Role Of Multi-slice CT In Diagnosis Of Inflammatory bowel disease

Essay

Submitted for partial fulfillment of the Master degree in Radiodiagnosis

By

Ahmed Mohamed Ahmed Abdallah
M.B.B.CH.
Faculty of Medicine
Ain Shams University

Supervisors

Prof. Dr. Omar Hussein Omar
Professor of Radiodiagnosis
Faculty of Medicine
Ain Shams University

Dr. Amir Louis Louka
Lecturer of Radiodiagnosis
Faculty of Medicine
Ain Shams University

2010

دور الأشعـة المقطعيـة متعددة المقاطـع
فى تشخيص مرض التهاب الأمعـاء

رسالة مقدمة من

الطبيب / احمد محمد أحمد عبدالله

بكالوريوس الطب والجراحة

كلية الطب – جامعة عين شمس

توطئة للحصول على درجة الماجستير فى الأشعة التشخيصية

تحت اشراف

أ. د . عمر حسين عمر

استاذ الأشعة التشخيصية

كلية الطب– جامعة عين شمس

د. امير لويس لوقا

مدرس الأشعه التشخيصيه

كلية الطب– جامعة عين شمس

2010

Summary and conclusion

Inflammatory bowel disease is a term used mainly to describe two idiopathic disorders that are associated with gastro-intestinal inflammation. Crohn's disease and ulcerative colitis need to be distinguished from other conditions; which may display similar clinical and laboratory findings as infection and neoplasm.

Crohn's disease may involve any portion of the alimentary tract from mouth to anus. Mucosal inflammation may be generalized or patchy, and may extend gradually into the submucosa, muscularis and serosa, which may result in intestinal complications; whereas in ulcerative colitis a homogenous inflammatory process is confined to mucosa and starts in the rectum; but may involve any portion of the alimentary tract as well.

The diagnosis of inflammatory bowel disease is a challenging; as it constitutes a variety of examination techniques that must be performed. Full understanding of the anatomic and pathologic basis of the radiological features of IBD is important to appreciate the natural history and differential diagnosis of these diseases.

Radiological studies have an important role in the diagnosis of patients with suspected IBD and also in the differential diagnosis because of their ability to assess fine mucosal details.

Cross sectional imaging, as CT and MRI, have important role in the evaluation of IBD patients. Double contrast barium studies is a valuable technique in diagnosis of Crohn's disease and ulcerative colitis in patients with early disease; where as cross sectional imaging are valuable for showing the effects of this disease on the wall of the bowel and diagnosis of their intra-abdominal complications in patients with more advanced disease.

Colonoscopy and barium studies can diagnose early manifestations of IBD as erosions, aphthous ulcers and enlarged lymph nodes. MRI can detect variations in bowel wall thickness and contrast enhancement, and it could be the imaging technique of choice for follow up of patients with active IBD due to its lack of the ionizing radiation.

Multi-slice CT allows the diagnosis of Crohn's disease and small bowel masses with 100% sensitivity, 95% specificity, 97% accuracy, 94% positive predictive value and 100% negative predictive value.

With CT colonography, the walls of the bowel segments, which were severely affected by the disease, were illustrated by axial CT scans. Air filled sinus tracts, loss of haustrations, pseudo-polyps and deep ulcers are seen in CT colonography.

Contents

	Page
🕮 List of Abbreviations	II
🕮 List of Figures	III
🕮 List of Tables	IX
🕮 Chapter(1):Anatomy of small and large intestine	1
🕮 Chapter (2): Pathology of inflammatory bowel disease	17
🕮 Chapter(3):MSCT technique	32
🕮 Chapter (4) MSCT technique of the bowel	46
🕮 Chapter (5):MSCT manifestations of inflammatory bowel disease	63
🕮 Summary and Conclusion	95
🕮 References	97
🕮 Arabic Summary	

List of Abbreviations

2D	Two Dimensional
3D	Three Dimensional
AIP	Average Intensity Projection
CD	Crohn's Disease
CT	Computed Tomography
CTA	Computed Tomographic Angiography
CTDI	Computed Tomography Dose Index
CTE	CT Enterography
CTU	Computed Tomographic Urography
ESR	Erythrocyte Sedimentation Rate
GISTs	Gastro Intestinal Stromal Tumours
GIT	Gastro Intestinal Tract
HRCT	High Resolution Computed Tomography
HU	Hounsfield Unit
IBD	Inflammatory Bowel Disease
IMA	Inferior Mesenteric Artery
IVC	Inferior Vena Cava
MDCT	Multi-Detector Computed Tomography
MinIP	Minimum Intensity Projection
MIP	Maximum Intensity Projection
MPR	Multi-Planar Reformatting
MRC	Magnetic Resonance Colongraphy
MRI	Magnetic Resonance Imaging
MSCT	Multi-Slice Computed Tomography
OGIB	Obscure Gastro Intestinal Bleeding
PSC	Primary Sclerosing Cholangitis
ROI	Region Of Interest
SMA	Superior Mesenteric Artery
SMV	Superior Mesenteric Vein
SSD	Shaded Surface Display
UC	Ulcerative Colitis
US	Ultra Sonography
Z-axis	Longitudinal axis of acquisition

List of Figures

Figure		Page
1-1	Illustration showing the duodenum and pancreas	1
1-2	Illustration of various parts of the small intestine	4
1-3	Diagrams show the arrangement and variations of the loops of the mesenteric vessels	5
1-4	Illustration of various parts of the large intestine	6
1-5	Illustration shows the region of the caecum	7
1-6	Illustration of the region of the rectum and anal canal	9
1-7	Blood supply of the large intestine	11
1-8	Contrast material-enhanced CT scans of the abdomen demonstrate uniform enhancement of the small bowel and colon.	12
1-9	Coronal volume-rendered 3D multi-detector row CT scans to demonstrate the normal small bowel	13
1-10	Contrast enhanced axial CT scans show loops of small intestine	13
1-11	Contrast enhanced axial CT scans show transverse colon and descending colon	14
1-12	Contrast enhanced axial CT scans show sigmoid colon and rectum	15
1-13	Axial CT & Endoluminal CT colonographic view image show a well-distended clean colon and normal haustral folds	15
1-14	Reconstructed sagittal and coronal CT colonographic images show segments of the large intestine	16
2-1	Loop of small intestine shows Crohn's disease fissure	18
2-2	Endoscopy image of colon showing serpiginous ulcer	20
2-3	Endoscopic image of Crohn's colitis showing deep ulceration	22
2-4	Crohn's disease can mimic ulcerative colitis on endoscopy	23
2-5	Loop of the colon shows epithelial necrosis with ulceration in ulcerative colitis	24
2-6	Colectomy specimen. Colonic pseudo-polyps of a patient with intractable ulcerative colitis	25
2-7	Patients with ulcerative colitis can occasionally have	26

	aphthous ulcers involving the tongue	
2-8	Endoscopic image of UC affecting the left side of the colon	26
2-9	Amebic colitis	29
2-10	The sigmoid colon at the right appears lighter in color than the adjacent small intestine	31
3-1 (A)	Beam collimation in 16-section CT. Narrow collimation	33
3-1(B)	Beam collimation in 16-section CT. Wide collimation	33
3-2(A)	Section collimation in MDCT	33
3-2(B)	Section collimation in MDCT	34
3-3	Reconstruction of axial images from projection data	35
3-4 (A)	Effects of an overlapping reconstruction interval	35
3-4(B)	Effects of an overlapping reconstruction interval	36
3-5(A)	Anisotropic and isotropic data	36
3-5(B)	Anisotropic and isotropic data	37
3-5 (C)	Anisotropic and isotropic data	37
3-6	Use of a volumetric data set	37
3-7(A)	MPR. Coronal reformatted image from routine abdominal CT	38
3-7 (B)	MPR. Sagittal reformatted image produced from CT data acquired	38
3-8 (A)	Curved planar reformation. 3D volume-rendered image	39
3-8(B)	Curved planar reformation. Curved planar image of the right coronary artery	39
3-9 (A)	Effects of AIP on an image of the liver	39
3-9 (B)	Effects of AIP on an image of the liver	40
3-10(A-F)	Effects of MIP slab thickness on a coronal image of the abdomen	40
3-11(A)	Coronal slab image of the thorax	41
3-11 (B)	Coronal slab image of the thorax	41
3-11(C)	Coronal slab image of the thorax	41
3-12 (A)	SSD and volume-rendered images of IVC filter overlying the spine	42
3-12 (B)	SSD and volume-rendered images of IVC filter overlying the spine	42

3-13	3D volume-rendered image of a duplicated IVC	**42**
3-14	Orthographic volume rendering of the airways. Volume-rendered image	**43**
3-15	Perspective volume rendering of the airways	**43**
3-16 (A)	Region-of-interest editing. 3D volume-rendered image	**44**
3-16 (B)	Region-of-interest editing. The selected region is then removed from the image	**44**
3-16 (C)	Region-of-interest editing. Rib removal allows visualization of the fracture	**44**
3-17(A-E)	Use of an opacity threshold for segmentation, as shown on a full field of view 3D volume-rendered image of the chest and abdomen	**45**
4-1 (A-C)	Coronal reconstructions of different contrast agents for CT enterography	**47**
4-2 (A&B)	The combination of submillimeter slices and volume acquisition provides the option for multi-planar reconstructions	**48**
4-3 (A&B)	Coronal **(A)** and axial **(B)** reformatted images from a CT enteroclysis examination	**48**
4-4 (A&B)	**(A)** Coronal reformation of CT enteroclysis image shows hyper-enhancement of terminal ileal mucosa and mural thickening. **(B)** Coronal reformation of CT enteroclysis image obtained with dilute 0.1% barium sulfate shows similar findings	**51**
4-5	Coronal reformation of CT enteroclysis image obtained with water as enteral contrast agent shows 3-cm hyper-vascular mass in ileum	**52**
4-6	Transverse CT enteroclysis image shows thickened small bowel with mucosal and mural hyper-enhancement	**53**
4-7 (A&B)	Active inflammatory stenotic and fibro-stenotic subtypes of Crohn's disease	**53**
4-8	Sagittal reformation of CT enteroclysis image obtained with positive enteral contrast material	**54**
4-9 (A&B)	Comparison of active terminal ileal CD in the same patient at CT using neutral versus positive oral contrast	**57**

4-10 (A&B)	**(A)** Transverse CT image shows well-distended clean colon **(B)** Endoluminal CT colonographic view shows normal haustral fold	**58**
4-11 (A-C)	**(A)** Transverse CT image shows small polypoid lesion in the splenic flexure **(B)** Endoluminal CT colonographic image shows polypoid morphology of the lesion **(C)** Image from conventional colonoscopy performed 1 week later	**59**
4-12 (A&B)	**(A)** Transverse CT image shows small 5.6 mm polypoid lesion in the hepatic flexure **(B)** Conventional colonoscopic image in same patient shows polyp	**62**
5-1	Transverse CT scan of active Crohn's disease with mesenteric hypervascularity in a 17-year-old female patient	**63**
5-2	Transverse CT scan in the same patient shows a long and tortuous segment of ileum	**64**
5-3	CT enterograms demonstrate markedly dilated small bowel loops	**65**
5-4 (A&B)	**(A)** Thick slab volume rendered image obtained after ingestion of dilute water-soluble oral contrast medium **(B)** Thick slab volume rendered image with a surface shaded display shows longitudinal linear ulcerations along mesenteric border of multifocal small intestines and pseudosacculations	**67**
5-5 (A&B)	Axial MSCT **(A)** and coronal reconstruction **(B)** show dilated proximal small bowel loops and collapsed distal bowel in the pelvis indicating a proximal obstruction	**69**
5-6 (A&B)	Appearance of small bowel loops with active CD versus normal bowel loops	**70**
5-7	Collapsed terminal ileum has the same attenuation as adjacent bowel loops indicating the apparent thickening is caused by underdistention rather than CD	**70**
5-8	Normal jejunum enhances more than distal small bowel during the arterial phase. This increased enhancement should not be confused with CD	**71**

5-9 (A-C)	Variable patterns of mural hyperenhancement indicating active CD	**72**
5-10	Bilaminar stratification	**72**
5-11	Trilaminar stratification: active CD	**73**
5-12	Trilaminar stratification: chronic CD	**73**
5-13 (A&B)	Reversible strictures	**74**
5-14 (A&B)	Chronic, non reversible strictures **(A)** Narrowed stricture in the terminal ileum without significant wall thickening **(B)** Second stricture in the ileum with homogenous enhancing wall	**74**
5-15	Active CD with small bowel wall thickening and enhancement in the ileum with engorged vasa recta (comb sign)	**75**
5-16 (A-C)	Fistula types with CD	**76**
5-17	Reformatted coronal MDCT image reveals changes of ulcerative colitis in ascending and descending colon.	**76**
5-18	Transverse CT image in a 34-year old woman with ulcerative colitis	**78**
5-19	Transverse CT image in a 39-year old man with Crohn's disease (granulomatous ileocolitis)	**79**
5-20	Transverse CT image in a 45-year old man with chronic ulcerative colitis	**79**
5-21(A-C)	Active ulcerative colitis with "backwash" ileitis in a 28-year old woman	**80**
5-22	Transverse CT image in a 32-year old woman with ulcerative colitis and bloody diarrhea	**82**
5-23	Transverse CT image in a 24-year old woman with Crohn's ileocolitis	**83**
5-24	MSCT image in a 78-year-old man presented with acute abdominal pain 4 days after aortic aneurysm repair	**83**
5-25	Transverse CT image in a 35-year old patient with ulcerative colitis and toxic megacolon	**84**
5-26 (A&B)	CT images in a 37-year-old woman with Crohn's disease (ileocolitis)	**85**
5-27	Transverse thin-section multidetector CT image in a 70-year-old man with diverticulitis	**86**

5-28	Transverse CT image in a 57-yearold woman with diverticulitis of sigmoid colon	**87**
5-29	Transverse CT image in a 60-year old man with fistula formation due to tuberculous colitis.	**88**
5-30	Transverse CT image in a 33-yearold man with tuberculous ileocolitis	**88**
5-31	Transverse CT image in a 21-yearold man with right lower quadrant pain due to appendicitis	**89**
5-32(A&B)	Transverse CT images in a 31-yearold man with amebiasis	**91**
5-33	Transverse CT image in a 25-yearold man with pseudomembranous colitis	**91**
5-34	*Transverse CT image in a 56-yearold man with* pseudomembranous colitis	**92**
5-35	Transverse CT image in a 71-yearold man with ischemic colitis	**93**
5-36	Transverse CT image in a 22-yearold woman with ischemic colitis	**93**
5-37 (A&B)	Ischemic colitis in an 81-year-old woman with myocardial infarction.	**94**

List of Tables

Table		Page
Table (1):	Comparison between jejunum and ileum.	3
Table (2):	Comparison between Crohn's disease and ulcerative colitis	28

Anatomy of small and large Intestine

Gross Anatomy:

The Small Intestine:

The small intestine is a convoluted tube, extending from the pylorus to the colic valve, where it ends in the large intestine. It is about 7 meters long, and gradually diminishes in size from its commencement to its termination. It is surrounded above and at the sides by the large intestine; a portion of it extends below the superior aperture of the pelvis and lies in front of the rectum. It is in relation, in front, with the greater omentum and abdominal parietes, and is connected to the vertebral column by a fold of peritoneum, the mesentery. The small intestine is divisible into three portions: the duodenum, the jejunum, and the ileum **(Gray, 2008).**

The Duodenum (**Fig. 1-1)** 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).**

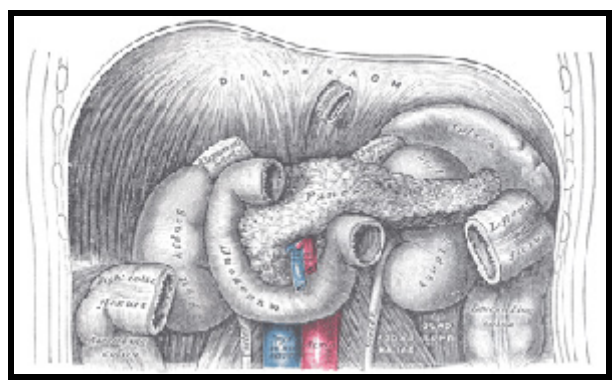

Fig. 1-1: Illustration showing the duodenum and pancreas **(Quoted from Gray, 2008).**