Role of MRI Enterography in Evaluation of Intestinal Lesions in Adults

Essay
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In Radiodiagnosis

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دور الرنين المغناطيسى على الأمعاء الدقيقة فى تقييم الآفات المعوية فى البالغين

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Summary and Conclusion

Inflammatory bowel disease (IBD) is a group of inflammatory conditions of the bowel. The major types of IBD are crohn's disease (CD) and ulcerative colitis (UC). Both disorders characterized by unpredictable periods of remissions and exacerbations. These disorders need to be distinguished from other conditions that may display similar clinical and laboratory findings, such as infection, allergy, and neoplasm.

For many years, the radiologic modality most commonly used to evaluate the small bowel has been the conventional small bowel follow through. Newer imaging methods including computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound are valuable tools in assessing intestinal wall and extra-luminal involvement.

Barium studies and endoscopy are the basic modalities in diagnosing Crohn’s disease in early stages with endoscopic guided biopsy and histopathological verification, however, the M.D.C.T. has been the cross sectional imaging modality of choice at most institutions due to its widespread availability, low cost and higher spatial and temporal resolutions relative to M.R. imaging, yet it is based on ionizing radiation.

Although CT is widely used in the imaging work-up for Crohn’s disease, it carries a high radiation burden; it is preferable to use a non ionizing modality such as MR imaging for diagnostic and follow-up evaluations.

Because of the increased use of CT, high cumulative radiation doses may be imparted to patients with Crohn disease. A recent study reported that CT accounts for up to 84.7% of the cumulative radiation in patients and that 15.5% of patients with Crohn disease received doses of more than 75 mSv.

Contents

Introduction and Aim of Work

The mesenteric small bowel is a long (variable in length) convoluted tube affected by a host of pathologic conditions that can be difficult and challenging to diagnose***. (Levine et al., 2008)***

Documented rarity complicated further by nonspecific clinical presentation and a small index of clinical suspicion makes the detection of small bowel tumors a challenge for both the physician and the radiologist. A mean delay of up to 3 years, from first symptoms to diagnosis, has been reported for benign tumors and 18 months for malignant neoplasms***. (Gourtsoyiannis .N.C and Bays .D, 2005)***

Non neoplastic small bowel diseases are much more common, yet they include a wide variety of diseases including Crohns disease, TB, acute and chronic ischemia, ulcerative colitis, systemic sclerosis, Whipple disease, Intestinal Lymphangiectasia and Nonsteroidal Anti-inflammatory Drug (NSAID) Enteritis which must be properly diagnosed and differentiated from each other. ***(Gourtsoyiannis .N.C and Nolan .D.J, 2005)***

The practice of gastrointestinal (GI) radiology has changed dramatically in the last two decades. There was a time when the small bowel follow-through was the dominant modality in the investigation of diseases of the small intestine. ***(Maglinte .D.T. and Rubesin .S., 2003)***

The introduction of multislice CT and MRI technology began to further change the way radiologists looked at the hollow viscera. This technology enabled faster acquisition of a larger amount of information and led to better details of the intestines and mesenteries. Reformatting and multiplanar imaging represented a further advance. ***(Maglinte .D.T and Rubesin .S, 2003)***

High soft-tissue contrast resolution, acquisition of multiplanar images, particularly in the coronal plane, and possibility to obtain functional information make MR enterography an interesting imaging technique for the evaluation of the small bowel.***(Laghi. A and Paolantonio .P, 2006)***

Another major advantage of MRI enterography, compared with conventional X-ray barium studies, is direct visualization of small bowel wall. This feature dramatically changes image interpretation process. ***(Laghi . A. and Paolantonio. P., 2006)***

As a result, MRI and MRI enterography have been propelled to the forefront of available imaging techniques for studying the small bowel***. (Lohan et al., 2008)***

The aim of work is to evaluate the role of MRI enterography in the diagnosis of neoplastic and non neoplastic small bowel lesions, detection of complications and follow up in the non pediatric age group.

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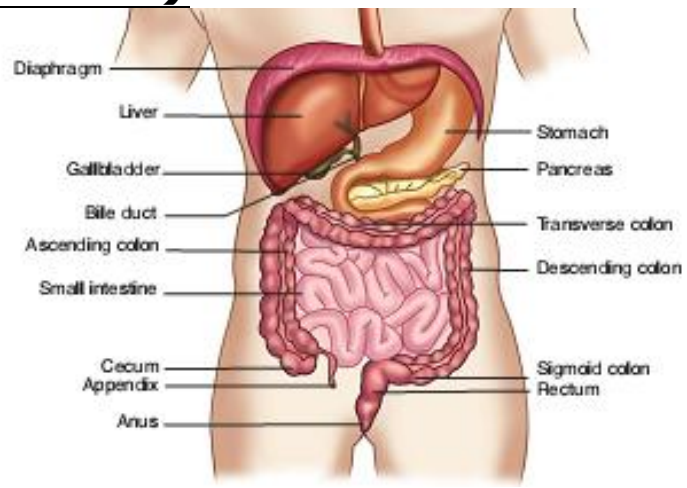
Anatomy of the Small Bowel

Gross anatomy



(Fig1): The gastrointestinal tract. (***Halvorson, 2008)***

The small intestine is that portion of the gastrointestinal tract (GIT) between the pyloric sphincter of the stomach and the ileocecal valve that opens into the large intestine. The length of the small intestine varies from 10-33 feet (3–10 meters). The average length is considered to be approximately 22 feet (6.5 meters) *(Gourevitc, 2006).*

The mesentery of the small intestine has a 6 inch (15 cm) origin from the posterior abdominal wall and commences at the duodeno-jejunal junction, just to the left of the second lumbar vertebra. The mesentery contains the superior mesenteric vessels along with lymphatics and lymph nodes which drain the small bowel. There are number of autonomic nerve fibers within the mesentery *(Horton et al, 2005).*

The small bowel is divided into three sections. The first section is the duodenum, which extends from the pylorus to the duodeno-jejunal flexure; this point is marked by the ligament of Treitz. *(Borley, 2005).*

The duodenum is the shortest (25 cm.), 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, so that its termination is not far removed from its starting-point ***(Gray, 2008).***

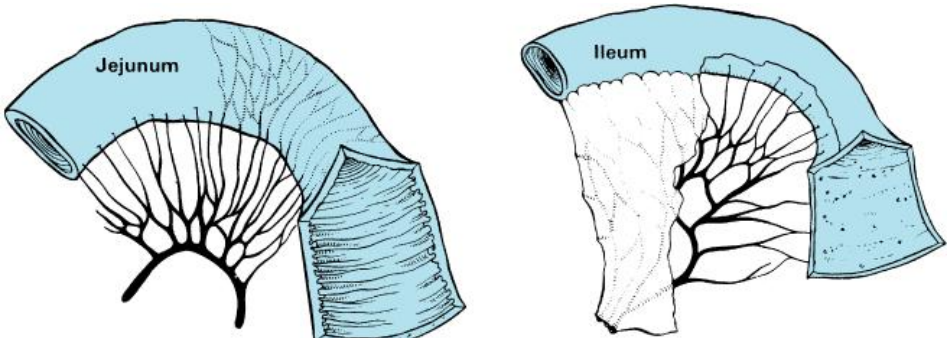
The duodenum is divided into four portions: superior, descending, horizontal, and ascending. The superior portion (first portion) is about 5 cm. long. Beginning at the pylorus, it ends at the neck of the gall bladder. The descending portion (second portion) is from 7 to 10 cm. long, and extends from the neck of the gall-bladder, on a level with the first lumbar vertebra, along the right side of the vertebral column as low as the upper border of the body of the fourth lumbar vertebra. The horizontal portion (third or transverse portion) is from 5 to 7.5 cm long and begins at the right side of the upper border of the fourth lumbar vertebra and ends in the ascending portion in front of the abdominal aorta. It is crossed by the superior mesenteric vessels and the mesentery. The ascending portion (fourth portion) of the duodenum is about 2.5 cm long. It ascends on the left side of the aorta; it turns abruptly forward to become the jejunum, forming the duodenojejunal flexure. It lies in front of the left Psoas major and left renal vessels (Gray, 2008).

Although there are distinctive features to each of jejunum and ileum (**Table 1**), there is a gradual transition from one to the other (*Robbins and Virjee, 2006*).

	Jejunum	Ileum
Diameter	Wider(3-3.5Cm)	Narrower(2.5Cm)
Wall thickness	Thicker	Thinner
Position	Left upper abdomen	Right lower abdomen
Valvulae connivents	Thicker&more prominent	Thinner&less prominent
Payer's patches	Fewer&bigger	More numerous
Arterial arcades	1-2 with few long braches	4-5 with many short branches

(Table 1): The morphological difference between jejunum and ileum (Ryan et al., 2004).

Small bowel is specialized for both digestion and absorption. It is formed of mucosa, submucosa, muscularis muscosa and serosa (adventitia in retroperitoneal parts). The wall should not measure more than 1-2mm thick when distended. Normal un-distended small bowel shows a feathery pattern due to circular mucosal folds known as *vulvulae conivents or plica cicularis*, although this may be absent in the distal ileum **(**Martini, 2006)



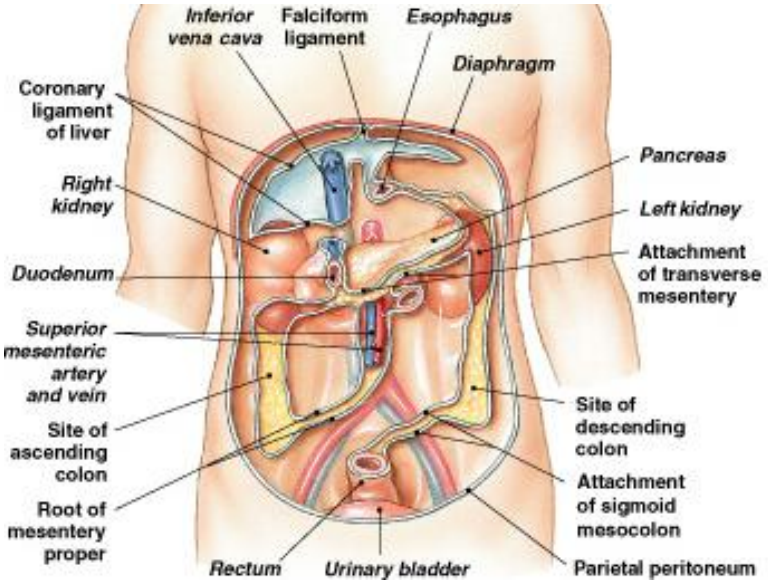
(Fig 2): Gross features of jejunum contrasted with those of ileum. Relative to the ileum, the jejunum has a larger diameter, a thicker wall, more prominent plicae circulares, a less fatty mesentery, and longer vasa recta ***(Charles et al., 2005)***

The mesentery

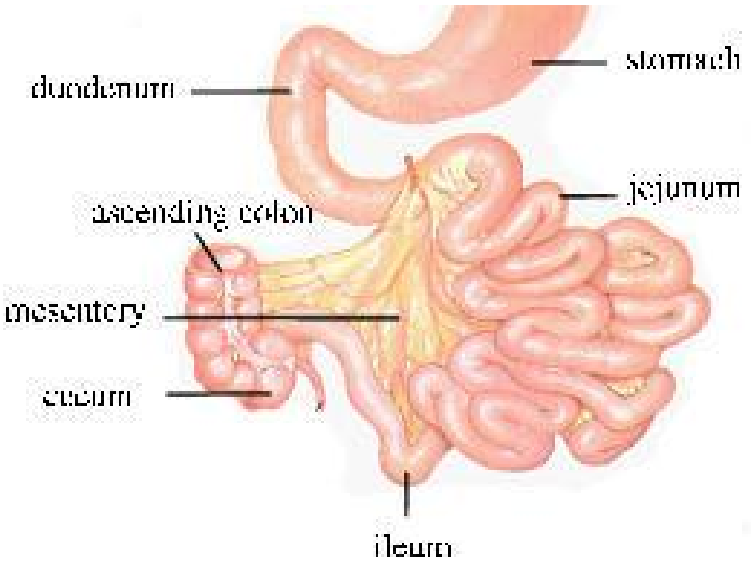
The mesentery suspends the jejunum and ileum from the posterior abdominal wall. It is composed of fatty extra-peritoneal connective tissue, blood vessels, nerves, lymphatics and an investment of peritoneum that reflects from the posterior parietal peritoneum. Features associated with the fan-shaped dimensions of the mesentery make it a unique suspensory ligament and contribute to the characteristic nature of the small bowel loops. The attached border, *the root of the mesentery*, extends from the point of termination of the duodenum, at the lower border of pancreas on the left side of second lumber vertebra, to the cecum in the right iliac fossa near the right sacro-iliac joint and measuring about 6-7 inches (about 15cm)(*Gourevitc, 2006)*.

Contents of the mesentery:

The mesentery contains coils of small bowel, superior mesenteric artery and its branches (lie in the root of the mesentery, superior mesenteric vein and its tributaries, sympathetic plexuses, mesenteric lymph nodes and extra-peritoneal fat *(Gourevitc, 2006)*



(Fig 3): Posterior abdominal wall showing peritoneal attachment of mesentery *(Van De Graaff, 2001).*



(Fig 4)*:* Mesentery of the small bowel (*Okino et al, 2001)*

The vascular supply and lymphatic drainage*:*

Arterial supply:

The small intestine develops from the midgut and this extends from the mid-duodenum to the distal transverse colon and is supplied by the **superior mesenteric artery (SMA)**, which arises from the aorta at the level of L1. The branches of superior mesenteric artery include, inferior pancreaticoduodenal artery, which supplies the pancreas and duodenum, jejunal and ileal branches of the SMA; these branches link with one another in a series of arcades, which are single in the jejunum but increased in number, up to five in the distal ileum. The arteries that enter the intestinal wall are end arteries and named **vasa recta**. The terminal part of the ileum is supplied by branches from **ileocolic artery** *(Ryan et al., 2004)*

Venous drainage

The veins of the jejunum and ileum follow the arterial supply and drain into the **superior mesenteric vein**. The superior mesenteric vein joins the splenic vein behind the neck of the pancreas to form the portal vein *(Robbins and Virjee, 2006).*

The never supply:

Small bowel is innervated from the vagi and thoracic splanchnic nerves through the celiac ganglia and superior mesenteric plexuses**.** *(Ryan et al., 2004)*

Lymphatic drainage:

Lymphatics of jejunum and ileum drain into a series of mesenteric lymph nodes arranged within the mesentery, which follow the same distribution of the regional arterial supply*(Ryan et al., 2004)*

Solitary lymphatic nodules are found scattered throughout the mucous membrane of the small intestine, but are most numerous in the lower part of the ileum. Each consists of a dense interlacing retiform tissue closely packed with lymph-corpuscles, and permeated with an abundant capillary network. The interspaces of the retiform tissue are continuous with larger lymph spaces which surround the gland, through which they communicate with the lacteal system. They are situated partly in the submucous tissue, partly in the mucous membrane, where they form slight projections of its epithelial layer (Borley, 2005).

The **aggregated lymphatic nodules** , also called P**eyer's patches** , form circular or oval patches, from 20-30 in number, and varying in length from 2 to 10 cm. They are largest and