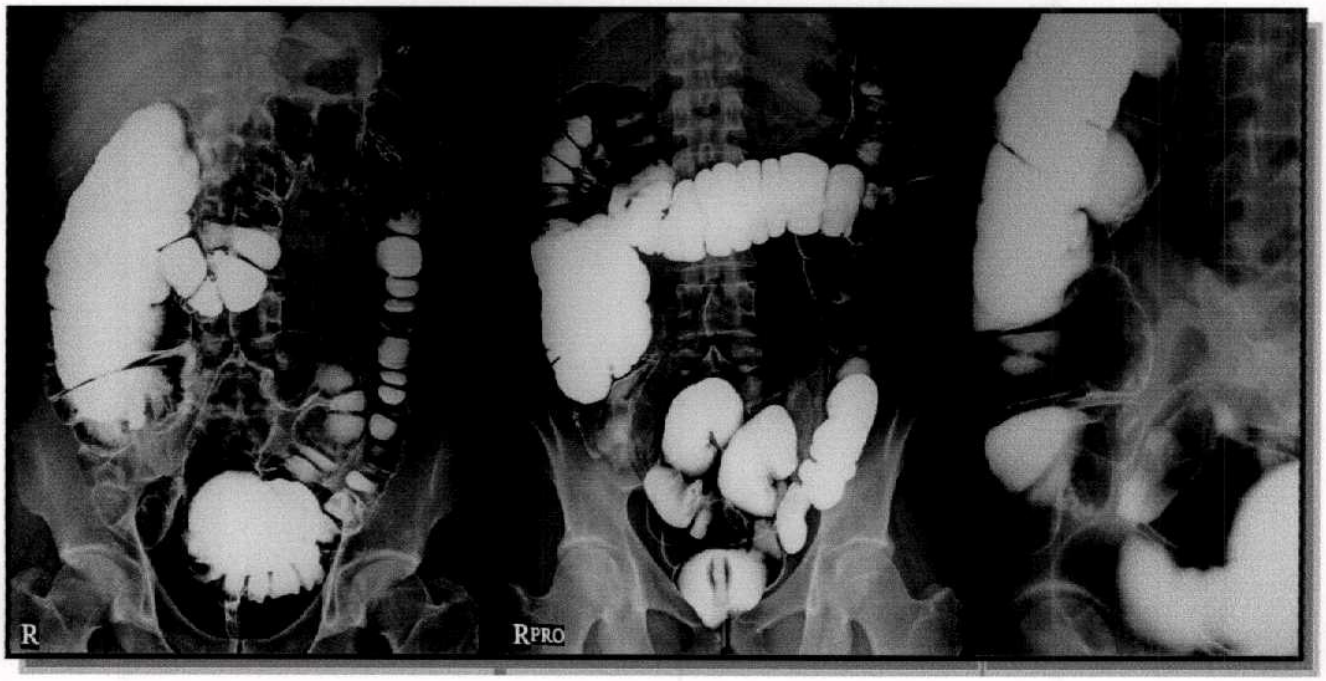
- **Diagnosis:**

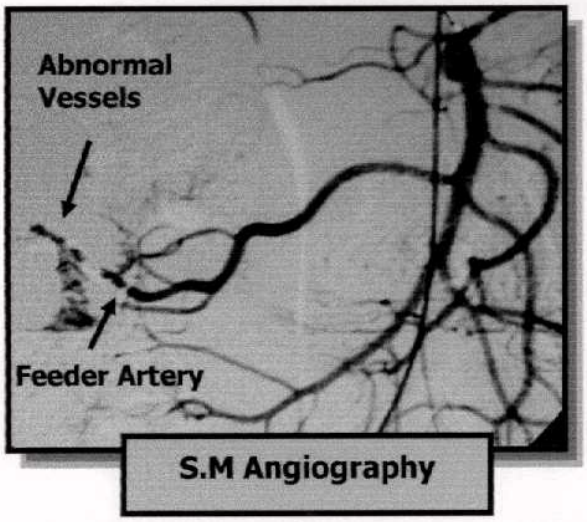
Angiodysplasia

- Normal enteroclysis examination

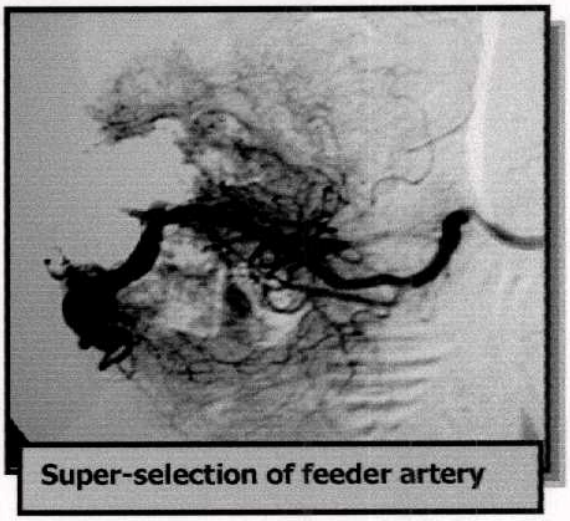


- Normal barium enema

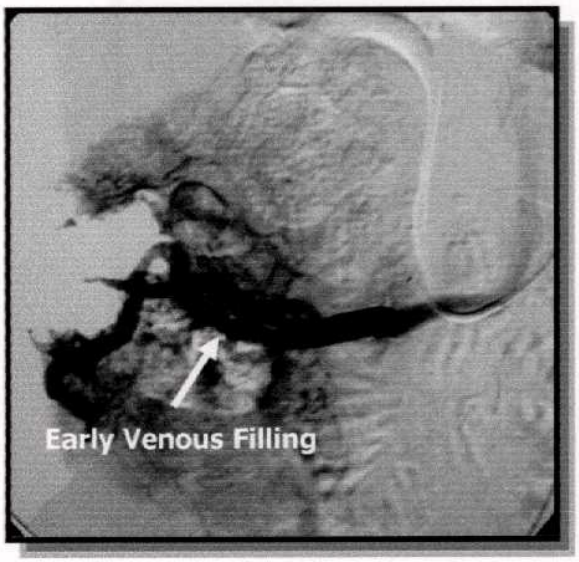


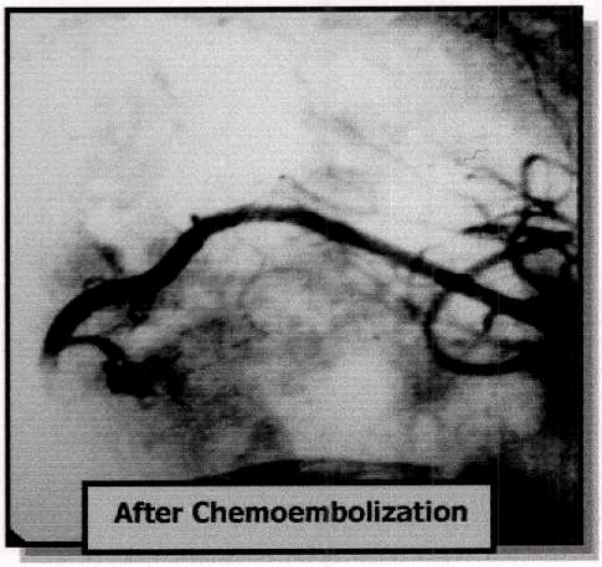


S.M Angiography

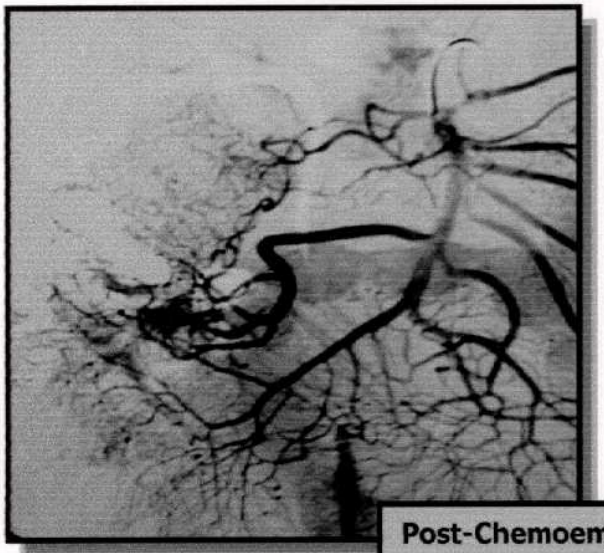


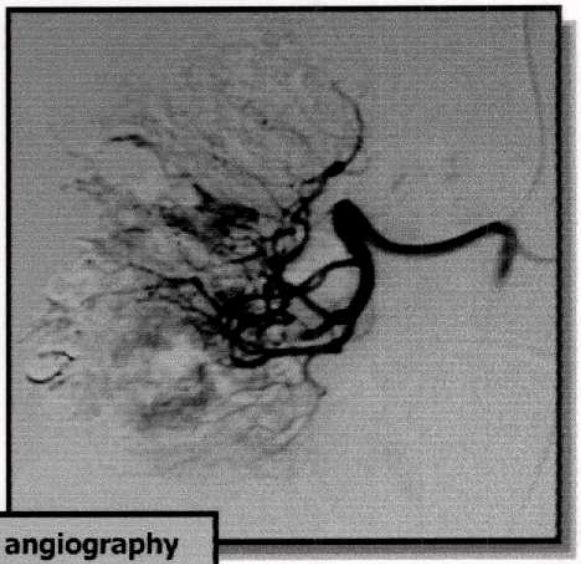
Super-selection of feeder artery





After Chemoembolization





Post-Chemoembolization angiography

Case No.15

- **Clinical presentation:**
  - A 40 years old male patient, presented with diarrhoea, abdominal colic and distension.

- **Laboratory findings:**
  - Stool analysis: Pus Cells.

- **Enteroclysis findings:**

- Relative effacement of the normal ileal mucosal fold pattern with non-uniform bowel calibre.
- The ileal loops were seen spaced from each other by the thickened oedematous intervening mesentery.
-The terminal ileum and ileo-ceacal region showed alternating areas of reduced calibre and dilatation resulting in uneven outline and non-uniform calibre

- **Other radiological investigation & findings:**
  - **CT scan and ultrasonography examinations of the abdomen & pelvis:** Essentially normal.

- **Colonoscopy findings:**

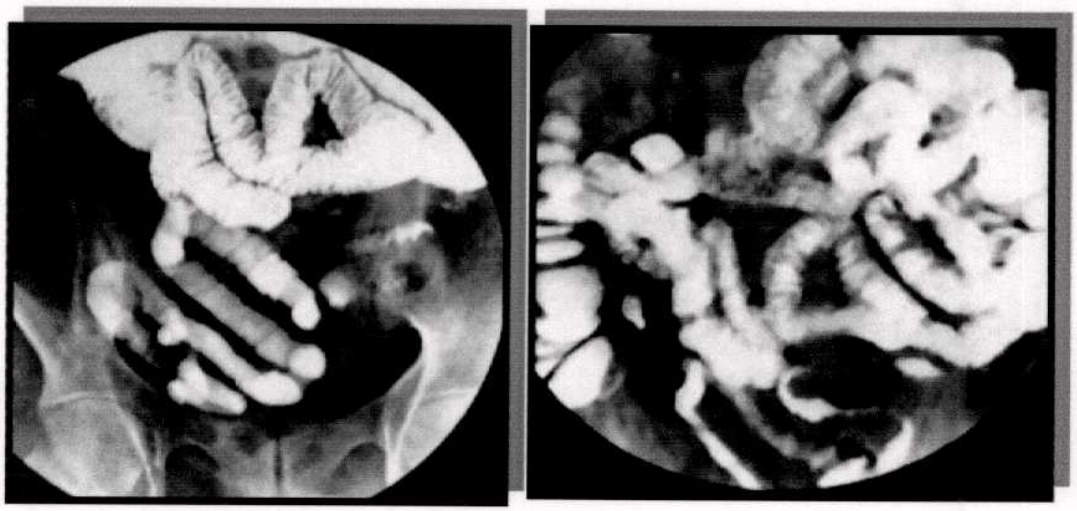
- Ulceration at the ileo-ceacal junction without actual stenosis.

- **Histopathological findings:**

- Picture was of a non-specific inflammatory process.

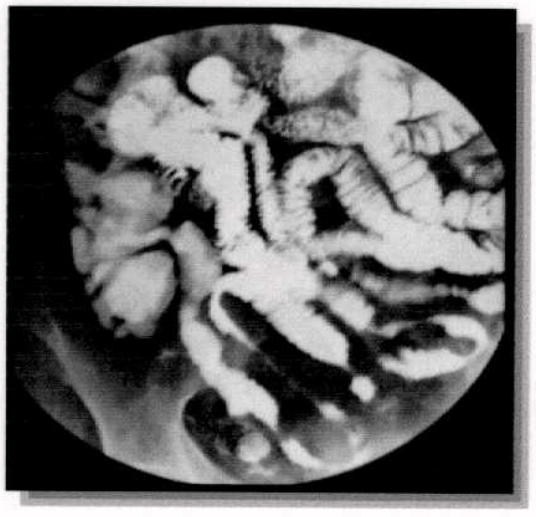
- **Diagnosis:**

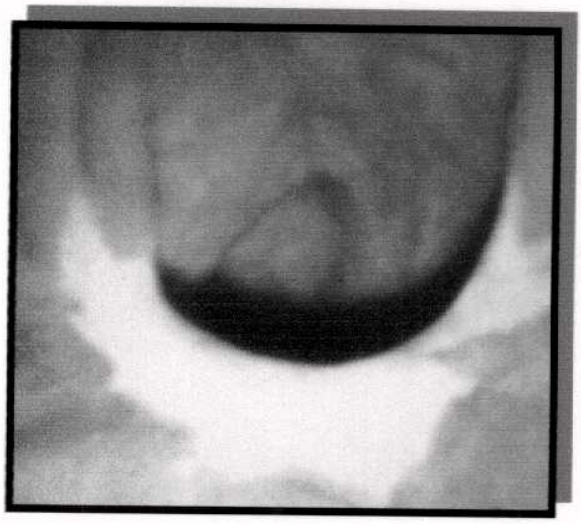
Non-specific enteritis



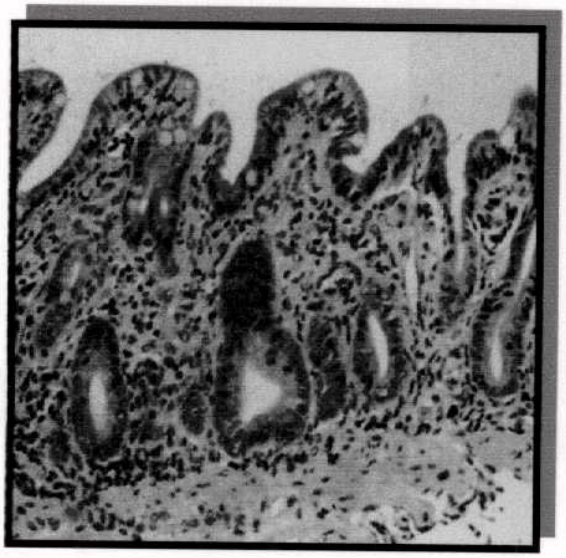
-Effaced ileal mucosal fold pattern with reduced bowel calibre.

-Spacing of the ileal loops with alternating areas of reduced calibre and dilatation at the terminal ileum and ileoceacal region.





-Colonoscopy revealed ulceration at the ileoceacal junction.



-Histopathological examination of biopsy specimen showed obvious reduction in the villous/crypt ratio, villous blunting and atrophy without evidence of increased intra-epithelial lymphocytes.

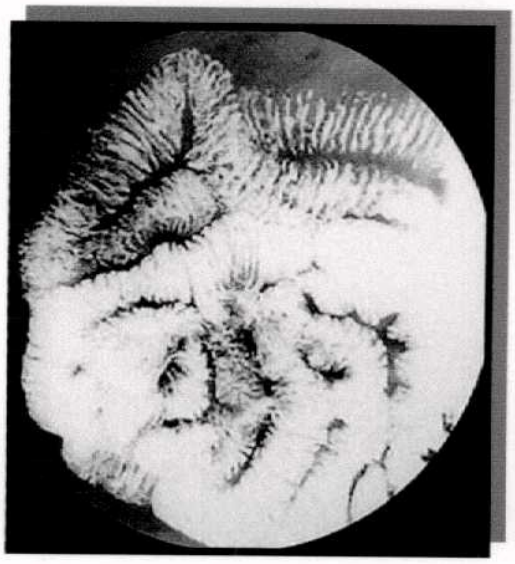
Case No.16

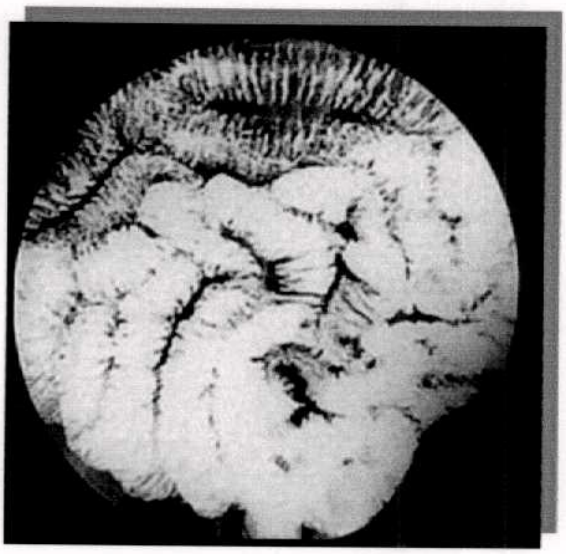
- **Clinical presentation:**
  - A 45 years old male patient, presented with diarrhoea, abdominal distension and haematemesis.
- **Laboratory findings:**
  - Stool analysis: (++) Vegetable cells, starch, and fat.
  - Blood picture: Anaemia.
  - Liver function tests: Impaired liver function.
  - Renal function: Normal.
- **Enteroclysis findings:**
  - Diffuse thickening of the mucosal folds throughout the small intestine, being more apparent at the jejunum.
- **Other radiological investigation & findings:**
  - **Ultrasound examination of the abdomen & pelvis:** Liver cirrhosis, splenomegaly, portal hypertension and ascites.
  - **CT scan of the abdomen & pelvis:** Advanced cirrhotic liver changes, splenomegaly, massive ascites and relative (retrospective) mural wall thickening of the small bowel loops.
- **Enteroscopy findings:**
  - Diffuse mucosal fold thickening.
- **Histopathological findings:**

- Atrophic villi, deep crypts and mono-nuclear cell infiltration, confirming the diagnosis.

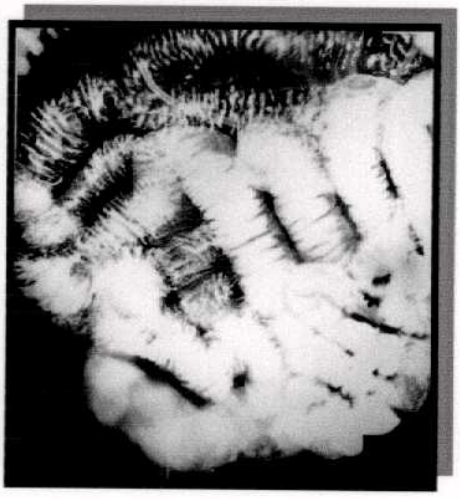
- **Diagnosis:**

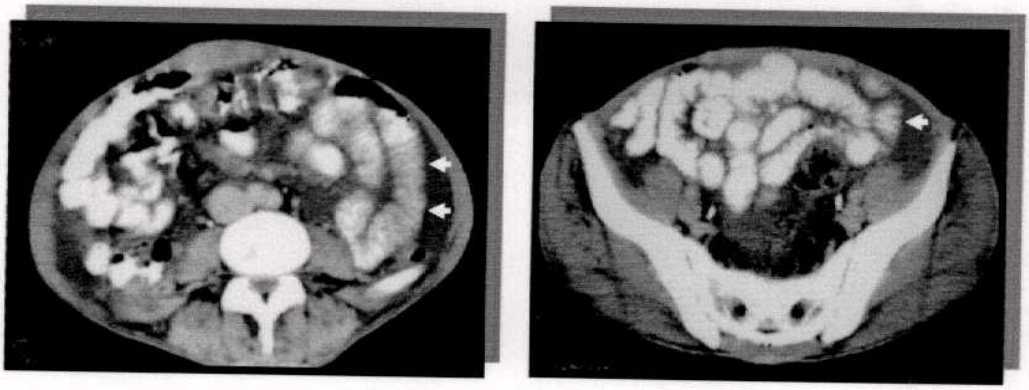
Malabsorption



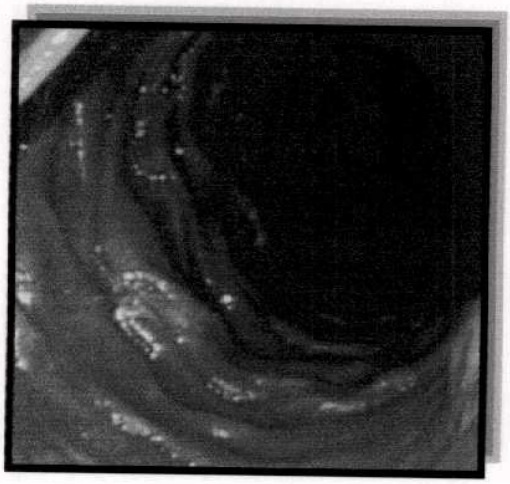


- Wide spread rather symmetrical thickening of the mucosal folds throughout the small intestine, being more apparent at the jejunum.

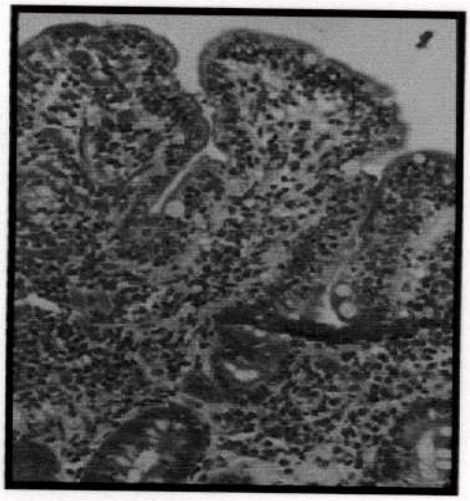




- CT shows ascetic fluid and relative (retrospective) mural wall thickening of the small bowel loops (arrows).



-Enteroscopy shows diffuse mucosal fold thickening.



- Histopathology examination revealed atrophic villi, deep crypts and mono-nuclear cell infiltration.

Case No.17

- **Clinical presentation:**

- A 50 years old male patient, presented with diarrhoea, weight loss abdominal colic. Past history of radical cystectomy, extensive radio- and chemotherapeutic treatment.

- **Laboratory findings:**
  - Stool analysis: Non-specific.
  - CBC, Liver & Renal function: Non-significant.

- **Enteroclysis findings:**

- The ileal loops showed straightening and thickening of the mucosal folds as well as narrowed lumen and serrated non-uniform outline

- Multiple areas of persistent narrowing were seen at the mid and distal ileum close to pelvic metallic surgical clips.

- **Other radiological investigations & findings:**

- **Ultrasonography of the abdomen & pelvis:** Normal.

- **Bone scan:** Negative.

- **Enteroscopic findings:**

- Non-specific mucosal changes.

- **Histopathology findings:**

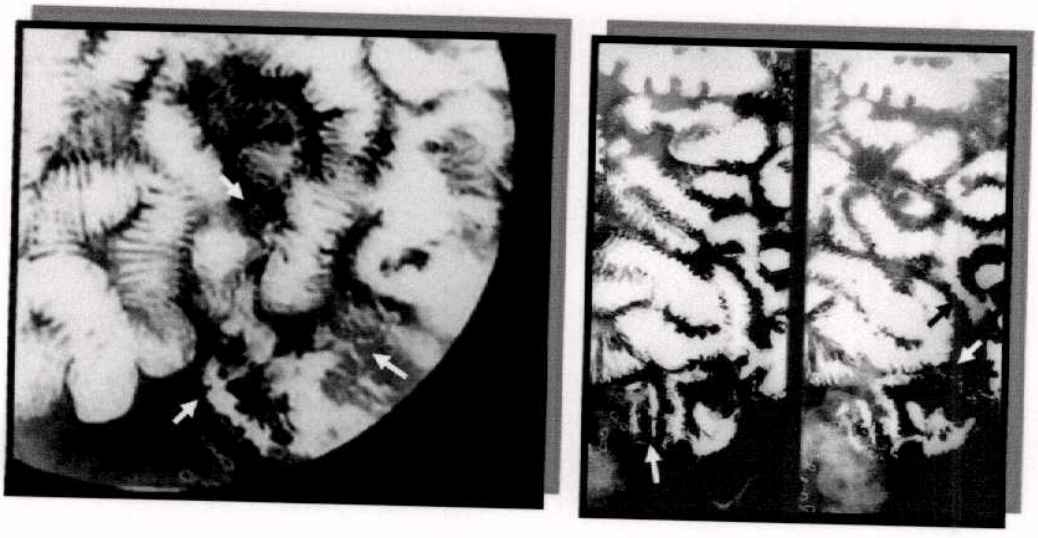
Of the enteroscopic biopsy showed non-specific findings consisting of:

- Mononuclear cellular infiltration.
- Mucosal ulceration
- Fibrosis
- Bizarre-shaped cells.

- **Diagnosis:**

Post-irradiation enteritis

- Thickened ileal mucosal folds showing narrowed lumen and serrated outline.



- Mid and distal ileal areas of persistent narrowing (arrows) at the proximity of pelvic metallic surgical staples.

Case No.18

- **Clinical presentation:**

- A 40 years old female patient, presented with diarrhoea, weight loss and abdominal colic Past history of pan-hysterectomy & radiotherapy cessions.

- **Laboratory findings:**
  - Stool analysis: Non-specific.
  - Liver & Renal function: Normal.

- **Enteroclysis findings:**

- Alternating areas of non-uniform narrowing and dilatation associated with loss of sharp stencil outline of some bowel loops, as well as thickening of the mucosal folds.
- Nodular filling defects were also noticed at the focused spot films.

- **Other radiological investigations & findings:**

- **CT scan of the abdomen & pelvis:** diffuse small bowel wall thickening as well as relative matting of some small bowel loops within the pelvic cavity.

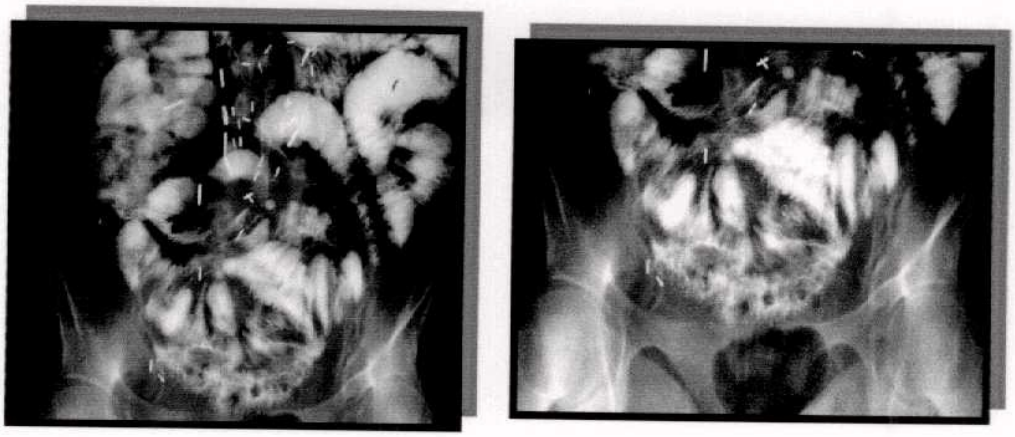
- **Enteroscopic findings:**
  - Non-specific mucosal changes.

- **Histopathology findings:**

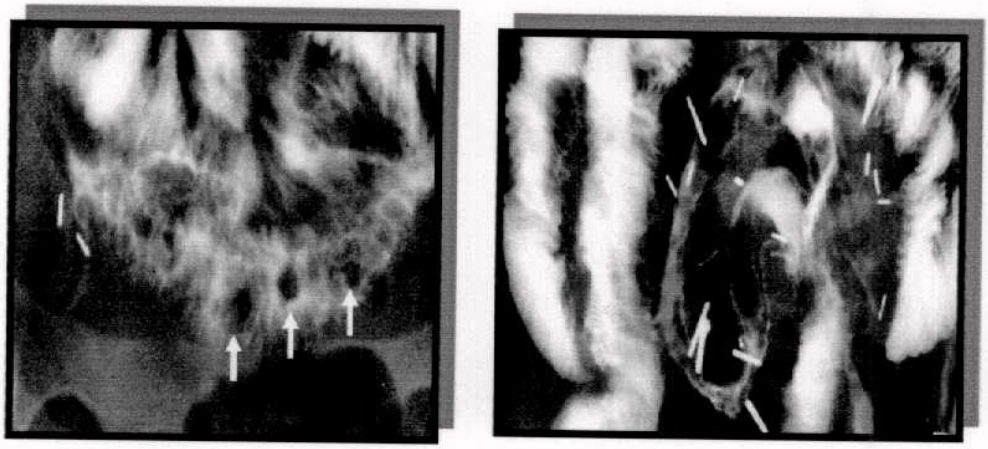
* Non-specific findings consisting of:
  - Mononuclear cellular infiltration.
  - Mucosal ulceration
  - Fibrosis & bizarre-shaped cells.

- **Diagnosis:**

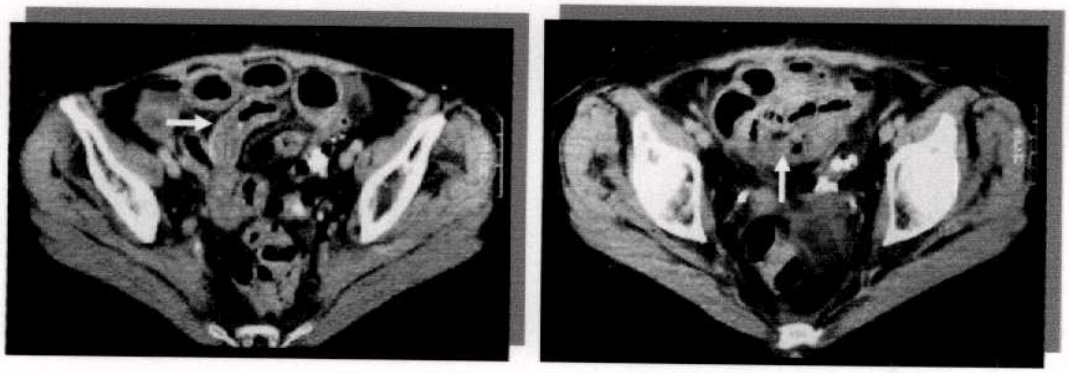
Post-irradiation enteritis



- Areas of narrowing and dilatation with thickening and straightening of the mucosal folds.



- Ileal nodular filling defects are noticed at the focused spot films (arrows).



- Axial CT images demonstrate diffuse intestinal mural wall thickening with matting of some of them within the pelvic cavity.

The small bowel had received the least interest in radiology for a long time. The low prevalence of small bowel disease and the inherent difficulty of the small bowel examination have failed to generate significant interest among radiologists. The radiologists' use of the traditional small bowel follow-through study is based on familiarity rather than scientific evidence. As Herlinger has stated, "There can be no shortcut to an adequate barium examination of the small intestine. It requires commitment of time, interest and expertise on the part of radiologists to apply successfully to the small bowel the same principles of diagnostic care which are employed in virtually all other areas of radiology." ***(Herlinger et al., 1994).***

The prevalence of small-bowel disease is low, and the clinical diagnosis is complicated by non-specific symptoms and a low index of suspicion. This frequently leads to delays in diagnosis and treatment. An accurate radiological examination is, therefore, important not only for recognition of small-bowel disease but also to help reliably document normal morphology ***(Heinz et al., 1998).***

The practice of gastrointestinal (GI) radiology has changed dramatically in the last two decades. There was a time when the small bowel follow-through and barium enema were the dominant modalities in the investigation of diseases of the small and large intestine. Enteroclysis was rejuvenated in the 1970s, and defecography was subsequently popularized. Most radiologists do not see small bowel abnormalities regularly and have difficulty categorizing them and making an accurate diagnosis ***(Dean et al, 2003).***

The approach to radiological examination of the small intestine has changed from initial interest in small bowel function to an evaluation of morphologic abnormalities. The aims of barium contrast radiography are to test the distensibility of each loop and to demonstrate the fold pattern. Each segment should be separated from the adjacent loop by compression or should be seen through another loop by double-contrast methods. Transit time varies widely among individuals and is of little diagnostic value. Flocculation depends on the type of barium suspension and the degree of

exposure to intestinal secretions and may occur in any patient with slow transit time. The use of flocculation as a diagnostic criterion is limited unless accompanied by other features to indicate the cause of a malabsorptive state. Caution should be exercised before interpreting minor variations in the appearance of the small intestine as evidence of organic disease, particularly when evaluating poorly coated and poorly distended loops ***(Heringer et al., 1994).***

Enteroclysis is the most, if not the only, proactive method of examining the entire mesenteric small bowel. Although not as widely known or utilized as the small bowel follow-through, the enteroclysis has historical roots that extend well into the early twentieth century ***(Dean et al, 2003).***

In Schatzki in 1943, published method of the small bowel enema that strongly resembled more current enteroclysis techniques. The modern era of enteroclysis was triggered by the work of *Johan Sellink in the 1970s.*

Enteroclysis is a challenge to radiologist and patient alike. In less skilful, inexperienced hands, the procedure can be confusing and its demonstrated findings will be unreadable. As a result, the patient very likely may experience excessive discomfort during such a procedure and leave without proportionate diagnostic reward. Thus, enteroclysis is clearly not everyman's forte ***(Arunas et al, 2002).***

The infusion method permits simultaneous demonstration of the entire small bowel, from the ligament of Treitz to the terminal ileum. Not only because the loops are fully distended, but the normal motor activity is temporarily decreased or abolished shortly after infusion. This is likely the effect of fluid overload. These two effect earlier recognition of lesions, particularly the obstructive type. In addition, it can clarify unspecified findings shown in a conventional study where a repeat study of the same kind may not necessarily be useful. Another advantage is that brief intermittent fluoroscopy of the segments of the small bowel in the fully distended state is possible ***(Sellink., 1994).***

The detailed per-oral small bowel examination is a dependable method of evaluating the small intestine, with an overall sensitivity comparable to enteroclysis for common disorder. The primary advantage of enteroclysis may be more precise delineation of focal lesions such as adhesions and Meckel`s diverticulum etc, however, the per-oral small bowel series has a number of advantages for use as a screening examination, including the need for less room and radiologist time, fewer side effects, less radiation exposure, and good sensitivity for most abnormalities when the examination is carefully performed ***(Diner et al., 1997).***

Enteroclysis has been used extensively in Europe and its use in the United States has markedly increased over the past few years. While many studies have demonstrated the high accuracy of this technique, advocates of the conventional per-oral small bowel series have cited very high radiation exposure, longer room and radiologist time, and higher costs as serious factors against its consideration as the primary or preferred method of investigating small bowel disease ***(Arunas et al., 2002).***

Enteroclysis offers many advantages in the evaluation of the small bowel and has enabled diagnosis of a wide variety of lesions. The regulating action of the stomach and pylorus is by-passed, and contrast material is administered at a pre-selected optimal rate. The direct intestinal infusion sufficient to produce relative small bowel hypotonia results in the simultaneous demonstration of all loops of the bowel in a state of luminal distension. Fold patterns can be accurately assessed, and surface abnormalities are clearly defined. Enteroclysis challenges the distensibility of the small bowel such that pre-stenotic dilatation develops at sites of minimal stricture which may not have been demonstrated by the unreliable timing of a serial examination. The examination is usually complete in 20-30 minutes, in a single sitting ***(Diner et al., 1997).***

The following factors characterizing enteroclysis are relevant to its diagnostic function: lumen distension, transit acceleration, delay of flocculation, demonstration of mucosal surface detail through overlapping

loops, and the need for the radiologist's attendance throughout the study. These factors would be expected to provide for enteroclysis the following main advantages:

(a) Lumen distension will aid the identification of focal, lumen-restricting processes that do not produce significant obstruction; inflammatory diseases (e.g., early Cohn's disease), adhesive bands, serosal metastases.

(b) Enteroclysis allows accurate demonstration of normality or of subtle alterations of the fold pattern, as in celiac disease or lymphoma with fine nodulation.

(c) Postponement of flocculation makes possible a diagnosis of Whipple disease or lymphangiectasia.

(d) Transit acceleration renders enteroclysis highly suitable for weak and elderly patients.

(e) A positive diagnosis of normality is more likely made with enteroclysis ***(Truelofe., 1994).***

The principal advantage of conventional enteroclysis is that the jejunum and ileum can be optimally distended. Conventional enteroclysis also provides functional information by defining distensibility or fixation of the small-bowel loops. Conventional enteroclysis may permit detection of partially or non-obstructive small-bowel lesions that may not be demonstrated with cross-sectional imaging techniques ***(Heinz et al., 1998).***

Enteroclysis produces far better delineation of the entire small bowel than follow-through study. Not only does enteroclysis produce better distension of individual small bowel loops, but the biphasic approach allows all loops to be visualized both in single and double contrast phases ***(Chen et al., 1996).***

The advantages of enteroclysis exist in its comprehensive inspection of the entire mesenteric small bowel in various phases of display observed during intermittently sustained fluoroscopic monitoring. Small bowel peristaltic activity, intra-abdominal bowel distribution, lumen distensibility, bowel wall thickness, circular fold morphology, and mucosal surface features comprise the range of diagnostic parameters routinely addressed by this method of small bowel study. Advocates of this method cite sensitivity and specificity values of 94% and 97%, respectively ***(Ott et al., 1985).***

As one of the primary methods of investigating the small bowel, enteroclysis remains a technique in evolution. More recently, its essential principle of volume challenge has been combined with the tremendous advantages of CT & MRI to give rise to the exciting new techniques of CT enteroclysis and MR enteroclysis. Through improvements in methodology and advancements in technology, the future of enteroclysis looks bright indeed ***(Dean et al., 2003).***

Enteroclysis is the preferred method for detecting early small bowel disease; its double contrast effect and active dilatation of the bowel contribute to its superior performance relative to conventional passive small bowel follow-through ***(Maglinte et al., 1996).***

Small bowel enema is generally considered to produce superior images of the small bowel, in particular of mucosal detail, when compared with follow-through examinations ***(Dixon et al., 1993).***

Retrospective studies declare to the superior sensitivity and specificity of small bowel enema compared with follow-through examination ***(Barloon et al., 1994).***

There is some controversy as to the relative merits of the traditional per oral small bowel series and enteroclysis as the initial radiographic examination. Factors to be considered when selecting the appropriate technique include the reason for the examination, the age of the patient, time and cost, patient acceptance, radiation exposure, and accuracy. The per-oral

study is more readily accepted, faster, and involves considerably less radiation than enteroclysis, which however is generally considered to be more accurate than the per-oral examination. An overall accuracy of 96% for enteroclysis was reported compared to only 72% for the small bowel series, with Crohn's disease accounting for most of the false negatives encountered with the latter technique. Peritoneal adhesions have been considered difficult to diagnose using the per-oral examination, and careful fluoroscopic observation combined with palpation and compression is necessary. However, Enteroclysis has proven to be quite useful for demonstrating adhesions directly even in the presence of small bowel obstruction, often showing both the level and cause of the obstruction whereas with the per-oral examination only the approximate site may be apparent. This is due to the better distension achieved by direct infusion of barium into the small bowel, as well as constant fluoroscopic observation which facilitates timely compression spot filming ***(Fleckenstien et al., 1995).***

In general terms, enteroclysis is also used as a gold standard for clarifying possible abnormalities found on standard per oral studies of the small bowel, because one of its great advantages is the clear demonstration of normality ***(Moch et al., 1994).***

Small bowel meal follow-through with professional compression fluoro-radiography is an acceptable alternative in patients who refuse intubation or cannot be intubated. In patients who have not previously had pelvic surgery and whose indication for examination is suspected inflammatory bowel disease, the dedicated small bowel meal may suffice. Some gastroenterologists are requesting enteroclysis because it shows normality better than the oral methods, for excluding other diseases of the small bowel. In a patient with prior abdominal surgery, enteroclysis should be the method of choice in evaluating the small bowel ***(Herlinger., 1994).***

Opponents of the enteroclysis examination frequently persist that the upper edge in diagnostic accuracy of enteroclysis over a standard per-oral study is not great enough to warrant the variably extended examination

times, or the increased radiation levels. Comparing enteroclysis with a dedicated small bowel series, *Ott et al 1985*, found only minimal difference in overall sensitivity and specificity between the two modes of examination for Crohn's disease, adhesions, and metastatic disease. Only in delineating obstructive peritoneal adhesions was enteroclysis more effective ***(Ott et al., 1985).***

Because routine endoscopy of the small bowel is not feasible, the most common techniques to visualize this organ are the small bowel follow-through study and enteroclysis. Enteroclysis, which should be restricted to patients with a high level of suspicion of small bowel disease, has several advantages over the small bowel follow-through study. It is independent of the activity of the pylorus, so a high-quality study can usually be completed in less than 30 minutes. Double-contrast enteroclysis allows complete evaluation of all loops of small bowel, including ileal loops that often are superimposed on one another within the pelvis. Common indications for enteroclysis include partial mechanical small bowel obstruction, suspected peritoneal neoplasms, suspected radiation enteritis, unexplained, intermittent lower gastrointestinal bleeding, Crohn's disease being considered for surgery, and malabsorption due to small bowel disease ***(Wittich., 2000).***

The conventional small bowel study has several potential limitations that render a lesion non-detectable even in retrospect. As interval films are taken of the small bowel when it is possible, particularly with slow transit, for lesions not to be adequately included in the opacified loops. More important, however, the segment containing the lesion be opacified and shown on the film and yet cannot be diagnosed. In *Pygott et al 1990*, opinion, this is due to lack of full distension which is impossible to achieve with the conventional technique, no matter how much barium is administered orally. The intact pylorus of the stomach normally regulates the gastric emptying, preventing full distension of the intestine ***(Pygott et al., 1990).***

The limitations of small-bowel radiological investigation with oral contrast material have long been recognized. The dilemma of choosing

between the oral approach, which is more acceptable to the patient, and the intubation-infusion method (enteroclysis), which is less well tolerated in the absence of conscious sedation, has not been resolved by the radiological community. On the basis of long-term follow-up results, enteroclysis has been shown to be a reliable method for investigation of an organ where a high negative predictive value is needed ***(Dean et al., 2000).***

Enteroclysis is a more detailed technique for imaging the small bowel; major indications for enteroclysis include partial or intermittent small bowel obstruction, malabsorption states, obscure GI tract bleeding, and evaluation of the extent and severity of known Crohn's disease ***(Herlinger., 2000).***

Enteroclysis can provide the most discriminating anatomic detail in the small bowel. However, because it is considered as an invasive examination and because it causes some discomfort to the patient, it is not the routine radiological examination of the small bowel. The most frequent clinical circumstances where enteroclysis is useful are small-bowel obstruction and occult gastrointestinal bleeding. The examination will frequently show the cause of intermittent obstructions such as adhesive bands or small-bowel tumours, which may be the cause of intermittent intussusception. In patients with these clinical symptoms, enteroclysis is the preferred examination. The issue of small-bowel obstruction also arises frequently in patients who have had previous abdominal surgery for malignancy, particularly for gynaecologic tumours. In these patients, the question often arises of whether symptoms of small-bowel obstruction are due to postoperative adhesions, recurrent tumour, or radiation ***(Heringer et al., 1990).***

Although enteroclysis can be performed in virtually all adult patients and seems especially suited for the less mobile and compliant elderly population, some clinical settings may present unique anatomic limitations that are better avoided than approached. Nearly all such unique cases involve post-surgical patients. It is very difficult to establish and maintain satisfactory enteric catheter position and avoid significant reflux during a standard enteroclysis in patients who have either undergone previous Billroth-II type

gastric resection or total gastrectomy and esophago-jejunostomy. Patients with radical small bowel resection (i.e., "short gut syndrome") may also not profit significantly from a standard enteroclysis when a simple per-oral passive procedure might be just as diagnostic and considerably less discomforting. However, colostomy and ileostomy patients, as well as patients with ileo-anal anastomosis following proctocolectomy present only minor additional technical difficulty requiring only minimal modification of the standard enteroclysis technique ***(Arunas et al., 2002).***

To measure the accuracy of small bowel enema, enteroscopy may not have been sufficient in that it may not have given an accurate determination of features such as length of disease and presence of sub-mucosal disease, or extra-mural extension. Furthermore, fistulas, if present, may not be appreciated, endoscopically. This also would have required a third procedure in patients already undergoing two procedures ***(Wittich., 2000).***

Recent experience suggests that the latest generation of video enteroscopy offers the best combination of diagnostic and therapeutic capabilities. Unfortunately, even with the latest technology and under the best conditions, the entire small intestine cannot routinely be visualized. Therefore, radiographic studies remain essential in the evaluation of the small bowel. Although it remains controversial, enteroclysis appears to offer superior sensitivity in detecting lesions in the small intestine compared to conventional per-oral small bowel series ***(Jeff et al., 1996).***

Surgery would provide reasonable comparison, although also imperfect, because there may be aspects of mucosal disease including length could not appreciated surgically. Fistulas and length of strictures would have been most likely appreciated surgically. Small bowel barium radiography is essential to determine if patients have recurrent disease, extent of recurrence or to establish the site and severity of strictures or fistulas ***(Bernstein et al., 1997).***

Enteroclysis is not a screening tool. Extended examination room time, increased radiation dose, and relative patient discomfort are factors limiting

its wide acceptance and use. However, in appropriately focused clinical settings, where suspicion of small bowel pathology is sufficiently high, enteroclysis is the logical diagnostic alternative ***(Arunas et al., 2002).***

One of the biggest criticisms of enteroclysis is the uncomfortable and sometimes difficult intubation of the small bowel, usually carried out by fluoroscopically guided placement of an enteroclysis tube via the nasopharynx or oropharynx. This method can be troublesome, time consuming and cause prolonged exposure to radiation. Intubation of the small intestine under conscious sedation decreases patient discomfort and exposure time to radiation. *Thoeni and Gould* study in 1991, comparing radiation doses in patients undergoing enteroclysis and small bowel series, report that the majority of fluoroscopy time during enteroclysis was required only for intubation. Some radiologists have reported the use of conscious sedation to eliminate the problems associated with fluoroscopic intubation ***(Dixon et al., 1999).***

Enteroclysis must be viewed as an aggressive, moderately invasive procedure that presents variable degrees of technical difficulty to the radiologist, as well as discomfort to the patient. Yet, it's greater and more graphically convincing diagnostic yield frequently makes enteroclysis the inevitable method of choice for the clinically indicated patient ***(Arunas et al., 2002).***

Reflux of barium or fluid from the duodenum into the stomach occasionally occurs. This does not affect the quality of examination to any significant degree, but may (rarely) produce nausea and vomiting. The nearer the tip of the tube is to the ligament of Treitz the less likely this to occur ***(Scot et al., 1994).***

Traditionally, the per-oral small bowel series has been used most often, and it remains popular because of its simplicity. However, it is often carried out in a brief manner with inadequate fluoroscopic evaluation and compression views, so that enteroclysis has been advocated as more accurate for detection of focal lesions. The enteroclysis is considerably more time

consuming for the radiologist and also delay the progress of the patients. Although advocates of enteroclysis have stated that this added time contributes to a more meticulous evaluation of the small bowel, many radiologists with a substantial volume of fluoroscopic studies may be unable to afford the time needed for adequate enteroclysis. On the other hand, the reduced physician time required for the per-oral series readily makes it possible for the radiologist to closely supervise the progress of the examination, including intermittent fluoroscopic evaluation and compression spot-filming of the entire small bowel ***(Vallance., 1991).***

Putting in consideration the annoying naso-jejunal intubation, there was no significant difference in the attendance rate for the two techniques and therefore this does not favour one technique over the other. The major difference in outcome for the intended procedures was due to failure to perform naso-jejunal intubation. Whereas some of these are due to the patient refusing the procedure, most are due to technical failure ***(Bernstein et al., 1997).***

The major obstacle that faces us in this study was the intubation technique either that it's difficult to be accepted by the patient or the needed manoeuvres to reach the appropriate site; at the ligament of Treitz. In fact this is the only difficulty we face, the actual time consumer, the factor of increasing the radiation exposure and longer room time. By practice, the intubation time decreases, using appropriate anaesthetic nasal gel and spray lowers the patients` sense of discomfort.

Ruedi et al., 1991, showed that the average skin entry radiation dose for enteroclysis was almost three times greater than that for the dedicated per-oral small bowel series.

Some investigators found total in-room examination time to be two and a half times longer for enteroclysis, and fluoroscopy time (=radiation exposure) was five times greater. A more recent investigation, however, reported a less striking difference of only a threefold increase in radiation exposure ***(Thoeni et al., 1991).***

Minimizing exposure to ionizing radiations is an important aspect of any radiological procedure. This is particularly true of younger patients, in whom it is desirable to less gonad exposure and reduces possible genetic effects. The mean fluoroscopic time for the per-oral study was 4 minutes, compared to 22 for enteroclysis, accounting for more than a five-fold increase in surface exposure ***(Vallance., 1991).***

Hart et al., in 1994, found the mean radiation dose-area product for small bowel enema to be 680 $cGycm^2$ and estimated that for follow-through to be 440 $cGycm^2$.

These differences in comparative doses can be accounted for by the fact that follow-through examinations are intrinsically variable between operators and institutions and can vary from a few plain radiographs to long periods of screening to assess motility and multiple compression views to separate loops ***(Barloon et al., 1988).***

Enteroclysis, on the other hand, requires a much more uniform technique between operators. The median room time for the small bowel enema was more than twice that for follow-through and has major influence on choice of technique employed. Enteroclysis is offered in cases of possible subacute obstruction, unsatisfactory barium follow-through examination or where clinical suspicion of small bowel disease remains high despite a normal barium follow-through examination ***(Andoni et al., 2001).***

Although radiation exposure and patient discomfort are higher with enteroclysis, studies have documented significantly higher overall diagnostic yield, higher sensitivity, and almost same procedure times as with follow through ***(Dixon et al., 1993).***

Enteroclysis may be complementary to enteroscopy when performed after a negative examination result. Because nasal placement and pyloric intubation are the most uncomfortable aspects of enteroclysis tube placement recent diagnostic activities have used endoscopic placement of the enteroclysis tube after a negative push-type enteroscopy examination. The insufflation of air during enteroscopy and the administration of conscious

sedation and glucagon do not seem to compromise the quality of the radiographs. Enteroclysis applied in this technique was helpful in making a positive diagnosis in 8% of patients with negative enteroscopy results and improved the yield of enteroscopy from 54% to 58% ***(Willis et al., 1997)***.

Despite recent advances in abdominal imaging, intestinal obstruction remains a difficult disease entity to diagnose accurately and treat. Small bowel obstruction (SBO) is a common clinical condition, often presenting with signs and symptoms similar to those seen in other acute abdominal disorders. Once intestinal obstruction is suspected based on the patient's clinical history and physical examination, diagnostic imaging is charged with the task of verifying the presence of obstruction and providing sound information on the site, severity, and probable cause of the obstruction. Because of its ability to provide important anatomic and functional information, enteroclysis has become a vital tool in the clinical decision making of patients with known or suspected SBO ***(Maglinte et al., 1997)***.

Open communication among radiologists, primary care physicians, and surgeons is essential in the work-up and management of SBO. The selection of imaging is based on knowledge of the patient's history, physical examination, laboratory results, and abdominal plain film findings. The dilemma that radiologists face is not the use of one technique over the other, but the decision of which examination to use first in the context of the clinical presentation and abdominal plain film findings ***(Balthazar, 1994)***.

According to *Miller et al., in 2000*, the three most common causes of SBO are (1) adhesions, (2) Crohn's disease, and (3) neoplasia. In the past, hernias represented a major cause of SBO. Hernias, however, still represent the predominant cause of SBO in many developing countries. Crohn's disease has only recently been acknowledged in the surgical literature as a leading cause of SBO, a fact that has long been suspected in many clinical radiology departments ***(Miller et al., in 2000)***.

Unfortunately, the plain-film examination is diagnostic in only 46% to 70% of SBO cases. Therefore, approximately 30% of patients never have

diagnostic plain films, and may have their surgery delayed for several days. This delay can be lethal. The major morbidity and mortality associated with SBO is related to associate intestinal ischemia or infarction resulting from strangulation ***(Frager et al., 1995).***

It is generally agreed that complete small bowel or large bowel obstruction requires surgery, although partial small bowel obstruction (SBO) can be managed conservatively at least initially. The final management of partial small bowel obstruction obviously depends on the specific diagnosis. The abdominal radiograph in obstructive series has, over the decades, played a critical role in determining the final diagnosis. SBO could be diagnosed with the demonstration of dilated loops of small intestine with air fluid levels and no or little colonic gas, while colonic obstruction appears as colonic distension ***(Soybel., 2001).***

Contrast studies including upper gastrointestinal series, small bowel series, barium enema, gastrografin small bowel series, and gastrografin enema have been used over the years but their accuracy is questionable. Although the passage of contrast into the colon indicates the SBO is not complete, it does not exclude the need for eventual surgery. Furthermore, in high-grade partial obstruction water-soluble contrast is considerably diluted even if some is reconstituted in the colon, and barium can take 12–24 hours to reach the colon under those circumstances. In the temporary, no diagnostic information is provided in many of these cases. Enteroclysis is an excellent method in diagnosing SBO. In particular, it is an excellent method in grading partial obstruction and delineating multifocal obstruction. The disadvantages of this technique are that it is operator dependent, fluoroscopy staff must be available on an emergency basis, it is time-consuming, and requires a considerable amount of radiation. Additionally, the wall of the small bowel is not visualized directly such that strangulation may be difficult to appreciate. Furthermore, barium used in enteroclysis precludes utilization of other cross-sectional imaging studies or angiography when there is no obstruction. Ultrasound can readily detect distended fluid-filled loops, which

certainly suggests the possibility of obstruction, but defining the location type and cause of obstruction is extremely operator dependent, and therefore very variable. Also, where gaseous distension predominates, ultrasound is technically limited ***(Maglinte et al., 1994).***

Enteroclysis is the best radiological technique for delineating the site and cause of obstruction in patients with intermittent or low-grade small bowel obstruction ***(Balthazar, 1994).***

The most diagnostically fascinating role for enteroclysis appears to be in small bowel obstruction, especially the low-grade variety. Although it is effective in graphically demonstrating closed-loop obstruction more rapidly than with passive techniques, the examination is most useful for investigating clinically suspected obstruction, particularly when plain films of the abdomen seem normal or are inconclusive for the site and cause of obstruction. The clarity and accuracy of demonstrating partially obstructive and even non-obstructive adhesive small bowel change is unparalleled by any passive method of small bowel study ***(Nolan, 1996).***

Patients with clinical findings of high-grade obstruction and obviously abnormal findings on abdominal plain radiographs may either be taken to surgery or managed conservatively. If decompression has been done, the site, severity, and nature of the obstruction can be readily demonstrated by an enteroclysis. The choice between medical or surgical decompression can be aided by the early performance of enteroclysis. If the clinical situation suggest simultaneous colon disease (e.g., caecal cancer or inflammatory bowel disease), a retrograde small bowel examination is the technique of choice. Tight or moderately tight obstruction can be diagnosed with the conventional follow-through study. However, when rapid diagnosis is needed, enteroclysis method is preferable. In the evaluation of intermittent or partial small bowel obstruction, enteroclysis with its ability to challenge the elasticity of the bowel wall is the method of choice. ***Gazelle et al., 1994***, studied a group of patients in whom small bowel obstruction developed after laparotomy for malignancy, and found that enteroclysis was able to determine

the cause of obstruction (adhesions, metastases or radiation injury) in 90% of cases. However, carefully performed follow-through examination may also show adhesions, but the relative lack of distension makes recognition more difficult ***(Gazelle et al., 1994).***

Enteroclysis is an excellent technique for evaluating all types of mechanical SBO, and radiologists have specifically advocated its use in the immediate postoperative period ***(Gazelle et al., 1994).***

Barium studies have been a useful adjunct in certain patients with a presumed obstruction. In particular, enteroclysis, which involves the oral insertion of a tube into the duodenum to infuse air and barium directly into the small intestine and to follow the movement fluoroscopically, has been helpful in the assessment of obstruction. Enteroclysis has been advocated as the definitive study in patients where the diagnosis of low-grade, intermittent small bowel obstruction is clinically uncertain. In addition, barium studies can precisely demonstrate the level of the obstruction as well as the cause of the obstruction in certain instances. The main disadvantages of enteroclysis are the need for naso-enteric intubation, the slow transit of contrast material in patients with a fluid-filled hypotonic small bowel, and the enhanced expertise required by the radiologist to perform this procedure ***(Miller et al., in 2000).***

Enteroclysis can assist in determining the degree of obstruction, with higher-grade partial obstructions requiring earlier operative intervention. Although an initial trial of non-operative management of most patients with partial small bowel obstruction is warranted, it should be emphasized that clinical deterioration of the patient or increasing small bowel distension on abdominal radiographs during tube decompression warrants prompt operative intervention ***(Townsend, 2001).***

Plain abdominal films are usually not helpful in distinguishing an ileus from obstruction. CT scans may be useful in this regard, and in particular, enteroclysis studies may be quite helpful in determining if an obstruction exists and the level of the obstruction ***(Townsend, 2001).***

Enteroclysis overcomes the limitations of the non-intubation techniques by challenging the distensibility of the bowel wall and exaggerating the effects of mild or sub-clinical mechanical obstruction. The small bowel intubation bypasses the pylorus, enabling delivery of a non-diluted barium or iodinated contrast bolus directly into the jejunum. The resultant luminal distension facilitates detection of both fixed and non-distensible bowel segments. Clinical studies have shown that the intubation infusion method of small bowel examination can correctly predict the presence of obstruction in 100%, the absence of obstruction in 88%, the level of obstruction in 89%, and the cause of obstruction 86% of patients ***(Sharke et al., 1996).***

The choice between surgical intervention and conservative (non-surgical) therapy with partial small bowel obstructions (SBO) is seldom clear from clinical information alone. Computed tomography (CT) and enteroclysis have both been shown to be excellent imaging tools in complete or high-grade partial obstruction and in patients with SBO, and a negative plain film series. A study done by ***Gregory et al., in 1996,*** stated that enteroclysis has been believed to detect the presence of a partial obstruction (all grades), when present, in 100% of the time. They also reported it to accurately demonstrate the level of partial obstruction (all grades) in 89% of patients and the associated characteristics in 86% ***(Gregory et al., 1996).***

SBO is excluded by enteroclysis or CT enteroclysis when free flow of contrast material is observed within normal-calibre small bowel loops from the duodeno-jejunal junction to the right colon. The diagnosis of mechanical SBO is confirmed by the demonstration of a transition zone, defined as a change in the calibre of the intestinal lumen from a distended segment proximal to the site of obstruction to a segment that is either collapsed or decreased in calibre distal to the site of obstruction. The level of obstruction is identified during the single-contrast phase of the examination, whereas the cause of the obstruction is best evaluated during the double-contrast phase of the study when observation of mucosal detail is optimal. In partial SBO, enteroclysis has been shown to be approximately 85% accurate in distinguishing adhesions

from metastases, tumour recurrence, and radiation damage. Obstructions can occur synchronously at multiple levels, such that if dilated fluid- or gas-filled small bowel loops are encountered distal to a transition zone, additional downward obstructions need to be assessed. Enteroclysis is particularly helpful in patients about whom the diagnosis of low-grade SBO is clinically uncertain. Its ability to distinguish low-grade obstruction from a normal examination makes it an important tool in this difficult clinical problem ***(Herlinger et al., 1993).***

Enteroclysis can also objectively estimate the severity of intestinal obstruction, an important advantage over other imaging modalities. In low-grade partial SBO there is no delay in the arrival of contrast to the point of obstruction, and there is sufficient flow of contrast through the point of obstruction such that fold patterns in the post-obstructive loops are readily defined. High-grade partial SBO is diagnosed when the presence of retained fluid dilutes the barium and results in inadequate contrast density above the site of obstruction, allowing only small amounts of contrast material to pass through the obstruction into the collapsed distal loops. Complete obstruction is diagnosed when there is no passage of contrast material beyond the point of obstruction as shown on delayed radiographs obtained up to 24 hours after the start of the examination. The term closed-loop obstruction implies acute obstruction with a tendency to progress toward infarction with the need for urgent surgery. Enteroclysis can also provide complementary information about the obstruction, such as how much contrast material is moving through the transition zone. Partial closed-loop obstruction has been demonstrated by enteroclysis in the sub-acute setting ***(Maglinte et al., 1996).***

Because enteroclysis requires conscious sedation, naso-intestinal intubation, and near-constant radiologist involvement, it can be impractical to perform adequately in the outpatient clinic setting. Many institutions also lack individuals with the proper expertise to perform the study. If expertise is lacking, a dedicated small bowel follow-through with close fluoroscopic monitoring is an acceptable substitute, provided that high-grade obstruction is

not present. In patients with complete or high-grade obstruction, dilution of barium occurs proximal to the site of obstruction and makes diagnostic evaluation suboptimal. Moreover, barium retained in the small bowel can degrade the diagnostic quality of subsequent CT examinations ***(Maglinte et al., 1996).***

Prompt preoperative recognition of closed-loop obstruction is crucial, because strangulation represents a dangerous complication that carries a much higher risk of mortality than simple mechanical SBO. Most closed-loop obstructions result from entrapment of the small bowel either within an internal or external hernia. CT is the imaging modality of choice for evaluating closed-loop obstruction in the acute setting, whereas CT or barium enteroclysis serve more complementary roles by establishing the presence of an incomplete closed-loop obstruction or by helping to clarify the cause of obstruction ***(Royal, 1994).***

The enteroclysis findings of closed-loop obstruction are similar to those seen in single-band adhesive obstruction, except that the crossing defect traverses two adjacent segments of a single loop of bowel. Volvulus is diagnosed if the afferent and efferent limbs seem to cross or intermingle with twisting of the folds at the point of obstruction. A separation between the two obstructed limbs excludes the presence of volvulus. In patients with moderate to high-grade obstruction, it may be difficult to exclude volvulus if the involved limbs appear closely approximated, tightly compressed, and angulated at the point of obstruction. It is often impossible to differentiate closed-loop obstructions caused by herniation through mesenteric defects from those caused by prolapse of bowel under adhesive bands. If the constriction is tight, there is usually delayed filling and delayed emptying of the contrast from the incarcerated loop ***(Maglinte et al., 1994).***

In patients with acute abdominal symptoms who have normal or abnormal but non-specific bowel gas pattern on abdominal plain films, CT is recommended. When the CT examination is not diagnostic, enteroclysis (CT,

barium, or MR) or a fluoroscopy based small bowel barium study can be performed as a complementary examination ***(Dean et al., 2003).***

Enteroclysis has gained increasing support among gastrointestinal radiologists. The value of enteroclysis for diagnosis of other causes of intestinal obstruction has been well documented. The ability of the infusion method to challenge the distensibility of the intestinal wall makes it valuable in the differentiation of obstruction related to oedema or spasm from obstruction secondary to stricture. This is critical for patient management to the gastroenterologist and surgeon, because of the potential difficulty in clinically distinguishing the features of acute inflammation of Crohn's disease from symptoms of intestinal obstruction ***(Maglinte et al., 1995).***

Unfortunately, erroneous application of imaging studies is frequent in clinical practice. Recent improvements in CT and enteroclysis technology have changed the approach to the evaluation of patients suspected of having SBO. These modalities are complementary and serve as essential adjuncts to abdominal plain film radiography in the diagnosis and management of SBO ***(Bender et al., 1997).***

In our study 14 cases complained of intestinal obstruction which was due to intestinal intussusception, post-operative adhesive band obstruction and stricture or secondary to malignant tumour mass (lymphoma). Enteroclysis accurately diagnosed all of them, determining the exact site of intestinal obstruction & and differentiating the malignant from the non-malignant types according to the mucosal pattern changes, these changes are proven on operative bases. It showed a sensitivity of 82% and specificity of 90% in detection of dilatation of the small bowel; and a sensitivity of 85% and a specificity of 92% in detection of strictures.

CT & ultrasound only played a role in diagnosing the tumour type intestinal obstruction, by detecting the causative mass lesion without evident proof of intestinal infiltration.

In our cases of intestinal obstruction we encountered the following changes:

- Mild to marked proximal bowel dilatation.
- Mucosal changes varying from normal slightly stretched to destructed mucosal fold pattern (in the malignant type).
- Segmental calibre reduction at the site of obstruction.

Cohn's disease is a chronic granulomatous inflammatory process characterized by a trans-mural and segmental involvement of the intestinal wall. Conventional radiology plays a well-established role in the initial evaluation of patients with suspected Cohn's disease, although the relative merits of the small bowel follow-through (SBFT) and small bowel enema (enteroclysis) studies are still controversial ***(Bernstein et al., 1997).***

The small bowel follow-through and enteroclysis are both excellent techniques for diagnosing Crohn's disease. In contrast, CT and MR are often used to assess complications such as intra-abdominal abscesses. Early findings of Crohn's disease on barium studies include a coarse villous pattern of the mucosa, thickened folds, and aphthoid ulcers, whereas advanced findings include mesenteric border linear ulcers, intersecting linear and transverse ulcers ("cobblestone"), strictures, and fistulas ***(Kelvin et al., 1999).***

The role of enteroclysis in Crohn's disease is clearly defined, not only it is a sensitive detector of low-grade or suspected but previously undiagnosed disease. Particularly in cases of obstructive multifocal fibrostenotic disease, enteroclysis is often of diagnostic value. Consequently, its use in preoperative assessment of Crohn's disease is essential ***(Bartram., 1996).***

A thorough radiographic investigation such as barium enema, small bowel follow-through, or preferably enteroclysis to delineate the extent of the fistula should be performed before surgery ***(Feldman, 2002).***

Patient discomfort and lack of evaluation of gastro-duodenal disease are the main drawbacks of enteroclysis which, however, has gained wide acceptance as the preferred technique. This is due to the ability of

enteroclysis to detect early mucosal abnormalities and to reliably exclude the disease; however, most of the radiographic findings of Cohn's disease, although highly suggestive, are not specific and can be observed in a variety of different conditions. This is particularly true in the ileo-ceacal area which is involved in up to 65-70% of patients. Enteroclysis is currently regarded as the radiological technique of choice in evaluating small bowel disease ***(Willis et al, 1997).***

In patients with inflammatory bowel disease involvement of the terminal ileum may help to establish a diagnosis of Cohn's disease, rather than ulcerative colitis, given the considerable overlap of pathological findings on colorectal biopsies. Although retrograde ileoscopy can be effectively performed in most patients with Cohn's disease, it may not always be feasible, and even in patients with documented terminal ileitis radiological examination of the small bowel is still indicated to evaluate the extent of the disease. In this respect, enteroclysis is particularly well suited due to the trans-radiance and the improved distensibility of bowel loops determined by the methylcellulose. Enteroclysis is also largely acknowledged to allow detection of early mucosal abnormalities. In conclusion, it is found that enteroclysis is a very sensitive technique in evaluating both the extent and severity of small bowel involvement in patients with Cohn's disease; however, the overlap of radiographic findings with those of other diseases may slow down its accuracy when the disease is confined to the ileo-ceacal area ***(Camera et al., 2000).***

Clinical studies have shown that the delay between the onset of symptoms and the diagnosis of Crohn's disease is greatest when the disease is limited to the small intestine. These and other reports also suggest that a substantial number of false negative results are obtained with barium examinations of the small bowel for Crohn's disease. In addition, a number of patients in whom the diagnosis of Crohn's disease was made with conventional barium examination were found to not have the disease at endoscopic examination and clinical follow-up assessment. In 1979, the National Cooperative Crohn's Disease Study reported an average lag time of

36 months (from onset of symptoms to time of diagnosis) for small bowel Crohn's disease. In all of these reports, the conventional small bowel follow-through or barium meal was the method used for radiological examination ***(Dean et al., 1992).***

Enteroclysis specifically excels in showing the presence or absence of skip lesions and the length of involved segments and in differentiating an unyielding fibrous stricture from a distensible inflamed spastic segment that may be reversible with medical treatment. Determining the anatomic extent of involvement and evaluating the nature of an area of narrowing are important issues relevant to surgical and medical management in Cohn's disease, for this reason, patients with known small bowel Cohn's disease are optimally evaluated by enteroclysis, augmented by retrograde ileoscopy at the time of colonoscopy ***(Heinz et al., 1998).***

Enteroclysis can provide the clinician with a sensitive method of diagnosing the disease, even in its early stages, and allows diagnosis of other entities with symptoms that can mimic those of Crohn's disease of the small bowel. The reliability of enteroclysis in exclusion of the disease makes it an important diagnostic tool in the workup of patients with suspected Crohn's disease of the small intestine ***(Dean et al., 1992).***

It serves as the primary examination in a variety of other less common circumstances. These include the preoperative evaluation of patients with Cohn's disease to ensure that there are no proximal skip lesions. It is also used in patients with celiac disease where a per oral examination results only in flocculation of the barium. In these patients it is important to obtain good anatomic information, because celiac disease may be complicated by tumours of the small bowel ***(Herringer et al., 1994).***

Enteroclysis produces far better delineation of the small bowel than in follow-through study. Not only does enteroclysis produce better distension of individual small bowel loops, but the biphasic approach allows loops to be visualized both in single and double contrast including the distal ileum, determining the anatomic extent of involvement and evaluating the nature of

narrowing areas that are important topics determining the nature of the indicated management in Cohn's disease ***(Gasparaitis et al., 1997).***

All cases of Crohn's diseases at this study (representing 5 cases, with all of them are proven histopathologically), showed a variety of enteroclysis abnormalities. They show mucosal pattern changes, various types of ulcerations, altered calibre, with some of them were complicated by fistulous tracts, while other showed terminal ileal affection. CT only raised a suspicion of mural wall thickening in three cases, showed thickening & blurring of the mesenteric fat planes, and proved the presence of sacro-ilietis in two cases. On the other hand, ultrasound could not detect any abnormalities in the cases.

The colonoscopy & enteroscopy findings were confirmative to the enteroclysis results, demonstrating jejunal & ileal ulcerations, confirming the presence of fistulous openings, showing inflammation and oedema of ileo-ceacal valve mucosal folds, proving the presence of stenotic segments. The most important issue is enabling the biopsy uptake, for histopathological verification.

Multiple disease entities are associated with malabsorption, reflecting the term "sprue pattern" or "malabsorption pattern" which is referred to the radiographic findings in such cases of malabsorption. The diseases associated with malabsorption are classified into:

- Celiac sprue, the prototype of malabsorption syndrome.
- Constitutional diseases involving the small bowel:
  - Whipple's disease.
  - Scleroderma.
  - Lymphosarcoma.
  - Amyloidosis.
  - Diabetes.
  - Carcinoid syndrome.
- Primary small bowel diseases:
  - Intestinal lymphangiectasia.
  - Parasitic infections(Strongyloides, and Giardia).
  - Diverticula, blind loops, and strictures.

- Crohn's disease and tuberculosis.
- Mesenteric vascular insufficiency.
- Eosinophilic gastroenteritis.

- Post-operative conditions.
- Faulty digestion:
  - Diseases of the liver and biliary tract.
  - Zollinger-Ellison syndrome.
  - Pancreatic insufficiency.

(Maglinte et al., 1994).

The name "sprue" is given to a group of three diseases of the small bowel that share a similar pathologic appearance; celiac disease of children, non-tropical sprue of adults, and tropical sprue. All available evidence now indicates that celiac disease and non-tropical sprue are the same entity occurring at different times of life, and the term "celiac sprue" is generally used to include both celiac disease of children and non-tropical sprue. They exhibit similar lesions in small bowel biopsies. There is a flattening, broadening, and coalescence of the villi and sometimes a complete loss of these structures. The overall thickness of the mucosa may not be much different from the normal thickness. These mucosal abnormalities associated with celiac sprue tend to be more pronounced in the jejunum than in the ileum ***(Levine et al., 2002).***

Almost every patient with sprue, however, exhibits changes in the small intestine in the form of varying degrees of dilatation, hypersecretion, segmentation, fragmentation, either a thickening or thinning of the folds of the small bowel may be seen, these changes referred as the malabsorption pattern. Dilatation is usually best visualized in the mid and distal jejunum and is not as common in the distal ileum. On occasion, it is diffuse throughout the small intestine ***(Maglinte et al., 1994).***

Excessive amount of fluid in the intestinal lumen is a constant finding in most patients with sprue resulting in a coarse, granular appearance with areas of flocculation dispersed irregularly in the intestinal loops, instead of

the homogeneous appearance of barium in the normal small intestine ***(Cooke et al., 1994).***

The term "segmentation" refers to masses of barium those are moderately large, definitely separated from adjacent clumps, and usually present in dilated segments. The small, contracted, barium-filled segments of small bowel connected by strands of barium that are seen in association with spasm are not included in this definition. Segmentation is most pronounced in the distal jejunum and proximal ileum. Employing micro-pulverized barium preparations containing suspending agents segmentation is greatly reduced ***(Levine et al., 2002).***

When dilatation of the jejunum occurs, the mucosal folds appear to be straightened and thinned. If secretions are abundant, the folds may appear to be thickened rather than thinned. Decreased number of folds per inch in the jejunum and its increase in the ileum is called ("jejunization" of the ileum) (***Maglinte et al., 1994).***

The term "moulage sign," derived from the French, *moulage,* meaning "molding" or "casting". The mucosal folds appear to be effaced, and the barium-filled lumen resembles a tube into which wax has been poured and allowed to harden ***(Herlinger et al., 1986).***

Intestinal oedema and hypoproteinemia also cause thickening of the mucosal folds which is usually diffuse. The fold pattern is symmetric, but the folds appear to be redundant and excessive. Intra-luminal defects secondary to enlarged lymphatic have been described. Increased secretions are invariably present. The combination of oedema and secretions may produce blunting and fragmentation of the folds. Dilatation is minimal or absent. Hypoproteinemia in itself can result in pathologic changes in the gastro-intestinal tract, most commonly in the small intestine. These changes have been termed intestinal oedema and occur in a variety of illness, including cirrhosis, nephritic syndrome and other condition that cause leakage of protein into the intestine. When the serum albumin level is

significantly reduced or secretions are markedly increased, thickening of the folds also occurs ***(Cooke et al., 1994).***

In our study population we encountered two cases showing the malabsorption pattern due to hypoproteinemia secondary to liver cirrhosis. The enteroclysis changes consist of generalized symmetrical thickening of the intestinal mucosal folds, being more apparent at the jejunum. Ultrasound & CT examinations demonstrated liver cirrhosis, splenomegaly, portal hypertension and ascites, while CT also showed relative retrospective intestinal mural wall thickening. Enteroscopy and histopathology confirmed the forementioned intestinal changes.

The small bowel is one of the most difficult organs to study diagnostically and to examine clinically. When faced with a high clinical suspicion and a markedly abnormal scintigraphic study, a negative upper gastrointestinal series and follow-through does not exclude the possibility of small bowel disease and should provide the motivation to search for an obstructing lesion. The enteroclysis provides a relatively safe, efficient, and reliable study to further evaluate the bowel in an attempt for preoperative diagnosis of an undetected tumour. Therefore, it is a necessity that a thorough evaluation includes enteroclysis before exploratory surgery in this circumstance ***(Glenn et al., 1998).***

The small bowel follow-through or enteroclysis can be used to diagnose various malignant tumours of the small bowel, including carcinoma, carcinoid, stromal tumours (i.e., leiomyosarcomas), lymphoma, and metastases. These tumours often can be differentiated by their characteristic findings on barium studies, but CT or MR usually is required for proper staging of the lesions ***(Maglinte et al., 1999).***

Enteroclysis is ideal for detecting neoplasms, demonstrating chronic radiation enteritis and identifying Meckel`s diverticulum. The sensitivity of enteroclysis in the diagnosis of small bowel neoplasia is much higher, approaching 95%. ***(Maglinte et al., 1996).***

Our study included 5 cases of intestinal tumours, 4 non-Hodgkin's lymphomas and 1 carcinoid tumour. The case of carcinoid appeared as irregular non-uniform narrowing of the terminal ileum and ileo-ceacal region in the enteroclysis study, while CT scan revealed multiple pathologically proven metastatic hepatic focal lesions, but could no detect the fine enteric mucosal changes.

On the other hand, the two lymphoma cases showed distorted mucosal fold pattern with alternating areas of luminal dilatation and narrowing as well as abrupt lumen interruption. Associated splenic focal lesions & enlargement and retro-peritoneal lymphadenopathy, are only detected by both CT and ultrasound examinations. Whereas, the other two demonstrated multiple wide spread nodular filling defects throughout the small bowel in enteroclysis with predominant affection of the distal jejunum and proximal ileum.

Enteroscopy illustrated distorted jejunal mucosal fold pattern with multiple non-ulcerated polyps in the former two lymphoma cases, while, colonoscopy examination of the last two cases showed multiple terminal ileum sessile polypoid projections. Histopathological examination of the enteroscopy, colonoscopy & nodal biopsies confirmed the diagnosis of non-Hodgkin's lymphoma.

Occult and obscure gastrointestinal bleeding are common clinical scenarios, yet the meaning and diagnostic criteria for these terms are not well delineated. *Stedman's Medical Dictionary 1995* briefly defines occult GI bleeding as blood in the faeces in amounts too small to be seen but detectable by chemical tests ***(Spraycar., 1995).***

The role of enteroclysis in evaluating obscure gastrointestinal bleeding was first reported by ***Maglinte et al., in 1985.***

Rex et al 1999, subsequently showed that the diagnostic yield of enteroclysis in these patients was about 10%. In a subgroup of their patients with normal findings on barium studies and/or endoscopy of the upper gastrointestinal tract and the colon, however, the diagnostic yield of enteroclysis was reported to have approached 20%. The authors concluded

that enteroclysis was a valuable diagnostic test in patients with unexplained gastrointestinal bleeding.

In recent years, per oral enteroscopy has become a technique used increasingly on examining patients with obscure-gastrointestinal bleeding. Numerous publications describe the instruments and techniques used. The sonde-type enteroscopy requires 6-8 hrs to reach the ileum and has been largely replaced by the newer push-type enteroscopy, which has high resolution video capability and a channel for forceps biopsy or cauterization. Currently, no agreement exists among gastroenterologists and radiologists about the respective roles of enteroclysis and enteroscopy in the evaluation of patients with obscure gastrointestinal bleeding. Some authors favour enteroclysis, if it is available, as the next diagnostic test when barium studies and/or endoscopy of the upper gastrointestinal tract and the colon have failed to show a potential source of bleeding. Others prefer enteroscopy as the first diagnostic procedure and do not even mention enteroclysis as a practical alternative ***(Gostoul et al., 1994).***

Recent published data suggest that enteroclysis and enteroscopy are complementary techniques for examining patients with obscure gastrointestinal bleeding ***(Maglinte et al., 1999).***

Carefully performed enteroclysis can detect many lesions in the small intestine that can cause gastrointestinal bleeding. If enteroclysis fails to demonstrate lesion as a likely source of bleeding, an arteriovenous malformation is the probable cause, and enteroscopy may be required for diagnosis and treatment of these vascular malformations. Thus, we believe that enteroclysis is a valuable diagnostic modality and that it should precede enteroscopy examination of patients with obscure gastrointestinal bleeding ***(Moch et al., 1994).***

Obscure bleeding has undergone a number of varied descriptions, the definitions changing with the evolution of investigative procedures that have progressed from radiology to endoscopy. When barium radiographs were used as the primary means of evaluation, gastrointestinal haemorrhage was

called obscure if its cause remained unknown after standard radiological investigations ***(Lewis et al., 1998).***

Obscure bleeding is more appropriately defined as bleeding of unknown origin that persists or recurs. No single study has followed the longitudinal course of obscure bleeding to determine the denominator for frequency or the diagnostic numerator of the various tests. Although as many as 30%-50% of occult bleeding cases will not have a source identified at colonoscopy and upper endoscopy ***(Foutch et al., 1990).***

In about 95% of all patients with gastrointestinal bleeding, bleeding site can be detected by barium studies and/or endoscopy of the upper gastrointestinal tract and the colon. In the remaining 5%, these diagnostic procedures fail to establish a cause for the bleeding. Often this obscure bleeding originates in the small intestine, posing a difficult diagnostic problem. Scintigraphy, angiography, enteroclysis, and enteroscopy are all procedures that have been used in an attempt to show these bleeding sites in the small intestine. Scintigraphy can be done when a Meckel`s diverticulum is suspected on clinical grounds. In adults, this abnormality often goes undetected on scintigrams, but can be shown by carefully performed enteroclysis. However, a Meckel`s diverticulum is an unlikely cause of gastrointestinal bleeding in patients more than 40 years old. Angiography also may be used to show bleeding sites in the small intestine, but this invasive procedure usually is not part of the routine workup of patients with low-grade or intermittent gastrointestinal bleeding ***(Lewis et al., 1998).***

In patients with unexplained GI blood loss, enteroclysis is a valuable technique for detecting small bowel lesions when radiological and endoscopic examinations of the upper GI tract or colon fail to demonstrate a bleeding source. *Moch et al., 1994,* declared that enteroclysis had a diagnostic yield of about 20% in identifying the presumptive site of bleeding in such patients. The majority had tumours involving the small bowel, but some had other lesions, including arteriovenous malformations and Meckel`s diverticulum ***(Moch et al., 1994).***

Though only 8% of the patients in a study done by *Jeff et al., in 1996,* with gastrointestinal bleeding had a finding identified by enteroclysis, the radiographic study excluded lesions of the distal small bowel other than angiodysplasia. A negative evaluation can be very helpful and cost-effective in the clinical management of patients with suspected small bowel pathology by eliminating the rare but possibly significant small bowel tumour or other abnormality in the length of small bowel outside the reach of the enteroscopy. In fact, the reported overall sensitivity and specificity of enteroclysis in detecting small bowel lesions in that study was 94% to 96% and 95% to 97%, respectively ***(Jeff et al., 1996).***

Barium studies are often used for further work-up of the small bowel in obscure bleeding, either before enteroscopy or when push-enteroscopy has failed to reveal a source ***(Aliperti et al., 1996).***

Angiodysplasia is the common cause of small intestinal bleeding. These lesions are not readily identified by small bowel follow-through or enteroclysis. Although enteroclysis may identify small bowel tumours as a source of bleeding, it has an overall yield of less than 10%. Small bowel ulcerations, which are associated with NSAID use, often are difficult to identify with barium evaluation ***(Collins et al., 1994).***

Like all luminal contrast radiology, enteroclysis is virtually incapable of confidently identifying sub-mucosal vascular abnormalities such as varices, angiodysplasia, or arteriovenous malformations, despite isolated sporadic reports to the contrary. Consequently, diagnosis of the most frequent source of occult small bowel bleeding remains outside the grasp of this otherwise highly diagnostic procedure, permitting it to play only an "exclusionary role" in this diagnostic exercise ***(Thoeni et al., 1991).***

Mesenteric angiography of the celiac, superior and inferior mesenteric arteries can identify angiodysplasias successfully. Endoscopic evaluation of the small bowel may be able to overcome the disadvantages of the other modalities as well as apply therapy if needed ***(Rex et al., 1999).***

Preoperative evaluation (enteroclysis, red blood cell scan, and angiography) occasionally helps identify areas of concern along the bowel. Recurrent bleeding has been known to occur, however, because lesions may still be missed or new ones may develop ***(Fallah et al., 2000).***

However, in studies specifically addressing occult bleeding, enteroclysis had a yield of 0% when performed after negative colonoscopy and upper endoscopy, and follow-through had a yield of 0%-4% although the numbers of patients studied were small. When enteroclysis is used in a wider range for the diagnosis of obscure gastrointestinal bleeding, its yield can range from 10% to 21% which is higher than the yield of follow-through (0%-5.6%) ***(Antes et al., 1996).***

Although enteroclysis has been suggested as the radiological study of choice for the investigation of suspected gross disorders of the small bowel there is a low yield in the diagnosis of angiodysplasia. In a study of 128 patients with obscure gastrointestinal bleeding, only 2% had subtle findings suggestive of angiodysplasia and confirmed on pathological examination of resected bowel ***(Moch et al., 1994).***

When enteroscopy was combined with enteroclysis, angiodysplasias were found in 22% and small bowel tumours in 4%, with all tumours identified only by enteroclysis. In one of the largest studies, angiodysplasias were identified in 34%, small bowel ulcers in 27%, neoplasms in 2%, and non-specific mucosal findings of uncertain significance in 5%. It is evident that angiodysplasia is the most common small bowel cause of obscure bleeding, followed by small bowel tumours ***(Aliperti et al., 1996).***

This study included one case suffering from obscure rectal bleeding who underwent enteroclysis examination that proved to be normal excluding the possibility of small bowel abnormalities and served as a negative screening technique after uncompleted colonoscopy examination (reaching almost up to the hepatic flexure and had to be terminated) and normal double contrast barium enema study. Selective superior mesenteric angiography was the magic stick that points to the causative caecal angiodysplasia.

The small bowel is subject to a variety of surgical interventions for the treatment of a broad spectrum of disease processes. Most operative procedures applied to the small bowel are straightforward techniques burdened by few complications, whereas other procedures are considerably more complex and can be associated with significant post-operative morbidity. Familiarity with the anatomic alterations related to the various operations is essential, for evaluation of early post-operative complications and those abnormalities that manifest late in the post-operative course. The surgeon and radiologist should carefully coordinate clinical suspicion with the strengths of the various imaging modalities to optimize post-surgical assessment and provide appropriate and accurate diagnosis ***(Lappas et al., 1997).***

Enteric anastomosis, the different forms of enterostomy, and the varied constructions of small bowel pouches and reservoirs are each associated with unique anatomy and therefore optimal techniques of assessment. Small bowel contrast studies such as enteroclysis and CT imaging represent the primary modalities for imaging of the post-operative bowel and its related abnormalities. Small bowel transplantation continues to progress as a realistic treatment for intestinal failure, and the role of diagnostic imaging in these unique and challenging patients is evolving ***(Lappas et al., 2003).***

Radiological studies are often performed as routine follow-up of the surgical procedure; rather they are done to assess the integrity of the small bowel or to investigate post-operative complications. In patients with a prior history of small bowel surgery that present with gastrointestinal symptoms, the post-operative anatomy and site of any anastomosis should be evaluated by carefully performed small bowel studies. Small bowel enteroclysis in conjunction with real-time fluoroscopic observation of the luminal infusion ideally demonstrates the anatomic detail of the surgically altered intestine ***(Lappas et al., 1997).***

Contrast studies performed with water-soluble contrast media may demonstrate an intestinal leak, although similar findings are detectable on CT,

which also has the advantage of localizing contaminated peritoneal fluid and imaging the complication of abscess formation ***(Lappas et al., 2003).***

In blind pouch syndrome, abdominal radiographs may suggest the presence of a blind pouch, appearing as either a fluid-filled soft tissue mass or a gas-filled structure of variable size and shape. Small bowel contrast studies, particularly enteroclysis, demonstrate the pouches and their anastomotic relationships ***(Lappas et al., 2003).***

Distal enterostomy / ileostomy is primarily used for evacuation of intestinal contents in clinical situations that preclude normal use of the colon or require its surgical removal, as in familial adenomatous polyposis and inflammatory bowel disease. Barium contrast examinations, including enteroclysis infusion, can be safely performed in retrograde fashion in patients with an ileostomy and are ideal methods for evaluation of ileostomy dysfunction or other complication. Specific techniques for adapting enteroclysis catheters, small foley`s catheters, and externally applied ostomy cones for ileostomy intubation have been described. Although ileostomy infusion is well tolerated by patients and is the preferred approach for most diagnostic examinations, good results also have been reported with antegrade small bowel enteroclysis ***(Lappas et al., 1997).***

In cases of post-operative partial small bowel obstruction, antegrade enteroclysis infusion may be needed to accurately demonstrate the presence of functionally significant adhesions. Fascial scarring with narrowing of the prestomal segment of ileum as it passes through the abdominal wall also may be a cause of partial intestinal obstruction and resulting ileostomy dysfunction. Recurrent Crohn's disease in the distal small bowel can result in symptoms and radiological findings similar to those of obstructive ileostomy dysfunction ***(Kay et al., 1998).***

In our study we encountered ten cases of post-operative complications, which were diagnosed by enteroclysis and the findings, were proved operatively. The enteroclysis findings were:

- Detection of a jejuno-ileal fistula after failure of other modalities to define the exact cause of the patient's symptoms.

- Proximal small bowel dilatation with accurate definition of the exact site and causative factor which were distal jejunal & ileal obstruction alternatively secondary to previous operative intervention. While CT scan & ultrasonograpy of the abdomen & pelvis only revealed small bowel dilatation but could not define the underlying cause.

- An about 1.7 cm mid-jejunal post-operative stricture with consequent relative ectasia of the proximal bowel loops, where, the ultrasonography of the abdomen & pelvis was normal.

Most cases of acute radiation enteritis are self-limiting, and the treatment is only supportive ***(Feldman, 2002).***

The management of chronic radiation enteritis remains a challenge because of the progressive evolution of the lesion, mainly obstructive endarteritis and fibrosis ***(Ott et al., 1985).***

We encountered 4 cases of post-radiation enteritis, all of which enteroclysis depicted the present changes.

Enteroclysis examination of two of them demonstrated straightening, thickening of the ileal mucosal folds as well with serrated non-uniform outline and multiple areas of persistent narrowing. The enteroscopy revealed non-specific mucosal changes.

The rest of them showed alternating areas of non-uniform narrowing and dilatation, loss of sharp stencil outline of some bowel loops, with mucosal fold thickening as well as nodular filling defects. CT scan of the abdomen &

pelvis revealed diffuse small bowel wall thickening as well as relative matting of some small bowel loops within the pelvic cavity.

Tuberculosis is a common disorder in Asia and Africa. The ileum, particularly the terminal ileum is the most frequent site of involvement. Patient's may have associated pulmonary T.B or have been infected by drinking un-pasteurized milk. Even in the absence of pulmonary lesions the possibility of tuberculosis must always be considered in cases of multiple ulcerated inflammatory lesions of the small bowel or an ulcerated lesion of the ileo-ceacal junction ***(Nolan 2003).***

The earliest morphologic changes are a stiffening of the mucosal pattern and nodularity in the distal part of the ileum. Intestinal tuberculosis is usually seen as circumferential ulceration in the lower ileum and ceacum with associated lymph node enlargement. The ileo-ceacal area, the pre-valvular ileum is circumferentially narrowed, the valve is gaping, and the outer caecal border opposite the ileo-ceacal valve is retracted toward the valve. It is usually shown in barium studies as a narrowed, thickened, rigid terminal ileum with some proximal dilatation, often with a small, thick pulled-up ceacum and a disturbed ileo-ceacal angle. The ulcers may be large or small and are sometimes multiple; healing sometimes occurs with fibrosis, leading to obstruction in some cases ***(Gleeson, 2002).***

The ulceration is usually transverse and associated with spasm of the ileum and lower ascending colon. If fibrosis follows, there is segmental or diffuse narrowing of the bowel with marked shortening of the caecal pole. Peritonitis when developed is due to peritoneal spread or local ulcer perforation. Fistulas may occasionally be observed which occur not only in

cases of Crohn's disease but also in cases of tuberculosis, actinomycosis, radiation enteritis, and even atypical tumours ***(Heinz et al., 1998).***

In acute cases, CT will delineate any masses, presence of ascites, and thickening of the bowel. Glandular enlargement with iso- to hypodense central areas and peripheral enhancement are seen when necrosis occurs ***(Bender, 1999).***

It may be difficult to be differentiated from Crohn's disease. In ileo-ceacal tuberculosis the segment of terminal ileum involved is usually shorter than in the Crohn's disease. Asymmetry and cobblestone are features of Crohn's disease not seen in tuberculosis. Longitudinal ulceration sometimes occurs in Crohn's disease but not seen in tuberculosis. The presence of linear ulceration, cobblestone, fistulation, and asymmetry of the changes in the bowel wall strongly favour the diagnosis of Crohn's disease rather than tuberculosis. Definitive diagnosis is by finding caseating granulomas either in the bowel wall or regional nodes ***(Gleeson, 2002).***

Our study included four cases of intestinal tuberculosis; chest X-ray examinations, sputum analysis (early morning samples for 3 consecutive days, using Ziehl-Nielsen stain) as well as tuberculin test were done for each of them. Enteroclysis examinations for these cases demonstrated the following changes:

- Destructed terminal ileum mucosa, serrated outline, with intermingled linear and nodular filling defects.
- Reduced distensibility of the distal ileal loops showing irregular contour, obliteration and distortion of the mucosal folds.

- Contracted pulled-up ceacum depicting an irregular outline and distorted configuration.

CT study of the abdomen and pelvis showed doubtful mural wall thickening at the ceacum and ileo-ceacal region. On the other hand, colonoscopy of two cases revealed a large ulcer in the terminal ileum covered by whitish necrotic tissue and caecal stricture with an ulcer on top at the other cases. Colonoscopy guided biopsies were sent for histopathological assessment and the diagnosis was confirmed.

A prospective study of 50 cases with suspected small intestinal diseases was performed by enteroclysis examination, aiming at identification of the enteroclysis characteristics of the different small intestinal disorders, and the accuracy of the overcome results.

Patients were either referred for enteroclysis examination because of suspected small bowel lesions based on their clinical presentation and investigations other than enteroclysis, or selected from cases with disease process known to involve the small intestine in order to assess the enteroclysis picture and diagnostic criteria of such diseases. Results of enteroclysis were reviewed, correlated with the available clinical data, other laboratory & radiological investigations and proposed diagnosis compared with the outcome of enteroscopy, colonoscopy as well as tissue biopsies when obtained.

The results from this thesis as well as other studies conclude that enteroclysis is a highly sensitive imaging tool for detecting small bowel disorders. Its major advantages reside in its unique ability in by-passing the regulating action of the stomach and pylorus with administration of the contrast material at a pre-selected optimal rate. These are coupled with the direct intestinal infusion sufficient to produce relative small bowel hypotonia resulting in the simultaneous demonstration of all loops of the bowel loops in a state of luminal distension. Conventional enteroclysis also provides functional information by defining intra-abdominal bowel loops distribution, lumen distensibility, fixation as well as, bowel wall thickness, circular fold morphology, and mucosal surface features, thus enabling early detection of bowel lesions.

Enteroclysis has been shown to be a reliable method for investigation of an organ where a high negative predictive value is needed.

However, enteroclysis is not a screening tool or a routine radiological examination of the small bowel, yet, when suspicion of small bowel pathology is sufficiently high, enteroclysis is the logical diagnostic examination.

On the other hand, there are several factors to be considered when selecting the appropriate technique including the reason for the examination, the age of the patient, time and cost, patient acceptance, radiation exposure, and needed accuracy.

Enteroclysis must be viewed as an aggressive procedure that presents variable degrees of technical difficulty to the radiologist, as well as discomfort to the patient. Besides, extended examination room time, increased radiation dose, and patient acceptance are the major criticisms that limit its wide popularity and use. Intubation of the small intestine under conscious sedation will solve this dilemma by decreasing patient discomfort and exposure time to radiation.

In a trial to overcome the disability of CT & MR imaging in detecting the early stages of intestinal diseases, as the small bowel is usually in a collapsed state. Recent investigations seek new techniques for examining the small bowel, combining the strengths of enteroclysis (mucosal detail and small-bowel distension) and cross-sectional imaging of CT and MR (demonstrating mural and extramural disease).

CT & MR enteroclysis are the results of these researches. CT enteroclysis profits from excellent distention of the entire small bowel, which allows detection of small lesions in the bowel wall and improves the detection of low-grade partial small bowel obstruction. However, its disadvantages are increased exposure of ionizing radiation, lack of functional information, lack of fluoroscopic control of the small bowel filling in the CT examination room, and poor soft tissue contrast.

Because of its excellent soft tissue contrast and multi-planar imaging capabilities, MR imaging steps forward leading the new era to be the optimal imaging method for evaluation of the small bowel with application of ultra-fast sequences to overcome the peristalsis, and respiratory motion artefacts.

Still, MR enteroclysis has several drawbacks. MR enteroclysis is time consuming and expensive. There is more concern about vomiting because the MR unit may be soiled or even damaged. Unfortunately, conventional fluoroscopy and radiation are still required for small bowel tube placement. The spatial resolution of MR enteroclysis is less than with conventional enteroclysis and tiny lesions might escape detection. There are still contraindications to MR imaging in general, such as pacemakers. The mobility and flexibility of small bowel loops cannot be tested the same as with conventional enteroclysis, and adhesions without obstruction might escape detection. Collapsed bowel loops also may simulate wall thickening and small bowel disease. They also may enhance with gadolinium and can be difficult to distinguish from tumour or inflammatory masses.

Thus, it is concluded that conventional enteroclysis has a high potential value in the evaluation of different small bowel diseases, in spite of its disadvantages and should be the radiological examination of choice whenever small bowel disease is suspected, or be an adjuvant to other imaging modalities to combine extra-intestinal disorders based on the relevant clinical data.

- Abbie A.A: The blood supply of the developing gut. J.Anat. 1993; 67: 491-521.
- Abbot M.E: A new approach to the problem of human evolution. Soc.Surg. 1992; 75: 70-88.
- Abrams J.S., and Holden W.D.: Tuberculosis of the gastrointestinal tract. Arch. Surg. 1994; 89:282-9.
- Acheson R.M.: Effects of nutrition and disease on human growth. Human growth. Symposia of the society for the study of human biology. Pergamon: Oxford. 1998; 3: 73-92.
- Akwari O.E.: Cancer of the bile ducts associated with ulcerative colitis. Ann. Surg. 1995; 181:303-7.
- Alexander R. Margulis, Joachim Burhenne.: Alimentary tract radiology. Third edition. Saunders: Philadelphia. 1983; 853-1029.
- Alien E, Pratt J.P, Newell Q.U, Bland L.J.: Early gut development. Contrib.Embryol.Carnegie.Washington. 1997; 22: 45-75.
- Alien L.: Lymphatic and lymphoid tissues. Annul.Rev.Physiol. 1996; 29: 197-24.
- Aliperti G, Zuckerman G.R, Willis J.R, Brink J.: Enteroscopy with enteroclysis. Gastrointest.Endosc.Clin.North Am. 1996; 6:803-10.
- Anand B.K.: Regulation of visceral activities by the central nervous system. In: Wolstenhoime , Knight J (Eds). control processes in multicellular organisms (Ciba Foundation Symposium). Churchill: London. 1990 ;356-80.
- Andoni P.T, Andrew Barltrop and Alan H. Freeman.: A prospective randomized study comparing enteroclysis with small bowel follow-through examinations in 244 patients. Abdominal imaging. 2001; 201-10.
- Andrew A, Kramer B, Rawden B.B.: The embryonic origin of endocrine cells of the gastrointestinal tract. Gen.Comp.Endocrinol. 1998; 47: 249-65.
- Anson B.J, McVay C.B.: Surgical anatomy 9th edition. Saunders: Philadelphia. 1996; 110-19.
- Antes G, Neher M, Hiemeyer V, and Burger A.: Gastrointestinal bleeding of obscure origin: Role of enteroclysis. Euro.Radiol. 1996; 6:851-4.
- Argeme M, Mambrini A, Lebreuil G.: Dissection du muscle de Treitz. Assoc. Anat. 1990; 147: 76-86.

- Arunas E. Gasparaitis P.L, Peter Mac-Eneaney.: Enteroclysis and computed tomography enteroclysis. Gastroenterology Clinics. 2002; 31:56-75.
- Aschoff K.A.: Das reticulo-edotheliale system. Ergebn.Inn.Med. 1994 ; 26: 1-18.
- Ashworth J.M.: Cell Differentiation. Chakan and Hall: London. 1993; 12-40.
- Askin M.P, Lewis B.S.: Push enteroscopy cauterization. Long term follow-up of 83 patients with bleeding small intestinal angiodysplasia. Gastrointestinal endoscop. 1996; 43:580-3.
- Asteley R, and French J.M.: Small intestinal pattern in normal children and celiac diseases. Br.J.Radiol. 1991; 24:321-330.
- Azzopardi J.G, and Menzies T.: Primary malignant lymphoma of the alimentary tract. Br.J.Surg. 1997; 47:358-63.
- Baba S, Maruta M, Ando K, Teramoto T.: Endo-intestinal Behcet's disease: report of five cases. Dis.Colon Rectum. 1996; 19: 428-40.
- Bale P.M.: Pathology of tangier disease. J. Clin. Pathol. 1997; 24:609-12.
- Balinsky B.I.: An introduction to embryology. 5th edition. Saunders: Philadelphia. 1997; 115-25.
- Balthazar E.J.: CT of small-bowel obstruction. AJR. 1994; 162:255-61.
- Bamett C.H.: Phases of human gut. Lancet. 1996 ;2: 617-21.
- Barclay A.E. The digestive tract. Cambridge University Press: London. 1996; 110-25.
- Barkin J, Schonfeld W, Thomson S.: Enteroscopy and small bowel biopsy: An improved technique for the diagnosis of small bowel disease. Gastrointest. Endosc. 2000; 31:215-7.
- Barloon T.J, Lu C.C, Franken E.A, Honda H, Berbaum K.: Small bowel enteroclysis survey. Gastrointest.Radiol. 1988; 13:203-6.
- Barloon T.J, Lu C.C, Honda H, Berbaum K.S.: Does a normal small bowel enteroclysis exclude small-bowel disease? A long-term follow-up of consecutive normal studies. Abdom.Imaging. 1994; 19:113-5.
- Barret N.R.: Hiatus hernia: a review of some controversial points. J. Surg. 1994; 42; 231-7.

- Bartram C.I.: Small bowel enteroclysis. Abdom.Imaging. 1996; 21:245-6.
- Bauroganen R.V, Aranda Coddou, Baxter J.S.: Manual of embryology. The development of the human body 3rd edition. Bailliere. London. 1995; 60-82.
- Bavless T.M, and Knox D.L.: Whipple's disease: A multi-system infection. N. Engl.J.Med. 1997; 300:920-25.
- Beightol R.W, Coupal J.J, Shih W.J.: Prevention of metoclopramide induced akathisia during gastric emptying imaging (letter). J.Nucl.Med. 2000; 32:1644-45.
- Bell J.: The Anatomy of the human body. 13th edition, Collins: New York. 1999; 4:65-90.
- Bellairs R.: Developmental processes in higher vertebrates. Logos Press: London. 1996; 110-25.
- Belt E.: Leonardo the anatomist. University of Kansas Press: Laurence, Kansas. 1995; 95-112.
- Bender G.N, Maglinte D.D.T.: Small bowel obstruction: The need for greater radiologist involvement. Emerg.Radiol. 1997; 4:337-9.
- Bender G.N.: Computed tomographic enteroclysis: one methodology. Invest Radiol. 1999; 31:43–49.
- Benson C.D, Lloyd J.R, and Fischer H.: Intussusception in infants and children: An analysis of 300 cases. Arch. Surg. 1993; 86:745-55.
- Bernstein C.N, Boult I.F, Greenberg H.M, Van der Putten W, Duffy G, Graham G.R.: A prospective randomized comparison between small bowel enteroclysis and small bowel follow-through in Cohn's disease. Gastroenterology. 1997; 113:390-8.
- Bernstein J.: The occurrence of intestinal atresia in new- born with meconium ileus; the pathogenesis of an acquired anomaly, Am.J.Dis.Child. 1996; 99:804-10.
- Bloom W, Fawcett D.W.: A textbook of histology 15th edition. Saunders: Philadelphia. 1996; 65-85.
- Bluestone R, MacMahon M, Dawson J.M.: Systemic sclerosis and small bowel involvement. Gut. 1999; 10: 185-93.

- Bockman D.E, Coopor M.D.: Pinocytosis by epithelium associated with lymphoid follicles in the appendix and Payer's patches. An electron microscopic study. Am.J.Anat. 1993; 136: 455-77.
- Bodan P, Dive C.H, and Van Trappen G.: Radiological differences between ileo-ceacal tuberculosis and Crohn's disease. Diagnosis of Crohn's disease. Am.J. Dig.Dis. 1988; 6:604-10.
- Bodart P, and Pringot J.: Enteroclysis in small intestinal diseases J. Belg. Radiol. 1997; 60:83-88.
- Borow M, Smith M.Jr, and Soto D.Jr.: Diverticular disease of the duodenum. Am. Surg. 1997; 33:373-78.
- Bouslog J.S.: Radiological studies of infants' gastrointestinal tract. J.Pediatric. 1994; 6: 234-40.
- Bremer J.L.: Diverticulae and duplications of the intestinal tract. Arch. Pathol. 1994; 38:132-37.
- Brief D.K, and Botsford T.W.: Primary bleeding from the small intestine in adult: The surgical management. J.A.M.A. 1995; 184:15-19.
- Brow J.R.: The small intestinal mucosa in dermatitis herpetiformis. Severity and distribution of the small intestinal lesion and associated malabsorption. Gastroenterology. 1998; 60:355-60.
- Burrows F.G, Toye D.K.: Celiac disease. Barium studies. Clin.Gastroenterol. 1994; 3: 91-107.
- Bussey H.J.R.: Gastrointestinal polyposis. Gut. 1998; 11:970-74.
- Caffey J.J.: Pediatric X-ray diagnosis. 6th edition. Saunders: Philadelphia .1992; 430-60.
- Caletti G.C, Gullini S, Brocchi E.: Endoscopy with the guillotine needle biopsy in the diagnosis of intestinal submucosal tumours. Gastrointest.Endosc. 2000; 36:222-25.
- Camera L.C, Cirillo L.M, Delia Noce R, Castiglione G, Mazzacca M. :Accuracy of enteroclysis in Cohn's disease of the small bowel: A retrospective study. Gastrointestinal.Radiol. 2000; 59-63.
- Chambeerlin G.W.: Radiological anatomy of the small intestine.J.A.MA. 1990; 113:1537-47.

- Chen M.Y, Tot D.J, Kelley T.F, Gelfand D.W.: Impact of the small bowel study on patient management. Gastrointestinal.Radiol. 1996; 16(3):189-92.
- Civetta J.M, and Kolodny M.: Mesenteric venous thrombosis associated with oral contraceptives. Gastroenterology. 1995; 58:713-16.
- Clemett A.R, Fishbone G, Levine R.J, James A.E, Janower M.: Gastrointestinal lesions in mastocytosis. Am.J.Roentgen. 1988; 103: 405-12.
- Clemett A.R, Marshak R.H.: Whipple's disease. Roentgen features and differential diagnosis. Radiol.Clin.North Am. 1989; 7: 105-11.
- Code F.J.: A history of comparative anatomy. From Aristotle to the Eighteenth Century. Macmillan. London.1994; 110-29.
- Cokkinis A.J. :Observations on the mesenteric circulation. J.Anat. 1995; 64: 200-5.
- Collins A.J, Jenkinson T, and Notorianni L.J: Barium x-ray study of the small bowel in rheumatoid arthritis patients taking non-steroidal anti-inflammatory drugs. Br.J.Rheumatol. 1994; 33:1195-6.
- Comes J.S.: Multiple lymphomatous polyposis of the gastrointestinal tract. Cancer. 1998; 14:249-52.
- Conzales T.A, et al.: Legal medicine. Pathology and toxicology, 2 Ed. New York. Appleton-Century-Crofts. 1995; 115-25.
- Cooke W.T, Holmes G.K.T.: Celiac disease. Edinburgh: Churchill Livingstone. 1994; 15-27.
- Could V.E.: Neuro-endocarinomas and neuro-endocrine carcinomas: APUD cell system neoplasms and their aberrant secretory activities. Palliol. Annu. 1997; 12:33-39.
- Cullen J.H.: Intestinal tuberculosis: A clinical pathological study. Q. Bull. Sea View. Hosp. 1998; 5:143-49.
- Darling R.C, and Welch C.E.: Tumours of the small intestine. N.Engl.J.Med. 1996; 260:397-99.
- David Sutton, Richard W.W, Jeremy P.R, Rhys D, Janet M, William R.L.: Text book of radiology and imaging 7th edition. Volume 2. 2003; 863-891.
- Davidson D.M, Einstein B.R, Herts D.M, Balfe R.E, Koehler D.E, Morgan M, Lieber and Baker M.E.: Comparison of two barium suspensions for dedicated small-bowel series. AJR. 1999; 172: 379-82.

- Davidson J.D, et al.: Protein losing gastroenteropathy in congestive heart failure. Lancet. 1997; 1:899-905.
- Dawson I.M, Comes J.S, and Morson B.C.: Primary malignant lymphoid tumours of the intestinal tract: Report of 37 cases with a study of factors influencing prognosis. Br.J.Surg. 1998; 49:80-83.
- De-Busscher G.: Les anastomoses arteriveneuses. Acta.Neeri.Morphol. 1998; 6: 87-105.
- Dean D.T, Maglinte, john C.L, Darel E.H, and Gregory N.B.: Technical refinements in enteroclysis. Radiologic.Clinics of North America. 2003 ;(41) 2:213-29.
- Dean D.T, Maglinte M.D, Evan S, Siegelman M.D and Frederick M. Kelvin M.D. MR enteroclysis: The future of small bowel imaging. Radiology. 2000; 215:639-41.
- Dean D.T, Maglinte, Stanley M. Chernish, Frederick M. Kelvin, Katherine W, and James P. Hage.: Crohn's disease of the small intestine: Accuracy and relevance of enteroclysis. Radiology. 1992; 184:541-5.
- Dean D.T, Maglinte, Stephen Rubesin.: Advances in intestinal imaging. Radiologic.Clinics of North America. 2003 ;(41) 2:11-25.
- De-Lorimer A.A, Fonkalsrud E.W, and Hays D.M.: Congenital atresia and stenosis of the jejunum and ileum. Surgery. 1996; 65:819-22.
- Dew M.J, Thompson H., and Allan R.N.: The spectrum of hepatic dysfunction in inflammatory bowel disease. Q. J. Med. 1996; 48:113-16.
- Di Sant'Agnese P.A, and Lepore M.J.: Involvement of abdominal organs in cystic fibrosis of the pancreas. Gastroenterology. 1998; 40:64-66.
- Dimmette R.M, Eiwi A.M, and Sproat H.F.: Relationship of schistosomiasis to polyposis and adenocarcinoma of large intestine. Am.J.Clin.Pathol.1996; 26:266-69.
- Diner W.C, Hoskins E.O.L, Nava F.: Radiological examination of the small intestine: Review of 402 cases and discussion of indications and methods. South Med.J. 1997; 77:68-74.
- Dixon P.M, Koulsion M.K, Nallan P.: Enteroscopy and enteroclysis. Am. Gastroenterology. l999; 54:1413-5.

- Dixon P.M, Roulston M.E, Nolan D.J.: The small bowel enema: A ten year review. Clin.Radiol. 1993; 47:46-48.
- Dobbins W.O, Ileas G.H.: A structural study of the intestinal mucosa in congenital beta-lipoprotein deficiency with particular emphasis upon the intestinal absorptive cell. Gastroenterology. 1996; 50:195-205.
- Dodds W.J.: Clinical and roentgen features of the intestinal polyposis syndromes. Gastrointest.Radiol. 1996; 1: 127-42.
- Donnison A.B, Schwachman H, and Gross R.E.: A review of 164 children with meconium ileus seen at the Children's Hospital Medical Center. Boston. Paediatrics. 1996; 37:833-39.
- Ecker J.A, Williams R.G, and Clay K.L.: Pneumatosis cystoides inteslinalis: Emphysema of the intestine; a review of the literature. Am.J.Gastroenterol. 1997; 56:125-28.
- Edwards M.: Multilocular retro-rectal cystic disease: Cyst-hamartoma: Report of twelve cases. Dis.Colon Rectum. 1997; 4:103-11.
- Eisenberg R.L.: Gastrointestinal radiology. 4 ed. Lippincott Williams & Wilkins. 2004; 407-549.
- Ekberg H.K.: Double contrast examination of the small bowel. Gastroint.Radiol. 1997; 1: 349-53.
- Estrada R.L.: Anomalies of intestinal rotation and fixation. Springfield & Charles. Thomas Publisher. 1998; 16-26.
- Fallah Marc A., Chandra Prakash, Steven Edmundowicz.: Advances in gastroenterology. Acute gastrointestinal bleeding. Medical Clinics of North America. 2000; 5:20-26.
- Feldman L.K, Sleisenger F.H, Fordtran H.J.: Gastrointestinal and Liver Disease. Elsevier 7th ed. 2002; 116-225.
- Fisk J.D, Schulman H.M, Greening R.R, McDonald G.B, Sale G.E, Thomas E.D.: Gastrointestinal radiographic features of human graft-vs-host disease. Am.J. Roent. 1989; 136: 329-36.
- Fleckenstein P, Pedersen G.: The value of the duodenal intubation method (Sellink modification) for the radiological visualization of the small bowel. Scand. J.Gastroenterol. 1995:10:423-5.

- Forbes W.S.C, Nolan D.J, Fletcher E.W.L: Small Bowel Neoplasia. Br.J.Surg. 2000; 65:168-70.
- Fournier A.M, et al.: Pour un grele en double contraste et en 6 minutes. J. Radiol. 1999; 60:71-76.
- Foutch P.G, Sawyer R, Sanowski R.: Push-enteroscopy for diagnosis of patients with gastrointestinal bleeding of obscure origin. Gastrointest.Endosc. 2000; 36:337-41.
- Foutch P.G, Sawyer R, Sanowski R.A.: Push-enteroscopy for diagnosis of patients with gastrointestinal bleeding of obscure origin. Gastrointest.Endosc. 1990; 36:337-41.
- Frager D.H, Baer J.W.: Role of CT in evaluating patients with small bowel obstruction. Seminar ultrasound, CT& MRI. 1995; 16(2):127-40.
- Fraser G.M, Preston P.G.: The small bowel barium follow-through enhanced with oral effervescent agent. Clin.Radiol. 1998:34:673-9.
- Frazer J.E, Robbins R.H.: The factors concerned in causing rotation of the intestine in man. J.Anat. 1998; 50: 75-110.
- Friedman J, and Rigler L.G.: A method of double contrast roentgen examination of the small intestine. Radiology. 1998; 54:365-69.
- Frische L.H, Dotter C.T, Bilbao M.K.: William Cook voucher for Maglinte enteroclysis catheter set. 1996; 1-6.
- Fryx.W.: Radiological diagnosis. Volume 5.4th ed. 1991; 349-60.
- Garrett J.P, Nolan D.J.: Diverticula of the terminal ileum. Clin.Radiol. 1999; 40:178-9.
- Gasparaitis A, Curran J.: Endoscopically assisted catheterization in enteroclysis: A novel approach in combined modality diagnostics. In SGR. Cancun. Mexico, 1997; 10-22.
- Gazelle G.S, Goldberg M.A, Wittenberg J.: Efficacy of CT in distinguishing small bowel obstruction from other causes of small bowel dilatation. Am.J.Roentgenol. 1994; 162: 43-7.
- Gelfand M.D., et al.: Development of eosinophilic crypt abscesses. Gastroenterology. 1998; 51:401-9.

References

- Gershon Cohen J, and Shay H.: Barium enteroclysis: A method for the direct immediate examination of the small intestine by single and double contrast techniques. Am.J.Roentgenol. 1999; 42:456-59.
- Giancarlo Caletti, Paolo Bocus, Enrico Roda.: Needle biopsies of submucosal lesions. Gastroenterology. 2000:15; 256-73.
- Gilbert D, Buelow R, Cluing R.: Status evaluation: Enteroscopy. Gastrointest. Endos. 2001; 37:673-7.
- Glass R.E, and Baker W.N.: Role of the granuloma in recurrent Crohn's disease. Gut. 1996; 17:75-77.
- Gleeson J.A.: Text book of radiology and imaging 7th edition. Volume 2. 2002; 863-891.
- Glenn L, Osias J.D, Robert E, Tapper H.L.: Pseudo-gastroparesis as a presentation of adenocarcinoma of the proximal jejunum. American journal of gastroenterology. 1998: 6:115-19.
- Golden R.: Radiological examination of the small intestine. Philadelphia. 1990; 26-96.
- Gostoul C.J, Schroeder K.W, Burton C.G.C.: Small bowel enteroscopy: An early experience in gastrointestinal bleeding of unknown origin. Gastrointestinal Endoscopy. 1994; 37:5-8.
- Gostout C.J.: Improving the withdrawal phase of sonde enteroscopy with the push-away method. Gastrointest.Endosc. 2000; 39:69-72.
- Gough I.R.: Strangulating adhesive small bowel obstruction with normal radiographs. Br.J.Surg. 1998; 65: 431-4.
- Gourtsoyiannis N.C, Bays D, Malamas M, Barouxis G, Liasis N.: Radiological appearances of small intestinal leiomyomas. Clin.Radiol. 1992; 45:94-103.
- Gourtsoyiannis N.C, Nolan D.J.: Lymphoma of the small intestine: Radiological features. Clin.Radiol. 1998; 39: 639-45.
- Gourtsoyiannis N.C, Bays D.J.: Radiological appearances of small intestinal leiomyomas.Clin.Radiol. 1999; 45:94-103.
- Gray E.G.: Essays on the nervous system. Clarendon Press: Oxford. 1994; 131-154.

- Gregory N. Bender, Maj James H, Tammons I.T, William C, Williard J, and Jon Carter.: Computed tomographic enteroclysis: One methodology. Investigative Radiology. 1996; (31): 1: 43-9.

- Grimes O.F, and Stephens B.H.: Surgical management of acquired short oesophagus. Ann.Surg. 1995; 152:743-48.

- Hamilton W.J.: Early stages of human development. Ann.R.Coil.Surg. 1999; 4: 281-294.

- Hart D, Haggett P., Boardman P, Nolan D, Wall B.: Patient radiation doses from enteroclysis examinations. Br.J.Radiol. 1994; 67:997-1000.

- Haworth J.F, Handson H.L, Shay H.: Small intestinal pattern in normal children and celiac diseases. Br.J.Radiol. 1970; 24:321-330.

- Heinz Werner Umschaden, Dieter Szolar, Johann Gasser, Manfred Umschaden, and Helge Haselbach.: Comparison of MR enteroclysis images with conventional enteroclysis and surgical findings. Gastroenterology. 1998; 114 (6):1349-50.

- Heringer H, Maglinte D.T.: Clinical radiology of the small intestine. Philadelphia. Saunders. 1990:85-105.

- Herlinger H, Gore R.M, Levine M.S, Laufer.: Barium examinations. Text book of gastrointestinal radiology. Philadelphia. Saunders. 1994; 766-88.

- Herlinger H, Rubesin S.E, Gore R.M, Levine M.S, and Laufer.: Text book of gastrointestinal radiology. Philadelphia. W.B Saunders. 1993; 931-66.

- Herlinger H.A.: Modified technique for the double contrast small bowel enema. Gastrointest.Radiol. 1998; 3: 201-7.

- Herlinger H.: Double contrast examination of the small bowel. Gastrointest. Radiol. 1999:3:115-20.

- Herlinger H, Levine M.S.: Barium examinations of the small bowel. Textbook of gastrointestinal radiology. 2nd ed. Philadelphia. W.B Saunders. 2000; 704-25.

- Herlinger H.: Small bowel. In Laufer I editor: Double contrast gastrointestinal radiology with endoscopic correlation. Philadelphia. W.B. Saunders Co. 1999; 95-99.

- Herlinger H, Wrught G.P, Ryle J.A.: The small bowel enema and the diagnosis of Crohn's disease. Rad.Clinics of North Amirica. Symposium of radiology of the alimentary tract. 1990; 20(4):110-15.

- Herlinger H, Maglinte D.O.T.: Jejunal fold separation in adult celiac disease: Relevance of enteroclysis. Radiology. 1986; 158:605-11.
- Herringer D.O, Lappas J.C, Miller R.E, Burney B.T.: The biphasic enteroclysis. App.Radiol. 1994; 14:39-44.
- Higa E.: Mucosal hyperplasia, mucinous cystadenoma and mucinous cystadenocarcinoma of the appendix; a re-evaluation of appendicular mucocele. Cancer. 1998; 32:1525-29.
- Hollinshead W.H.: Anatomy for surgeons. Harper & Row. New York. 1997; 115-125.
- Holmes R.L.: Progress in anatomy. Cambridge University. Cambridge. 1995; 1:123-39.
- Horn R.C, Hery J.r.: Carcinoid tumours of the colon and rectum. Cancer. 1996; 2:819-23.
- Hoskins L.C.: Functional and morphologic alterations of the gastrointestinal tract in progressive systemic sclerosis. Am.J.Med. 1998; 33:459-62.
- Hutchinson M.C.E.: Handbook of physiology. Alimentary canal. American Physiological Society. Washington, DC. 1998; 2(6):705-42.
- Jeff M.A, Barter S.J, Hemingway A.P.: Detection of surgical lesions of the small bowel by enteroclysis. Am.J.Surg. 1996; 147:225-9.
- Jeffree M.A, Barter S.J, Hemingway A.P, Nolan D.J.: Primary carcinoid tumours of the ileum: The radiological appearances. Clin.Radiol. 1994; 35:451-55.
- Jit I, Mukerjee R.N.: Observations on the anatomy of the human. J.Anat.Soc. 1994; 9: 55-82.
- Johan Sellink J.L.: Radiological examination of the small intestine. Act.Radiol. Diagn. 1974; 15:318-32.
- John M, Kissane, Anderson W.A.D.: Anderson's Pathology. 2000; 26:1055-100.
- Johns T.N, Wheeler J.R, and Johns F.S.: Meckel's diverticulum and Meckel's disease: A study of 154 cases. Ann.Surg. 1995; 150:241-45.
- Johnstone J.M, and Morson B.C.: Eosinophilic gastroenteritis. Histopathology. 1998; 2:335-45.

References

- Joseph J.I, and Lattes R.: Gastric lymphosarcoma. Clinico-pathologic analysis of 71 cases and its relation to disseminated lymphosarcoma. Am.J.Clin. Pathol. 1996; 45:653-58.
- Kav S.: Tumours of the Gut. Cancer. 1999; 4:726-32.
- Kay V.J, Nolan D.J.: The small bowel enema in the patient with an ileostomy. Clin.Radiol. 1998; 39:418-22.
- Kean B.H, Cilmore H.R, and Van Stone W.W.: Fatal amebiasis: Report of 148 fatal cases from the Armed Forces Institute of Pathology. Ann.Intern.Med. 1996; 44:831-35.
- Keith Sir A.: Human embryology and morphology. 6th edition. Arnold: London. 1998; 55-66.
- Kellett M.J, Zboralske F.F, Margulis A.R.: Per-oral pneumocolon examination of ileo-ceacal region. Gastroint.Radiol. 1997; 1: 361-5.
- Kelvin F.M, Herlinger H.: Crohn's disease. Clinical imaging of the small intestine. New York: Springer Verlag. 1999; 259-89.
- Kelvin P.M, Gedgaudas R.K, Thompson W.M, Rice R.P.: Enteroclysis catheters, intubation, and infusion. In: Clinical radiology of the small intestine. Philadelphia: Saunders. 1998; 85-105.
- Kern F.J.R.: Hepato-biliary disorders in inflammatory bowel disease. Prog. Liver Dis. 1996; 5:575-79.
- Kevtmg W.S, et al.: Pneumatosis intestinalis; a new concept. Radiology. 1997; 76:733-35.
- Khojasteh A, Haghshenass M, Haghighi P.: Immuno-proliferative small intestinal disease. New England J.Med. 1993; 308: 1401-5.
- Kiesewetter W.B, Turner C.R, and Sieber W.K.: Imperforate anus: review of a sixteen year experience with 146 patients. Am.J.Surg. 1994; 107:412-16.
- King B.T.: New concepts of aetiology and treatment of diverticulae of oesophagus.Gynacol.Obstet. 1997; 85:93-99.
- Kissane J.M, Anderson W.A.D.: Anderson's Pathology. Eighth edition. 1996; 2: 1055-89.
- Kissane P.G, Alasdair D.T, Calk Lander R.B.: Pathology illustrated. Seventh edition. Churchill Livingstone. 1996; 410-90.

References

- Klaus F.R, Schiller, Richard H.Hunt.: Atlas of gastrointestinal endoscopy and related pathology. Second edition. Churchill Livingstone. 2002; 453-7.
- Kobayashi S, and Nishiaawa M.: X-ray examination of small intestine: double contrast method by duodenal intubation. Stomach.Incest. 2001; 11:157-59.
- Kochhar R, Gupta S.K, Malik A.K.: Endoscopic fine needle aspiration biopsy. Acta. Cytol. 2000; 31:481-4.
- Kumar P, Bartram C.I.: Relevance of the barium follow-through examination in the diagnosis of adult celiac disease. Gastroint.Radiol. 1999; 4:285-9.
- Lappas J.C, Maglinte D.D.T.: Advances in enteroclysis. In: Margulis AR, editors. Modern imaging of the alimentary tube. Berlin. Springer. 1997; 129-42.
- Lappas John C.: Imaging of the post-surgical small bowel. Radiologic.Clinics of North America. 2003; 41 (2):110-115.
- Laura R, Carucci, Marc S Levine.: Radiographic imaging of inflammatory bowel disease. Gastroenterology Clinics. 2002; 31(1):99-115.
- Laurance J., Rubbins M.B, Golden R.: Golden`s diagnostic radiology: digestive tract. 1990; 5:110-15.
- Levi S, De Lacy G, Price A.B, Gumpel M.J, Levi A.J, Bjamson I.: 'Diaphragm-like' strictures of the small bowel in patients treated with non-steroidal anti-inflammatory drugs. Br.J.Radiol. 1990; 63: 186-9.
- Levine Marc S., Stephen E, Rubesin, Igor Laufer, Hans Herlinger.: Barium studies. Gastrointestinal Endoscopy. 2002; 55(7):55-9.
- Lewis B, Waye J.: Small bowel enteroscopy. Pros and Cons. A.J.Gastroenterol. 2000; 83:799--802.
- Lewis B.S, Waye J.D.: Chronic gastrointestinal bleeding of obscure origin: role of small bowel enteroscopy. Gastroenterology. 1998; 94:1117-20.
- Limber Gazelle G.S, Goldberg M.A, Wittenberg J.: The small intestine. Gastrointestinal.endoscop. 1998; 43:580-3.
- Lopez M.J, Cooley J.S, Petros J.G, et al.: Complete intra-operative small-bowel endoscopy in the evaluation of occult gastrointestinal bleeding using the sonde enteroscope. Arch.Surg. 2001; 131:272-7.
- Lough.: Wolman's disease: electron microscopic, histochemical, and biochemical studies. Arch. Pathol. 1998; 89:103-10.

- Maglinte D.D.T, Peterson L.A, Vahey T.N, Miller R.E, Chemish S.M.: Enteroclysis in partial small bowel obstruction. Am.J.Surg. 1994; 147: 325-9.
- Maglinte D.D.T, Herlinger H.: Malabsorption. In: Clinical radiology of the small bowel. Philadelphia, PA: W.B. Saunders. 1994; 479-509.
- Maglinte D.D.T, Herlinger H, Turner W.W.: Radiological management of small bowel obstruction: A practical approach. Emerg.Radiol. 1994; 1:138-49.
- Maglinte D.D.T, Herlinger H.: Small bowel radiography: An overview. Dig.Dis. Set. 1999; 29:1057-9.
- Maglinte D.D.T, Kelvin F.M, O'Connor K.: Current status of small bowel radiography. Abdom.Imaging. 1996; 21:247-57.
- Maglinte D.D.T, Nolan D, Herlinger H.: Pre-operative diagnosis by enteroclysis of unsuspected closed loop obstruction in medically managed patients. J.Clin. Gastroenterol. 1997; 13:308-12.
- Maglinte D.D.T, Peterson L.A, Uahey T.N.: Enteroclysis in partial small bowel obstruction. Am.J.Surg. 1995; 147:325-9.
- Maglinte D.D.T, Reyes B.L, Harmon B.H.: Reliability and the role of plain film radiography and CT in the diagnosis of small-bowel obstruction. AJR. 1996; 167:1451-5.
- Maglinte D.D.T, Lappas J.C, Kelvin F.M, Rex D, Chemish S.M.: Small bowel radiography: how, when, and why?. Radiology. 1999, 163:297-305.
- Maglinte D.D.T, Elmore M.F, Chemisn S.M.: Enteroclysis in the diagnosis of chronic unexplained gastrointestinal bleeding. Medicine. 1985; 28; 403-5.
- Marc S, Levine, Stephen E, Rubesin, Igor Laufer, Hans Herlinger.: Barium studies. Gastrointestinal Endoscopy. 2002; 55(7):55-59.
- Marchand P.: The anatomy of oesophageal hiatus of the diaphragm and the pathogenesis of hiatus herniation. J.Thorac.Surg. 1996; 37:81-89.
- Margulis A.R, Burthenne H.J.: Alimentary Tract Radiology. Third edition. Mosby Company. London. 1983; 1: 853-1029.
- Marshak R.H, Lindner A.E, Maklansky D.: Ischaemia of the small intestine. Am.J.Gastroenterol. 1996; 66: 390-400.
- Marshak R.H, Linder A.E, and Maklansky D.: Lymphoreticular disorders of the gastrointestinal tract: reontogenographic features. Gastrointest.Radiol. 1979; 4:103-9.

References

- Marston A.: Basic structure and function of the intestinal circulation. Clin. Gastroenterol. 1995; 1:539-49.
- Martin E.I, and Potet F.: Pathology of endocrine tumours of the GI tract. Clin. Gastroenterol. 1994; 3:511-18.
- Martinez N.S., et al.: Heterotopic pancreatic tissue involving the stomach. Ann. Surg. 1998; 147:1-9.
- Mason G.R, Dietrich P, Friedland G.W, Hanks G.E.: The radiological findings in radiation-induced enteritis and colitis. A review of 30 cases. Clin.Radiol. 1990; 21:232-47.
- Mayo C.W, Stalker L.K, and Miller J.M.: Intra-abdominal hernia: review of 39 cases in which treatment was surgicy. Ann. Surg. 1997; 114:875-85.
- Meyers M.A, Morson B.C, Gourley W.K.: Intra-peritoneal spread of malignancies and its effect on disease prognosis. Am.J.Surg. 1991; 140: 325-9.
- Michael V, Sivak, Donna A, Schleutermann M.S.: Gastrointestinal Endoscopy. Second edition. Mosby Company. London. 2000; 256-735.
- Miller L.G, Jankovic J.: Metoclopramide induced movement disorders: clinical findings with a review of the literature. Arch.Intern.Med. 2000; 149:2486-92.
- Miller R.E, Miller W.J.: Small bowel obstruction. The complete reflux small bowel examination. Am.J.Surg. 1999; 109: 572-7.
- Miller R.E, Sellink L.: Enteroclysis: the small bowel enema. How to succeed and how to fail. Gastrointest.Radiol. 2000; 4: 269-83.
- Mitchell A.W.M, Spencer J, Allison D.J, Jackson J.E.: Meckel's diverticulum: angiographic findings in 16 patients. Am.J.Roentgen. 1996; 170:1329-33.
- Mitchell D.N, Rees R.J.W, and Goswami K.K.A.: Transmissible agents from human sarcoid and Crohn's disease tissue. Lancet. 1996; 2:761-77.
- Moch A, Herlinger H, Kochman M.L, Levine M.S, Rubesin S.E, Laufer I.: Enteroclysis in the evaluation of obscure gastrointestinal bleeding. AJR. 1994; 163:1381-4.
- Moffat R.E, Gourley W.K.: Ileal lymphatic metastases from caecal carcinoma. Radiology. 1980; 135: 55-8.
- Morson B.C, Dawson M.P, Day D.W, Jass J.R, Price A.B, Williams G.T.: Morson and Dawson's gastrointestinal pathology, 3 rd ed. Blackwell scientific. Oxford. 1990;1115-25.

- Moses H.L, and Cheatham W.J.: The frequency and significance of human herpetic esophagitis: an autopsy study. Lab. Invest. 1996; 12:663-73.
- Muller W.F.H.: Enteroclysis in celiac disease. Radiol.Clin. 1996; 45: 140-54.
- Murray Lyon I.M, Rake M.0, Marshall A.K, Williams R.: Malignant carcinoid tumour with gangrene of the small intestine. Br.Med.J. 1993; 4:770-1.
- Muto T, Bussey H.J.R, and Morson B.C.: Pseudocarcinomatosus invasion in adenomatous polyps of the colon and rectum. J.Clin. Pathol. 1998; 26:25-29.
- Navaratnam V.: Progress in Anatomy. Cambridge university press: Cambridge. 1995; 2: 138-160.
- Nesbit R.R.: Carcinoma of the small bowel: a complication of regional enteritis. Cancer. 1996; 37:2948-59.
- Nolan D.J.: The small intestine. Techniques in diagnostic radiology, 3rd ed. Whitehouse G.W. Worthington B.S. Blackwell Scientific, Oxford. 1996; 34-9.
- Nolan D.J.: Grainger & Allison's Diagnostic radiology. A text book of medical imaging. Fifth edition. 2001; 985-1008.
- Nolan D.J.: Tuberculosis of the small intestine: a comparative study of the radiological and pathological appearances. Clin.Radiol. 2003; 31:591-6.
- Norberg P.B.: Food as a cause of intestinal obstruction. Am.J.Surg. 1996; 104:444-49.
- Norris H.T.: Ischemic bowel disease: its spectrum. International Academy of Pathology. The gastrointestinal tract. Baltimore. The Williams & Wilkins Co. 1997; 11-25.
- Ochsner A, and Gage I.M.: A dynamic ileus. Am.J.Surg. 1996; 20:378-88.
- Ott D.J, Chen Y.M, Gelfand D.W, Van Swearingen F, Munitz H.A.: Detailed per oral small bowel examination vs. enteroclysis. Part I: Expenditures and radiation exposure. Radiology. 1985; 155:29-31.
- Ott D.J, Gelfand D.W, Ramquist N.A.: Causes of error in gastrointestinal radiology. II. Barium enema examination. Gastrointest.Radiol. 1997; 5:99-105.
- Oudkerk M.: Infusion rate in enteroclysis examination. Thesis, Leiden, Netherlands, Leiden University. 1998; 45-55.
- Painter M.S, and Burkitt D.P.: Diverticular disease of the colon: a 20th century problem. Clin. Gastroenterol. 1995; 4:3-11.

References

- Parker H, Agayoff J.: Enteroscopy and small bowel biopsy utilizing a per oral colonoscopy. Gastrointest. 2001; 29:139-40.
- Perkins D.E, and Spjut H.J.: Intestinal stenosis following radiation therapy. Am. J. Roentgenol. 1996; 88:953-59.
- Pesquera G.:A method for direct visualization of lesions in the small intestine. Am.J.Rad.Therapy. 1999; 22:254-7.
- Pirbram K.M, Kleiber F.S.: Enteroclysis: the small bowel enema. Gastrointest. Radiol. 1937; 4:269-75.
- Pomerantz M, and Waldmann T.A.: Systemic lymphatic abnormalities associated with gastrointestinal protein loss secondary to intestinal lymphangiectasia. Gastroenterology. 1997; 45:703-10.
- Price A.B, and Davies D.R.: Pseudo-membranous colitis. J.Clin.Pathol. 1997; 30:1-9.
- Putman H.C, Dockerty M.B, and Waugh J.M.: Abdominal actinomycosis: analysis of 122 cases. Surgery. 1995; 28:781-8.
- Pygott F, Stront D.P, Schollshncr M.F, Rhodes C.J.: Radiological investigation of the small intestine by small bowel enema technique. Gut. 1990; 12:306-10.
- Qizilbash A.H, Meghji M, and Castelli M.: Pseudocarcinomatous invasion in adenomas of the colon and rectum. Dis.Colon.Rectum. 1999; 23:529-39.
- Reeder M.M, Hamilton L.C.: Radiological diagnosis of tropical diseases of the gastrointestinal tract. Baltimore. The Williams & Wilkins Co. 1989; 7: 57-81.
- Rex D.K, Lappas J.C, Maglite D.T.: Enteroclysis in the evaluation of suspected small intestinal bleeding. Invest.Gastroenterology. 97:58-60, 1999
- Rock J, Hertig A.T.: Some aspects of early human development. Am.J.Obstet. Gynecol. 1998; 44: 973-83.
- Rohrmann C.A.Jr, Ricci M.T, Krishnamurthy S, Schuffler K.D.: Radiological and histological differentiation of neuromuscular disorders of the gastrointestinal tract: visceral myopathies, visceral neuropathies, and progressive systemic sclerosis. Am.J.Roentgen. 1984; 143: 933-41.
- Ronald Grainger, David Allison, Albert Bart and James Potchen.: Grainger & Allison's diagnostic radiology. A text book of medical imaging. Fifth edition. 2001; 985-1008.

References

- Roy cockle, Brayn F. Warren: Atlas of gastro-intestinal endoscopy and related pathology. Second edition.2002; 453-7.
- Royal H.D.: Technology assessment: scientific challenges. AJR. 1994; 163:503-7.
- Rubes Stephen.E.: Simplified approach to differential diagnosis of small bowel abnormalities. Radiological clinics of North America. 2003; 41(2): 42-57.
- Rubesin S.E, Herlinger H.: The small bowel differential diagnosis. Text book of gastrointestinal radiology. Philadelphia: W.B Saunders. 2003; 884-905.
- Rubin H.: The course and prognosis of histoplasmosis. Am.J.Med. 1997; 27:278-88.
- Ruedi F, Thoeni J.h, Robert G, Gould D.: Enteroclysis and small bowel series: Comparison of radiation dose and examination time. Radiology. 1991; 178:659-62.
- Russell J.G.: Radiology in the diagnosis of foetal abnormalities. Br.J.Obstet. Gynaecol. 1999; 76: 345-50.
- Rusznyak I, Foldi M, Szabo G.: Lymphatic and lymph circulation physiology and pathology. Pergamon Press. Oxford. 1999; 95-115.
- Sanders D.E, and Hoc S.: The small bowel enema: experience with 150 examinations. Am.J.Roentgen. 1999; 127: 743-44.
- Savery Muttu S.H, Peters A.M, Hodgson H.J, Chadwick V.S, Lavender J.P.: Indium leukocyte scanning in small bowel Crohn's disease. Gastroint.Radiol. 1993; 8: 157-161.
- Schatzki R.: Small intestinal enema. Rad.Therapy. 1943; 50:743-51.
- Schoefl G.T.: The migration of lymphocytes across the vascular endothelium in lymphoid tissue. A re-examination. J.Exp.Med. 1998; 136: 568-88.
- Schreiber D.S, Trier J.S, and Blacklow N.R.: Recent advances in viral gastroenteritis. Gastroenterology. 1997; 73:174-77.
- Schulman A, Morton P.C.G, Dietrich B.E.: Eosinophilic gastro-enteritis. Clin. Radiol. 1990; 31: 101-4.
- Scot H.W.G, Hamilton H.A.R, McCall Smith S.: Radiological investigation of the small intestine. Gut. 1994; 2:316-22.

References

- Seagram C.G. F.: Meckel's diverticulum: a 10-year review of 218 cases. Can. J. Surg. 1998; 11:369-74.
- Seliger G, Krassner R.L, Beranbaum E.R, Miller F.: The spectrum of roentgen appearance in amyloidosis of the small and large bowel: radiological & pathological correlation. Radiology. 1981; 100: 63-70.
- Sellink J.L.: Examination of the small intestine by means of duodenal intubation. London: Stenberg Kruse. 1998; 86-138.
- Sellink J.L: Radiology of the small intestine. Acta.Radiol. 1994; 15:318-31.
- Shrake P.D, Rex D.K, Lappas J.C. Radiographic evaluation of suspected small bowel obstruction. Am.J.Gastroenterol. 1996; 86:175-8.
- Sicracki J.C, and Fine G.: Whipple's disease observations on systemic involvement. II. Gross and histological observations. Arch. Pathol. 1999; 67:81-8.
- Smith C.R, Bartholomew L.G, and Cain J.C.: Hereditary hemorrhagic telangiectasia and gastrointestinal haemorrhage. Gastroenterology. 1996; 44:1-9.
- Soybel D.I, Greenfield L.J.: Ileus and bowel obstruction. Surgery scientific principles and practice. Philadelphia: Lippincott Williams and Wilkins. 2001; 798-812.
- Spraycar Stedman's M.: Medical dictionary. 26th ed. Baltimore. Williams & Wilkins. 1995.
- Sundier F.: Nerves in the gastro-intestinal tract. Neuroscience. 1998; 3: 419-25.
- Tada M, Akasaka Y, Misaki F.: Clinical evaluation of a sonde-type small intestinal fiberscope. Endoscopy. 2000; 9:33-8.
- Tagart R.E.B.: Endometriosis of the large intestine. Br. J. Surg. 1999; 47:27-35.
- Tandler J.: Keibel and Mall's manual of embryology. Lippincott: Philadelphia. 1998; 2:815-25.
- Thoeni R.F, Hart D, Wall B.F. Radiography of the small bowel and enteroclysis: a perspective. Invest.Radiol. 1991; 22: 930-6.
- Thoeni R.F, Gould R.G.: Enteroclysis and small bowel series: comparison of radiation dose and examination time. Radiology. 1991; 178:659-62.

References

- Thoeni R.F, Gould R.G. Enteroclysis and small bowel series: Rapid duodenal and jejunal intubation. Clin.Radiol. 1996; 30:183-5.
- Thompson H.: Vascular pathology of the splanchnic circulation. Clin. Gastroenterol. 1995; 1:597-604.
- Thompson H.L, and McCuffin D.W.: Melena: study of underlying causes, J.A.M.A. 1999; 141:1208-18.
- Torma M.J.: Necrotizing enterocolitis in infants: analysis of forty-five consecutive cases. Am. J. Surg. 1997; 126:758-62.
- Townsend Sabiston J.r: Sabiston textbook of surgery. Intestinal obstruction. 16th Ed. W. B. Saunders company. 2001; 1150-66.
- Treves Sir.F.: Lectures on the anatomy of the intestinal canal and peritoneum in man. Br.Med.J. 1995; 1: 415-70.
- Trier J.S, Belli A.M, Hemingway A.P.: Celiac sprue and refractory sprue. Gastroenterology. 1998; 75:307-17.
- Truelofe S.C.: The changing face of Cohn's disease. Crohn's workshop; a global assessment of Crohn's disease. London. 1994; 3-8.
- Underbill B.M.L.: Intestinal length in man. Br.Med.J. 1995; 2: 1243-6.
- Vaidya M.G, Sodhi J.S.: Gastrointestinal tract tuberculosis: a study of 102 cases including 55 hemicolectomies. Clin.Radiol. 1998; 29: 189-95.
- Valdes-Dapena A.: Adenocarcinoma of the small bowel in association with regional enteritis: four new cases. Cancer. 1996; 37:2938-46.
- Vallance R.: An evaluation of the small bowel enema based on an analysis of 350 consecutive examinations. Clin.Radiol. 1991; 31:227-32.
- Van Wiechen P.J.: Radiological changes in the distal part of the ileum in association with Yersinia enterocolitica infections. Radiol.Clin. 1994; 43: 242-53.
- Vincent H.S.: Double contrast gastrointestinal radiology. AJR. 2000; 175:1594-99.
- Wachington J.L. Fields and gradients. Locke M (Ed) Major problems in developmental biology. Academic Press. New York. 1996; 105-24.
- Waddington C.H.: Principles of embryology. Alien & Unwin: London - Waddington D.C. New patterns in genetics and development. Columbia University Press. New York. 1996; 190-215.

References

- Waldmann T.A.: The role of the gastrointestinal system in idiopathic hypoproteinemia. Gastroenterology. 1998; 41:197-211.
- Weedon D.D, et al.: Crohn's disease and cancer. N.Engl.J.Med. 1995; 289:1099-112.
- Weinstein W.M.: Collagenous sprue-an unrecognized type of malabsorption. N. Engl. J. Med. 1998; 283:1297-99.
- Weir J, Abraham P.H, Belli A.M, Hemingway A.P.: An imaging atlas of human anatomy. Mosby. Wolf. 1996; 109-141.
- Wells J.: Radiological pattern of the small intestine in infants and children. Radiology. 1990; 40:277-8.
- Wendell Smith C.P, Williams P.L, Treadgold S.: Basic human embryology. 3rd edition. Urban and Schwarzenberg. Baltimore. 1994; 512-30.
- William P.L, Roger W, Mary D.: Gary's anatomy of the human body. Twentieth ed. Churchill Livingstone. Philadelphia. New York. 2000; 1400-548.
- Williams E.D, and Sandier M.: The classification of carcinoid tumours. Lancet. 1997; 1:238-42.
- Willis Jeff R, Hitesh R, Chokshi, Gary R, Zuckerman D.O, Giuseppe Aliperti. Enteroscopy enteroclysis: experience with a combined endoscopic radiographic Technique. Gastrointestinal endoscopy. 1997; 45 (2):46-59.
- Willis Jeff R., Hitesh R, Chokshi, Gary R, Zuckerman D.O.: Metastatic spread to gastrointestinal tract. Gastroenterology Clinics. 1993; 31 (3):63-70.
- Willis S.J, Lobis I.F, Denstman F.J.: Cohn's disease: state of the art. Radiology. 1997; 202: 597-610.
- Wittich Gerhard R.: Diagnostic imaging procedures in gastroenterology. Chapter 121.Goldman: Cecil textbook of medicine, 21st ed. W. B. Saunders Company. 2000; 1230-9.
- Wonnsley K.G.: Scientific basis of gastroenterology. Churchill Livingstone. Edinburgh. 1994; 199-248.
- World Health Organization generic disorders: Prevention, treatment, and rehabilitation. (WHO Technical Report Series 497). World Health Organization: Geneva. 1992.
- Zeeman E.C.: Primary and secondary waves in developmental biology. Lectures on mathematics in the life sciences. Am.Math.Soc. 1994; 7: 69-101.

الملخص العربي

أشتمل البحث على دراسة نتائج التصوير الإشعاعي باستخدام قسطرة الأمعاء الدقيقة في خمسين حالة مصابة بمختلف أمراض الأمعاء الدقيقة بهدف استنباط المميزات الخاصة بهذا الفحص فى إبراز الخصائص المختلفة لهذه الأمراض ودقة النتائج التشخيصية المترتبة على استخدامه.

وقد وقع الاختيار على الحالات المكونة لهذه الدراسة لأحتمال أصابتهم بأمراض الأمعاء الدقيقة بناءاً على نوع الشكوى والأعراض المرضية وما تم إجراؤه من فحوصات أخرى مختلفة.

وكذلك تضمن البحث مجموعة قليلة من المرضى المصابين بأمراض من المعروف عنها أصابتها للأمعاء الدقيقة بصورة أو بأخرى.

وقد تم مراجعة نتائج هذا البحث مع الدلالات الإكلينيكية والمعملية للمرضى ونتائج المناظير المختلفة للجهاز الهضمي ومضاهاتها بما سبق نشره من أبحاث مختلفة في هذا المجال وكذلك التشخيص النهائي المثبت بتحليل ما تم أخذه من عينات سواء عن طريق المنظار أو بعد التدخل الجراحي.

وقد أثبت هذا البحث أهمية الدور التشخيصى للأشعة مستخدماً قسطرة الأمعاء الدقيقة في تقييم أمراضها المختلفة نظراً لما تتمتع به من حساسية مفرطة في الاكتشاف المبكر لمثل تلك الأمراض مرتكزة على قدرتها الفريدة في تخطى الدور التنظيمي للمعدة وبوابتها والقدرة المتفردة على دراسة أدق التفاصيل المعوية سواء كانت خصائص شكلية أو وظيفية واضعين في الأعتبار الاحتياج إلى تقنية تشخيصية ذات قدرة تنبؤيه سلبية عالية وبالرغم مما سبق فإن استخدام قسطرة الأمعاء الدقيقة في تقيم أمراضها لا تعتبر هي الطريقة الأكثر تداولاً لما لها من سلبيات وما تحتويه من صعوبات مختلفة سواء كانت تقنية أو من حيث ازدياد الجرعة الإشعاعية التى يتعرض لها المريض مما قلل من قبولها وانتشار استعمالها أخذين في الأعتبار وجود عدة عوامل تحكم اختيار الفحص المناسب كعمر المريض، وقدرته على تقبل مثل هذه التقنية وكذلك التشخيص المبدئي للحالات المرضية ونسبة

الدقة التشخيصية المطلوبة فيما يلى ذلك من فحوصات إشعاعية.

وقد ارتكزت الأبحاث الحديثة على محاولة الجمع بين مميزات هذه التقنية - لما لها من دور كبير في دقة التشخيص وسهولة قياس التغيرات الدقيقة التى قد تحدث في جدار الأمعاء - والفحوصات الأخرى كالأشعة المقطعية والرنين المغناطيسي - لقدرتهما على اكتشاف التغيرات المرضية خارج جدار الأمعاء- مما نتج عنه ظهور تقنيات جديدة تعتبر إجمالاً ذات حساسية فائقة ودقة تشخيصية عالية.

وعليه نتوصل إلى أن الفحص الإشعاعي باستخدام قسطرة الأمعاء الدقيقة على الرغم مما له من سلبيات لهو الطريقة المثلى لتقيم أمراضها كلما زاد الشك الإكلينيكي أو كعامل مساعد لفحوصات إشعاعية أخرى لها قدرة إظهار تأثير مثل هذه الأمراض خارج الجدار المعوي.

دور الأشعة بأستخدام قسطرة الأمعاء الدقيقة في تقييم أمراضها المختلفة

رسالة مقدمة توطئة للحصول على درجة الدكتوراه في الأشعة التشخيصية

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