

# ROLE OF MULTIDETECTOR COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF ACUTE MESENTERIC ISCHEMIA

An essay submitted for partial fulfillment of the master degree in Radiodiagnosis

By

Noha Mohamed Taha M.B., B.Ch.,

Supervised by

#### Prof Dr. Fatma Salah Eldin

Professor of Radiodiagnosis Faculty of medicine Ain shams university

#### Dr. Merhan Ahmed

Lecturer of Radiodiagnosis Faculty of medicine Ain shams university

Faculty of medicine Ain shams university 2012

# **CONTENTS**

Title	Page
Introduction & aim of work	1
Anatomy of mesenteric vessels.	3
Pathological considerations.	20
MDCT technique of examination.	30
MDCT manifestations of acute mesenteric ischemia	47
Summary & conclusion	81
References	85

### **LIST OF ABBREVIATIONS**

2D = Two dimensional

**3D** = Three dimensional

**CA**= Celiac axis

**CT** = Computed tomography

**CTA**= CT angiography

**DSA** = Digital subtraction angiography.

**IMA** = Inferior mesenteric artery

**IMV** = Inferior mesenteric vein

**IV**= Intravenous

**MDCT** = Multidetector computed tomography

**MDCTA**= Multidetector CT angiography

**MSCT**= Multislice computed tomography

**MIP** = Maximum intensity projection

**MPR**= Multi Planar Reformation

**MONI**= Non occlusive mesenteric ischemia.

**SMA** = Superior mesenteric artery

**SMV** = Superior mesenteric vein

**SSD**= Shaded surface display

**tCMT**= Contrast media transit time

**VR**= volume rendering

# **LIST OF FIGURES**

No.	Subject	Page
1	Arterial supply of GI tract Showing celiac, SMA and IMA,	3
2	A drawing that shows the anastomotic connections between the SMA& IMA.	5
3	Normal anatomy of the celiac trunk showing its branches.	6
4	Sagittal 3D MSCT scan demonstrates the normal anatomy of the celiac axis (thick solid arrow) and SMA (curved arrow). The SMA courses over the left renal vein (open arrow). The origin of the left renal artery is also visualized (thin solid arrow).	7
5	A diagram showing the SMA and its branches.	9
6	Sagittal 3-D volume rendering (VR) demonstrates the normal anatomy of the superior mesenteric artery (SMA) (upper arrow) arising from -near the L2 body approximately 1 cm caudal to the celiac axis (middle arrow). Inferior mesenteric artery (IMA) (arrowhead) arises approximately 7 cm caudal to the SMA.	9
7	Coronal 3D MSCT scan demonstrates the inferior pancreaticoduodenal artery (straight arrow), which arises from the SMA (curved arrow) and connects to the gastroduodenal artery.	10
8	Axial multi– detector row abdominal CT scans obtained at different levels demonstrate the normal appearance of the jejunal arteries (arrow). These vessels are very small and are much better visualized at CT angiography.	11

No.	Subject	Page
9	Volume Rendered Computed Tomography	12
	showing normal anatomy of the superior	
	mesenteric artery; 1) SMA 2) jejunal branches,	
	3)midlle jejunal a. 4)right colic a. 5)iliocolic a.	
10	Coronal 3D multi– detector row CT scan	12
	demonstrates the normal terminal branching	
	pattern of the ileocolic artery (black arrow),	
	which supplies the terminal ileum, cecum, and	
	lower ascending colon. With optimization of	
	technique, even the smallest branches feeding the	
	bowel can be visualized (white arrows). The	
	branches on this image represent the vasa recta.	
11	Coronal VR and coronal maximum intensity	13
	projection (MIP) demonstrating SMA branches:	
	intestinal branches (arrowheads), ileocolic artery	
	(lower arrow), middle colic artery (upper arrow),	
	and right colic artery (thin long arrow).	
12	The large intestine includes the cecum (and	14
	appendix), ascending colon, transverse colon,	
	descending colon, sigmoid colon, rectum, and	
	anal canal. Embryonic hindgut derivatives	
	include those distal to the distal transverse colon	
	and are supplied by the inferior mesenteric artery	
	(IMA) and its branches.	
13	(a) Sagittal 3D MSCT scan demonstrates the	15
	normal anatomy of the IMA (arrows) (b) Coronal	
	3D MSCT scan demonstrates the normal	
	branching pattern of the IMA (arrows)	
14	Coronal 3-D VR of IMA (arrowhead) with left	16
	colic artery (short arrow) and superior rectal	
	artery (dashed arrow).	

No.	Subject	Page
15	Normal portal venous system. Coronal volume rendering (VR) showing main portal vein (*), splenic vein (upper arrow), and superior mesenteric vein (SMV) (S) joining at the portal confluence. The inferior mesenteric vein (IMV) (lower arrow) and the gastroepiploic vein (arrowhead) can drain into the splenic vein.	17
16	Coronal 3D multi-detector row CT scan demonstrates the normal appearance of the SMV (straight solid arrow), which joins the splenic vein (curved arrow) at the portal confluence. The portal vein is also seen (open arrow).	17
17	Coronal 3D MSCT scan demonstrate a normal variant (IMV) (arrow) that joins other vessels at the spleno-portal angle.	18
18	Coronal 3D MSCT scan demonstrates the normal appearance of the mesenteric vessels. The IMV (straight solid arrow) joins the SMV (curved arrow), after which the two vessels join the splenic vein (open arrow) at the portal confluence.	19
19	Thin-slab coronal volume-rendered image demonstrates the normal appearance of the small bowel when water is used as oral contrast. Individual small bowel folds are often visible.	32
20	Drawings illustrate the value of using water as an oral contrast agent instead of high-attenuation contrast agents when evaluating small bowel disease and enhancement. Drawings A ("unenhanced CT scan") and B ("contrast material-enhanced CT scan") illustrate the results of using a high-attenuation contrast agent, whereas drawings C (unenhanced CT scan) and D (contrast-enhanced CT scan) illustrate the results	33

No.	Subject	Page
	of using a low-attenuation contrast agent (eg,	
	water). Intraluminal water clearly allows better	
	visualization of the enhancing bowel wall.	
21	Standard multiplanar post-processing of a multi-	40
	detector row CT data set for suspected abdominal	
	angina. Post-processing may include coronal	
	oblique (a, b) or sagittal (c, d) thin MIP images.	
22	Coronal MIP image demonstrates the normal	42
	anatomy of the mesenteric veins.	
23	(A) Sagittal volume-rendered 3D CTA	44
	demonstrates the normal anatomy of the celiac	
	axis and SMA. The origin and proximal segment	
	of these vessels is best appreciated in the sagittal	
	projection. (B) Coronal volume rendered 3D CTA	
	demonstrates the normal branching pattern of the	
	SMA. Distal branches of the SMA are visualized	
	best in the coronal projection using either volume	
	rendering or MIP.	
24	Sagittal volume-rendered 3D multi-detector row	45
	CT scan demonstrates the normal celiac axis	
	(straight arrow) and superior mesenteric artery	
	(SMA) (curved arrow). (b) Coronal volume-	
	rendered 3D multi-detector row CT scan shows	
	the normal branching pattern of the SMA (arrow).	
	(c) Coronal oblique volume-rendered 3D multi-	
	detector row CT scan shows the normal	
	branching pattern of the inferior mesenteric artery	
	(arrows). (d) Coronal volume-rendered 3D multi-	
	detector row CT scan demonstrates the normal	
	mesenteric veins.	4 -
25	A 16-slice CT examination of the chest and	46
	abdomen in the arterial and portal venous phases	
	(scan time 15 second per phase).	
	(A) Coronal maximum-intensity projection (MIP)	

No.	Subject	Page
	from the arterial phase shows the mesenteric and	
	hepatic vessels.	
	(B) Coronal MIP from the portal phase shows the	
	portal vein.	
	(C) Volume rendering (VR) based on the portal	
	phase shows the relationship between vessels and	
	organs.	
	(D) The isometric nature of the voxels facilitates	
	high-quality (almost anatomic) of the VR of the	
	entire chest and abdomen.	
26	Normal enhancement and appearance of small	49
	bowel in 77 years old woman. Axial CT scan	
	obtained at the level of kidneys with IV contrast	
	material and water as oral contrast agent shows	
	enhancement of normal bowel wall. Note thinly	
	enhancing valvulae conniventes (arrow). This	
	finding is often better seen when water alone is	
	given as oral contrast agent. Enhancement may be	
	obscured with positive contrast in the lumen.	
27	Contrast-enhanced CT image of abdomen in 40-	50
	year-old woman with superior mesenteric vein	
	and portal vein thrombosis. Wall thickening of	
	ascending and transverse colon (arrowheads) is	
	shown. Engorgement of mesenteric veins is also	
	visible.	
28	Contrast-enhanced transverse CT scan shows	51
	mesenteric venous infarction with massive small-	
	bowel wall thickening (arrows), total absence of	
	bowel wall enhancement, pronounced edema of	
	mesenteric fat (arrowheads), and ascites in a	
	patient with polycythemia vera who developed	
	multiple thromboses of distal and intramural	
	mesenteric veins.	

No.	Subject	Page
29	Contrast enhanced CT image of abdomen in 78-	52
	year-old man with embolism of superior	
	mesenteric artery. Bowel loops are distended with	
	air and their wall is "paper-thin."	
30	Diagram shows cross section of bowel wall with	54
	three layers of high (inner black layer), low	
	(middle gray layer), and high (Outer black layer)	
	attenuation. Together, these layers create a target	
	appearance known as the target sign.	
31	Abdominal CT scan showing circumferential wall	54
	thickening and target sign in small and large	
	bowels. Mesenteric changes are also noted with	
	engorged mesenteric vessels and haziness.	
32	Transverse CT scan of the abdomen after	55
	administration of oral and intravenous contrast	
	material in a 42-year-old man with ischemic	
	colitis. Layers representing target sign grossly	
	correspond to muscularis propria (straight white	
	arrow), submucosa (curved arrow), and mucosa	
	(black arrow).	
33	Contrast-enhanced transverse CT scan shows	56
	mild homogeneous wall thickening (arrows) of	
	the splenic flexure .The homogeneously hypo	
	attenuating appearance is caused by pronounced	
	mural edema.	
34	Non enhanced CT image of lower abdomen in	57
	patient with strangulating obstruction. Bowel wall	
	of involved segment is thickened and shows	
	increased density (circle) indicating hemorrhagic	
	infarction. Involved mesentery shows high	
	attenuation.	

No.	Subject	Page
35	Contrast enhanced CT image of lower abdomen obtained at equilibrium phase in patient with strangulating obstruction. Prominent mural enhancement of affected bowel segment (arrowhead) is shown, which indicates presence of bowel ischemia.	58
36	Arterial phase CT image of an 84-year-old woman with atrial fibrillation and thrombus at echocardiography who presented with abdominal pain. Note relative lack of enhancement of the descending colon (arrow head) when compared with the ascending colon (arrow). Ischemic segments of both small and large bowel were found at surgery.	59
37	A-Diffuse small bowel ischemia in a 60 years old patient with occlusive mesenteric ischemia, axial CT of the abdomen shows diminished caliber of the SMA (long arrow) in relation to the SMV. B-Axial cuts at the level of the IMA shows large caliber of the vessel (short arrow) with dilatation of the small bowel loops.	60
38	46-year-old man with superior mesenteric vein thrombosis.A) Contrast enhanced CT image obtained cephalad to B shows thrombi in superior mesenteric vein (arrowhead) and splenic vein (arrow).B)Contrast enhanced CT image shows engorgement of mesenteric veins (arrowhead) and mural thickening of intestine. Ascities is present.	62
39	Coronal volume-rendered image in a patient presenting with acute abdominal pain demonstrates extensive thrombosis (arrows) of the mesenteric veins. The proximal jejunum is thickened, and there also is mesenteric stranding.	63

No.	Subject	Page
40	Contrast-enhanced transverse MSCT scan in a patient with occlusive transmural colonic infarction shows widely dilated colon (based on the degree of distention) with mildly thickened colonic wall, mesenteric gas, and mixed bubble like (arrowheads) and band like (arrows) pneumatosis.	64
41	Mesenteric infarction. A–C, Contrast-enhanced CT images of upper (A), mid (B), and lower (C) abdomen show gas in portal venous branches (A), gas in mesenteric veins (circle ,B), and gas in bowel wall (arrowheads, C).	66
42	Contrast-enhanced transverse CT scan in a patient with acute transmural mesenteric infarction shows pronounced intrahepatic portal venous gas (branching hypo attenuating areas) extending into the periphery of both liver lobes.	68
43	Pneumobilia. Non-enhanced CT scan obtained in the middle of the liver shows tubular areas of low attenuation in the biliary tree. Note the central location of the air.	68
44	Superior mesenteric artery embolism. Contrast- enhanced CT image shows defect in superior mesenteric artery (arrowhead).	70
45	Superior mesenteric artery occlusion. A) Coronal 3D multislice CT angiographic image demonstrates occlusion of the superior mesenteric artery (open arrow). A stent at the right renal artery is also evident (solid arrow). B) Sagittal 3D multislice CT angiographic image demonstrates that the occlusion is approximately 1.5 cm below the origin of the superior mesenteric artery from the abdominal aorta (arrow).	71

No.	Subject	Page
46	(A) Thin-slab coronal volume-rendered image in a patient with acute abdominal pain and elevated lactic acid shows dilated small bowel loops with pneumatosis (arrows). The small bowel wall is not thickened (B) Sagittal volume-rendered 3D CTA demonstrates a large thrombus (arrow) in the SMA.	72
47	MDCT angiography (16 _ 1.25 mm collimation) was performed on a 70-year-old patient with abdominal angina and weight loss. Sagittal volume rendered (A) and maximum intensity projection (B) images demonstrate celiac (arrow) and superior mesenteric artery (SMA, arrowhead) occlusion. Mesenteric arterial supply is dependent on the inferior mesenteric artery (IMA). However, as shown in C, the IMA has moderate origin narrowing (arrow). A prominent Arc of Riolan serves as a collateral route between the IMA and SMA (D, arrow). The pancreaticoduodenal artery (D, arrowhead) serves to reconstitute the celiac vascular territory. Findings are confirmed at the time of IMA stent placement.	73
48	(A) Sagittal volume-rendered 3D CTA in a patient who has hypotension and sepsis shows marked narrowing of the celiac axis and SMA. (B) Coronal oblique volume-rendered 3D CTA in the same patient shows pruning of the SMA branches (arrows). The mesenteric veins (arrowheads) are prominent. The small bowel is dilated and fluid filled.	74

No.	Subject	Page
49	Contrast-enhanced CT image in 74-year-old man	75
	with superior mesenteric artery embolism shows	
	defect (arrowhead) in superior mesenteric artery.	
	In addition, contrast enhancement of right kidney	
	(arrow) is absent, which indicates embolism of	
	right renal artery.	
50	(A) Axial image demonstrates an isolated	76
	dissection of the SMA (arrow) (B) Sagittal MPR	
	also demonstrates the focal dissection flap	
	(arrow). Notice that there is no aortic dissection.	
51	Contrast-enhanced CT image in 40-year-old man	76
	with superior mesenteric vein thrombosis shows	
	defect in superior mesenteric vein (arrowhead).	
	Distal branches of vein are engorged.	





سورة التوبة رقم الأية 105





