



MRI ENTEROGRAPHY IN INFLAMMATORY BOWEL DISEASE IN PEDIATRIC GROUP

Essay

*Submitted for partial fulfillment of Master Degree
in Radiodiagnosis*

By

Heba T-allh Mohammed Yousry El Naggar

M.B., B.Ch.

Under The Supervision Of

Prof. Dr. Abeer Abd ElMaksoud Hafez

*Professor of Radiodiagnosis
Faculty of Medicine, Ain Shams University.*

Dr. Salma Fathy Abd Elkader

*Lecturer of Radiodiagnosis
Faculty of Medicine, Ain Shams University.*

**Faculty of Medicine,
Ain Shams University
2013**



وَقُلْ اَعْمَلُوا فَسَيَرَى اللّٰهُ
عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ

سورة التوبة رقم الآية ١٠٥





First and foremost, my deep gratefulness and indebtedness is to Allah, the Most Gracious and the Most Merciful.

I wish to express my deep gratitude and respect to Prof. Dr. Abeer Abd ElMaksoud Hafez, professor of radio-diagnosis, faculty of medicine, Ain Shams University, for her valuable advices, continuous encouragement, judicious guidance and kind support at this study.

I would like to express my great thanks to Dr. Salma Fathy Abd Elkader, lecturer of Radio-diagnosis, Faculty of Medicine, Ain Shams University for her kind assistance and support.

Lastly and not least, I send my deepest love to my family and my friends for their love and care.



Heba El-Naggar

List of Contents

Chapter	Page
Introduction and aim of the work	1
Anatomy of the Small And Large Intestine	4
MRI Anatomy of the Small And Large Intestine	15
Pathology of Inflammatory Bowel Disease	20
Technique of MR Enterography Including Recent Pulse Sequences	32
MRE Manifestations of Inflammatory Bowel Disease	52
Summary and Conclusion	86
References	88
Arabic summary	١

List of Abbreviations

SBM	Small bowel mesentery.
SMA	Superior mesenteric artery.
SMV	Superior mesenteric vein.
FISP	Fast imaging with steady state precession.
HASTE	Half-Fourier acquisition single-shot turbo spin echo.
SSFP	Steady state fast precession.
VIBE	Gadolinium-enhanced volumetric interpolated breath-hold examination.
IBD	Inflammatory bowel disease.
CD	Crohn disease.
UC	Ulcerative colitis.
NOD2/CARD15	Nucleotide-binding oligomerization domain containing 2/ caspase recruitment domain family member 15.
MRI	Magnetic resonance imaging.
CT	Computed tomography.
MRE	Magnetic resonance enterography.
GRE	Gradient recalled echo.
STIR	Short time inversion recovery.
SPGR	Spoiled gradient- recalled echo.
FSE	Fast spin echo.
NFS	Nephrogenic systemic fibrosis.
GBCA	Gadolinium based contrast agents.
IC	Indeterminate colitis.
IBDU	Inflammatory bowel disease unclassified.

List of Figures

Figure	Title	Page
Chapter one: Anatomy of small and large intestine		
1.1	Duodenum.	6
1.2	Difference between Jejunum and Ileum.	7
1.3	Macroscopic characteristics of the colon.	8
1.4	Drawing of the anatomy near the root of the SBM.	9
1.5	(A)Arterial supply of the small intestine. (B) Venous drainage of the small intestine.	11
1.6	(A) Arterial supply of the large intestine. (B) Venous drainage of the large intestine.	12
1.7	Histological features of the small intestine.	13
1.8	Histological features of the large intestine.	14
Chapter two: MRI anatomy of small and large intestine.		
2.1	Coronal T2-weighted MR image of 12-year old.	16
2.2	Coronal balanced SSFP image.	16
2.3	Coronal HASTE image.	17
2.4	(a) Coronal half-Fourier acquisition single-shot turbo spin-echo (HASTE) image. (b) Coronal true fast imaging with steady-state precession (FISP). (c) HASTE. (d) Fat-saturated HASTE. (e) gadolinium-enhanced volumetric interpolated breath-hold examination (VIBE).	18

2.5	Post-contrast T1-weighted fat-suppressed image of terminal ileum.	19
2.6	Contrast-enhanced T1-weighted MR image of 14-year-old girl.	19
Chapter three: Pathology of inflammatory bowel disease.		
3.1	Image obtained at colonoscopy shows aphthous ulcers.	22
3.2	Photograph of a resected bowel segment shows the cobblestoned appearance of edematous mucosa between longitudinal and transverse linear ulcers.	22
3.3	Deep, fissuring ulcer in a patient with Crohn disease.	23
3.4	Deep knifelike, fissuring, transmural ulcer in Crohn disease.	23
3.5	Colonoscopic image of a large ulcer and inflammation of the descending colon in a 12-year-old boy with Crohn disease.	24
3.6	A crypt abscess demonstrating active, neutrophilic inflammation in Crohn disease.	24
3.7	Fat wrapping on the serosal surface of the terminal ileum in Crohn disease.	25
3.8	Histological features of cobblestone appearance.	26
3.9	Cobblestone change of the mucosa of the terminal ileum in a patient with Crohn disease.	26
3.10	Histologic features of chronic Crohn colitis with crypt atrophy and branching, as well as lymphocytic infiltrate.	27
3.11	Granuloma in the mucosa of a Crohn disease patient.	27
3.12	Low-power image from a colon biopsy in a patient with ulcerative colitis illustrates changes limited to the mucosa.	29
3.13	Histology of ulcerative colitis.	30

3.14	Inflamed colonic mucosa demonstrating pseudopolyps in a patient with ulcerative colitis.	30
Chapter four: Technique of MR enterography including recent pulse sequences.		
4.1	MRI machine designed for children.	42
4.2	Imaging with a true FISP sequence.	44
4.3	Coronal True FISP image: normal bowel. The 'black boundary' artifact may be confused with bowel wall thickening.	44
4.4	Imaging with a single-shot fast spin-echo sequence. (a) Coronal fat-suppressed single-shot fast spin-echo MR image. (b) Coronal non-fat-suppressed single-shot fast spin-echo MR image.	45
4.5	Coronal T2-weighted single-shot (half-Fourier RARE) image shows motion from intraluminal fluid, which results in dark signal within the bowel, a known artifact of this sequence.	46
4.6	Coronal fat-saturated HASTE image: normal bowel. Intraluminal flow voids are seen, as this sequence is sensitive to fluid motion.	46
4.7	Coronal T1 fat-saturated post-contrast image: normal bowel wall shows mild homogeneous enhancement.	47
Chapter five: MRE Manifestations Of Inflammatory Bowel Disease.		
5.1	Mural stratification in two patients with Crohn disease. (a) Coronal two-dimensional gradient-echo. (b) Axial three-dimensional gradient-echo.	52

5.2	Coronal True FISP in a different patient (15 years old) shows extensive jejunal small bowel wall thickening.	53
5.3	A 16-year-old child with CD: (a) Axial single-shot fast spin-echo T2-W image. (b) Axial contrast-enhanced image.	54
5.4	A 15-year-old child with CD: (a) Coronal single-shot fast spin-echo T2-W image. (b) Axial T1-W contrast enhanced image.	54
5.5	A 14-year-old child with CD: (a,b) Axial single-shot fast spin-echo T2-W images. (c,d) Axial contrast-enhanced images.	55
5.6	Crohn ileitis in 17-year-old girl. A, Coronal single-shot fast spin-echo image. B, Axial 2D true fast imaging with steady-state precession image. C, Coronal gadolinium-enhanced 2D gradient-recalled image.	56
5.7	11-year-old boy with confirmed Crohn disease: Axial contrast-enhanced T2-weighted MR image(top). Unenhanced fat-saturated T1-weighted MR image (bottom left). Contrast-enhanced fat saturated T1-weighted MR image (bottom right).	57
5.8	Crohn ileitis with proximal disease in 14-year-old boy: (A) Coronal 2D true fast imaging with steady-state precession (true FISP) image. (B) Corresponding axial image through these pelvic mid small bowel loops. (C) Coronal 2D true FISP image. (D) Coronal gadolinium-enhanced 3D gradient-recalled echo image.	58

5.9	<p>Imaging with a gadolinium-enhanced spoiled gradient-echo sequence.</p> <p>(a) Non-fat-suppressed singleshot fast spin-echo MR image.</p> <p>(b) Unenhanced</p> <p>(c) Contrast-enhanced spoiled gradient-echo MR images.</p>	59
5.10	<p>17-year-old girl with confirmed ulcerative colitis: Axial fat-saturated T2-weighted image (top right) T1-weighted image (top left).</p> <p>Contrast-enhanced fat-saturated T1-weighted MR image (bottom).</p>	60
5.11	<p>17-year-old girl with confirmed ulcerative colitis: Coronal fat-saturated T2-weighted image (top right). T1-weighted image (top left).</p> <p>Contrast enhanced T1-weighted image (bottom).</p>	61
5.12	<p>17-year-old girl with confirmed crohn disease: Axial fat-saturated contrast-enhanced T1- weighted MR images (top right and left). Subtraction image (bottom).</p>	62
5.13	<p>Patient with fibrostenotic disease:</p> <p>(a) Coronal True FISP image.</p> <p>(b) Post contrast.</p>	63
5.14	<p>13-year-old child with CD:</p> <p>(a,b) Coronal T2-W images.</p> <p>(c) Axial T2-W fat-suppressed image.</p>	64
5.15	<p>16-year-old girl with blind-ending sinus track in coronal T2-weighted single-shot fast spin-echo (SSFSE) image.</p>	64