Journal of Advances in Medicine and Medical Research

33(20): 14-26, 2021; Article no.JAMMR.73742
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Multidetector Computed Tomography in Diagnosis of Mesenteric Vascular Occlusion

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2021/v33i2031100
Editor(s):
(1) Dr. Ashish Anand, University of Mississippi Medical Center and William Carey School of Osteopathic Medicine, USA.
Reviewers:
(1) Pon Rachel Vedamanickam, University Hospitals of North Midlands, UK.
(2) Kirti Savyasacchi Goyal, Deemed to be University, India.
(3) Rex Friday Ogoronte A. Ijah, Rivers State University Teaching Hospital and Pamo University Of Medical Sciences, Nigeria.
Complete Peer review History: https://www.sdiarticle4.com/review-history/73742

Original Research Article

Received 03 July 2021
Accepted 13 September 2021
Published 27 September 2021

ABSTRACT

Background: Multidetector computed tomography (MDCT) has high sensitivity and specificity for diagnosing acute primary mesenteric ischemia (MI). MDCT findings vary widely depending on the cause and underlying pathophysiology. MDCT findings of mesenteric ischemia should be characterized on the basis of the cause that lead to early diagnosis and intervention.
Aim: The aim of the study was to assess the impact of different MDCT phases in diagnosis of mesenteric vascular occlusion (MVO).
Patients and Methods: This study that was carried out on 20 patients with suspected mesenteric vascular occlusion who were referred to Tanta University Hospitals and General Surgery Department during a period one year starting from May 2018 till May 2019.
Results: Out of the 20 studied patients, 11 (55%) of them was male and 9 (45%) was female, the age of the studied patients ranged from 40 to 73 years old with mean age 57.10 ± 8.85 years. In our study the predisposing factors for MVO were as follow 6 (30%) had Primary thrombosis, 9 (45%) had cirrhosis, 8 (40%) had Portal hypertension, 4 (20%) had DM, 4 (20%) had Atherosclerosis, and 2 (10%) had ischemic heart disease.
Conclusion: Acute and chronic mesenteric ischemia are morbid conditions that are challenging to diagnose. Patients present with variable, nonspecific signs and symptoms, and the physical examination is often benign. A high index of clinical and radiologic suspicion is thus required for

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diagnosis MDCT is an accurate, fast, and non-invasive technique which should be used in clinically suspected patients with MVO in order to confirm the diagnosis identify the aetiology and in addition assessing the bowel loop status for adequate management with good prognosis. Familiarity with the MDCT imaging manifestations of mesenteric ischemia allows for a more precise, prompt diagnosis, early institution of therapy and potentially improved patient outcomes.

Keywords: Mesenteric ischemia; multidetector computed tomography; mesenteric vascular occlusion.

1. INTRODUCTION

Mesenteric ischemia (MI) is a group of disorders with incidence rates that may vary according to the acute or chronic presentation and the aetiology may be arterial, non-occlusive, or venous in origin [1].

MI is caused by blood flow that is insufficient to meet the metabolic demands of the visceral organs. The severity of ischemia and the type of organ involved depend on the affected vessel and the extent of collateral-vessel blood flow [2].

MI is an uncommon medical condition with high mortality rates. The disease can be divided into acute and chronic MI (CMI), with the first being subdivided into four categories. Therefore, acute MI (AMI) can occur as a result of arterial embolism, arterial thrombosis, mesenteric venous thrombosis and non-occlusive causes. AMI caused by arterial embolism accounts for 50% of acute ischemic conditions. The Superior Mesenteric Artery (SMA) is the visceral vessel the most susceptible to emboli due to its acute take-off angle from the aorta and higher flow [3].

Acute embolic SMA occlusion is usually cardiogenic in origin and may coexist with infarcts in other organs from multiple emboli... The Multidetector computed tomography (MDCT) appearance depends on the location of the thrombus, the degree and duration of vascular occlusion, and whether reperfusion has occurred multiple emboli [4].

Thrombosis of the SMA (approximately 25% of cases) is usually associated with pre-existing chronic atherosclerotic disease leading to stenosis. Many of these patients have a history consistent with chronic mesenteric ischemia (CMI), including postprandial pain, weight loss, or “food fear”, and thus a systematic history is important when evaluating a patient suspected to have AMI. Thrombosis usually occurs at the origin of visceral arteries; moreover, an underlying plaque in the SMA usually progresses to a critical stenosis over years resulting in collateral beds. Accordingly, symptomatic SMA thrombosis most often accompanies celiac occlusion. SMA thrombosis may also occur due to vasculitis, mesenteric dissection, or a mycotic aneurysm [5]. Involvement of the ileocolic artery will result in necrosis of the proximal colon. In situ thrombosis of the SMA is usually superimposed on pre-existing atherosclerotic plaque. The imaging appearance of SMA thrombosis can be similar to that of thromboembolism[6]. The key in differentiating thrombosis of the SMA from thromboembolism lies in the location and appearance of the occlusion [7].

Although, there are subtle differences between arterial and venous mesenteric ischemia, it is possible to clinically differentiate the two conditions. Patients with history of atrial fibrillation or heart disease are more likely to have arterial ischemia while personal or family history of deep venous thrombosis increases the suspicion of Mesenteric Venous Thrombosis (MVT). Physical findings and severity of ischemia do not correlate well. Rebound tenderness has not been shown to be an accurate sign for diagnosis of bowel infarction and also did not correlate with the severity of the ischemia. Laboratory testing is usually not helpful in the diagnosis of MVT. Contrast enhanced CT scan is the diagnostic modality of choice [7]. Increasing use of CT scan for abdominal pain in the emergency department is associated with decrease in the time to diagnosis from 1 week to 1 day. A filling defect in the mesenteric vein is the most common finding in patients with MVT [6]. Bowel wall thickening, pneumatosis intestinalis, portal vein gas and persistent enhancement of the bowel wall suggest bowel wall ischemia [8]. Although, these findings are specific, but their sensitivity is low in diagnosis of bowel infarction and transmural necrosis [9].

The vital role of MDCT in mesenteric ischemia is not only to detect the ischemic changes in the affected bowel loops but also to determine the cause of ischemia[10]. MDCT with 3-D reformatting can help to evaluate the mesenteric

vessels in patients with acute mesenteric ischemia. Mesenteric emboli and focal infarction of the affected bowel loops can be directly shown on an MDCT scan. Mesenteric venous thrombosis, an uncommon but potentially lethal cause of bowel ischemia, is well-demonstrated on MDCT, with 3-D reconstructions showing the entire mesenteric venous anatomy[11].

1.1 Aim of the Work

The aim of this work was to assess the impact of different multidetector computed tomography phases in diagnosis of mesenteric vascular occlusion.

1.2 Patients and Methods

This prospective study was carried out on 20 patients with clinically suspected mesenteric vascular occlusion referred to department of radio diagnosis and intervention in Tanta university hospitals for multi detector computed tomography assessment. The study was done in a period of one year from May 2018 to May 2019.

1.3 Inclusion Criteria

Patients with clinically suspected mesenteric vascular occlusion were presented by acute abdominal pain, vomiting, diarrhea and signs of intestinal obstruction.

1.4 Exclusion Criteria

- Patients with renal impairment.
- Patients with history of severe allergic reaction from the contrast media that will be used.

1.4.1 Risks and ethical consideration

1. Any unexpected risk encountered during the course of the research was cleared to the participants as well as to the Ethical Committee on time.
2. Every patient received an explanation to the purpose of the study and the benefits and risks of the procedure.
3. There were adequate provisions to maintain privacy of participants and confidentiality of data through:
   - Each participant had a code number.
   - All data and investigations of subjects were confidential with a private file for each patient.
   - The results of the research was used only for the scientific purpose.
   - All given data was used for the current medical research only.
   - The name of the patient was hidden from the photos used in the study or published at the research paper.

2. METHODS

Every patient was subjected to the following:

1. Full history taking. Including clinical manifestations, operative data and any contraindications for the MDCT study
2. Complete clinical examination.
3. Laboratory investigations: Blood urea, serum creatinine level, and full CBC.
4. Multidetector computed tomography examination of the abdomen and pelvis, non contrast and enhanced series (arterial and venous phases).

- CT-128 detectors was performed within the first 48 hours from patient admission using slice/rotation CT GE(OPTIMA).
- The CT data was correlated with the surgical, medical and laboratory results.
- The medical ethics was considered. The patient was aware of the examination, patient's approval was obtained in a written consent.

2.1 Patient Preparation

No special preparation was needed for patients with severe symptoms (vomiting and abdominal pain) except fasting for about 4-6 hours before examination for cases of mild symptoms.

2.2 Contrast Material

A) Intravenous contrast

- Non-ionic iodinated contrast material (Iohexol) was injected with an automatic injector at rate 3 mL/s through an 18-gauge antecubital intra venous line. The total amount of injected contrast l-2mL/ kg,
- In this study IV contrast was injected in 20 patients with normal creatinine clearance result.
- Pre and post contrast CT examination, all post contrast images were obtained in late arterial (45 seconds), portal venous phases (70 seconds) and delayed phase.

B) Oral contrast

Diatrizoate meglumine and Diatrizoate sodium solution was used as oral contrast in eight patients with mild symptoms to allow visualization of the bowel (750–1000 ml as tolerated by the patient), because it is safe, well tolerated, and allows exquisite visualization of the enhancing bowel wall and abdominal vessels.

2.3 Patients Scanning

- Patient scanned in supine position without gantry tilt. The CT protocol consisted of volumetric data acquisition commencing at 5cm above the diaphragm to5cm below the symphysis pubis with breath-hold technique (as possible as patient can) to avoid the motion artifacts.
- Images were interpreted by dedicated workstation and post processing software using coronal, sagittal
- Scan parameters:
  - KVP : 120 - 140
  - mAs : 150 - 450
  - Gantry rotation speed of: 0.5 second..
  - Slice thickness: 0.5-1 mm.

2.4 Statistical Analysis

Collected data were recorded then presented and analyzed statistically by computer using SPSS version 20 (SPSS Inc. Chicago, IL, U.S.A) as follow:

1. Editing and coding
2. Data entry in computer.
3. Data were summarized and presented in tables and graphs and summarized as median and mean ± standard deviation for quantitative variables and as number and percentage for qualitative variables.
4. Data were handled using appropriate statistical tests of significance such as:

- Chi-square test and Fisher's exact test, wherever appropriate, were used for data analysis.
- Independent two-sample t-tests or Mann-Whitney-U tests were applied to compare the continuous variables between the two groups.
- Other parameters were assessed with Spearman's correlation test and Monte Carlo test.
- P value equal to or less than 0.05 was considered statistically significant.

The diagnostic value indices including the specificity, sensitivity, positive and negative predictive were determined by:

- Sensitivity of the test: the percent of the positives by the test and the true positives.
- Specificity of the test: the percent of the negatives by the test and the true negatives.
- Positive predictive value: the percent of the true positives and all the positives by the test.
- Negative predictive value: the percent of the true negatives and all the negatives by the test.
- Accuracy: the percent of agreement between the two tests.

Sensitivity, specificity, positive and negative predictive value as well as accuracy are expressed as percentages.

3. RESULTS

This study was carried out on 20 patients, 11 (55%) of them were male and 9 (45 %) were female, the age of the studied patients ranged from 40 to 73 years old with mean age 57.10 ± 8.85 years (Table1).

In our study the predisposing factors for MVO were as follow 6 (30%) had Primary thrombosis, 9 (45%) had cirrhosis, 8 (40%) had Portal hypertension, 49 (20%) had Diabetes Mellitus, 4 (20%) had Atherosclerosis, and 2 (10%) had ischemic heart disease. (Table 2).

This table showed that there was non-statistically significant difference between acute and chronic occlusion as regard predisposing factors except as regard portal hypertension which is more frequent in chronic type.

This table shows that there is non-statistically significant difference between SMA and SMV according to imaging findings except as regard thick bowel wall which was more in SMV, and thin bowel wall more in SMA.

In our study the predisposing factors for MVO were non-statistically significant difference between acute and chronic occlusion as regard predisposing factors except as regard liver cirrhosis which is more frequent in SMV type, and atherosclerosis which is more in SMA.

The final diagnosis of the studied cases: The diagnosis of acute MVO was surgically proven in 10 patients; three patients were with SMA thrombosis and one patient was with SMA thromboembolism and six patients with porto-mesenteric venous thrombosis. And two patients were with chronic MVO.

However, two patients presented with porto-mesenteric venous thrombosis were treated conservatively and serial CT scans showed improved bowel appearance as the venous thrombosis decreased in size after anticoagulant therapy and the diagnosis of acute MVT was done on this basis. six patients with chronic MVO were treated conservatively by anticoagulant .

Case 1 in the present study was a 57-year-old male complaining of acute abdominal pain, vomiting, absolute constipation for 3 days. He is diagnosed with acute superior mesenteric vein occlusion. (Figs 1, 2 & 3).

On the other hand, case 2 was a 45-year-old female patient with history of deep vein thrombosis of right lower limb 5 months ago complained of abdominal pain for 3 days. (Figs 4 & 5).

Table 1. Distribution of the studied cases according to demographic data (n = 20)

Demographic data	No.	%
Sex		
Male	11	55.0
Female	9	45.0
Age (years)		
40 – <45	1	5.0
45 – <50	2	10.0
50 – <55	4	20.0
55 – <60	5	25.0
60 – ≥65	8	40.0
Min. – Max.	40.0 – 73.0	
Mean ± SD.	57.10 ± 8.85	
Median (IQR)	57.0 (50.0 – 64.0)	

Table 2. Distribution of the studied cases according to predisposing factors (n = 20)

Predisposing factors	No.	%
Primary thrombosis	6	30.0
Secondary to hyper coagulable state	1	5.0
Liver cirrhosis	9	45.0
Portal hypertension	8	40.0
DM	4	20.0
Atherosclerosis	4	20.0
Ischemic heart disease	2	10.0

Table 3. Comparison between Acute and Chronic according to predisposing factors

Predisposing factors	Total (n = 20)		Acute (n = 12)		Chronic (n = 8)		χ^2	^{FE}p
	No.	%	No.	%	No.	%		
Primary thrombosis	6	30.0	5	41.7	1	12.5	1.944	0.325
Secondary to hyper coagulable state	1	5.0	1	8.3	0	0.0	0.702	1.000
Liver cirrhosis	9	45.0	3	25.0	6	75.0	4.848	0.065
Portal hypertension	8	40.0	2	16.7	6	75.0	6.806*	0.019*
DM	4	20.0	3	25.0	1	12.5	0.469	0.619
Atherosclerosis	4	20.0	3	25.0	1	12.5	0.469	0.619
Ischemic heart disease	2	10.0	2	16.7	0	0.0	1.481	0.495

Table 4. Comparison between SMA and SMV according to imaging procedures including (n = 20)

Imaging findings including	Total (n = 20)		SMA (n =5)		SMV (n =15)		χ^2	^{FE}p
	No.	%	No.	%	No.	%		
Acute	12	60.0	4	80.0	8	53.3	1.111	0.603
Chronic	8	40.0	1	20.0	7	46.7	1.111	0.603
PORTAL Vein	8	40.0	0	0.0	8	53.3	4.444	0.055
Thick bowel wall	14	70.0	1	20.0	13	86.7	7.937*	0.014*
Thin bowel wall	5	25.0	4	80.0	1	6.7	10.756*	0.005*
Hyper dense bowel wall	4	20.0	1	20.0	3	20.0	0.0	1.000
Hypo dense bowel wall	6	30.0	0	0.0	6	40.0	2.857	0.260
Hyper enhancement	5	25.0	1	20.0	4	26.7	0.089	1.000
No enhancement	11	55.0	3	60.0	8	53.3	0.067	1.000
Target sign	8	40.0	0	0.0	8	53.3	4.444	0.055
Pneumatosis intestinalis	10	50.0	4	80.0	6	40.0	2.400	0.303
Mesenteric fat stranding	14	70.0	2	40.0	12	80.0	2.857	0.131
Intra peritoneal free fluid	12	60.0	2	40.0	10	66.7	1.111	0.347
Intestinal obstruction	2	10.0	1	20.0	1	6.7	0.741	0.447
Organ infarction	2	10.0	2	40.0	0	0.0	6.667	0.053
In proximal part	3	15.0	0	0.0	3	20.0	1.176	0.539
In distal part	3	15.0	2	40.0	1	6.7	3.268	0.140
Along its length	14	70.0	3	60.0	11	73.3	0.317	0.613

Table 5. Comparison between SMA and SMV according to predisposing factors

Predisposing factors	Total (n = 20)		SMA (n =5)		SMV (n =15)		χ^2	^{FE}p
	No.	%	No.	%	No.	%		
Primary thrombosis	6	30.0	1	20.0	5	33.3	0.317	1.000
secondary to hyper coagulable state	1	5.0	0	0.0	1	6.7	0.351	1.000
Liver cirrhosis	9	45.0	0	0.0	9	60.0	5.455*	0.038*
Portal hypertension	8	40.0	0	0.0	8	53.3	4.444	0.055
DM	4	20.0	2	40.0	2	13.3	1.667	0.249
Atherosclerosis	4	20.0	4	80.0	0	0.0	15.0*	0.001*
Ischemic heart disease	2	10.0	2	40.0	0	0.0	6.667	0.053

Table 6. The final diagnosis and management of the studied cases

Final diagnosis	Surgical management	Follow up, repeated CT	P
Acute MVO	10 (75%)	2 (25%)	**0.001***
Chronic MVO	2 (25%)	6 (75%)	

4. DISCUSSION

Mesenteric ischemia is a medical condition in which inflammation and injury of the small intestine result from inadequate blood supply. Causes of the reduced blood flow can include changes in the systemic circulation (e.g. low blood pressure) or local factors such as constriction of blood vessels or a blood clot, which is common in the elderly[12].

Mesenteric ischemia is caused by a reduction in intestinal blood flow and is classified as acute (sudden onset of intestinal hypoperfusion) or chronic depending on the time course of symptoms. Chronic mesenteric ischemia, also called intestinal angina, refers to episodic or constant hypoperfusion of the small intestine that can occur, typically in patients with multivessel mesenteric stenosis or occlusion.[13].

Mesenteric ischemia (MI) is an uncommon medical condition with high mortality rates. The disease can be divided into acute and chronic MI (CMI), with the first being subdivided into four categories. Therefore, acute MI (AMI) can occur

as a result of arterial embolism, arterial thrombosis, mesenteric venous thrombosis and non-occlusive causes. AMI caused by arterial embolism accounts for 50% of acute ischemic conditions. The SMA is the visceral vessel the most susceptible to emboli due to its small take-off angle from the aorta and higher flow [3].

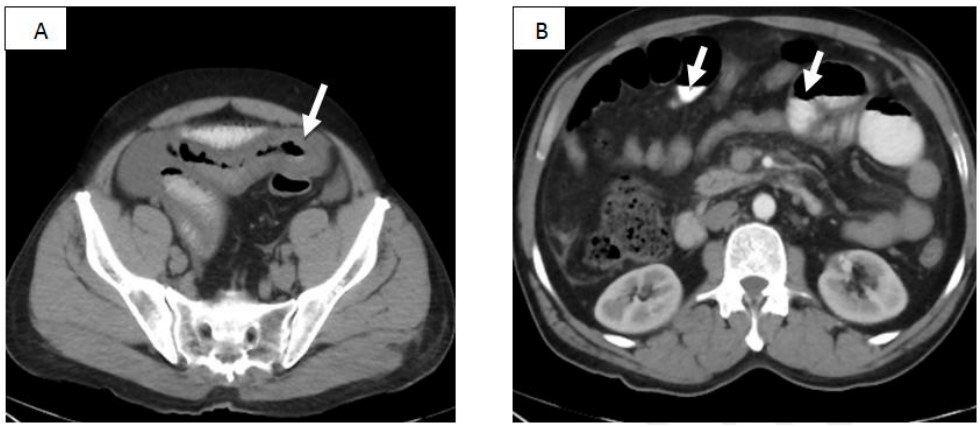

Fig. 1. (a) Axial un enhanced CT showed thick edematous bowel, hypo dense bowel wall. b) axial contrast enhanced CT arterial phase showed multiple dilated loops

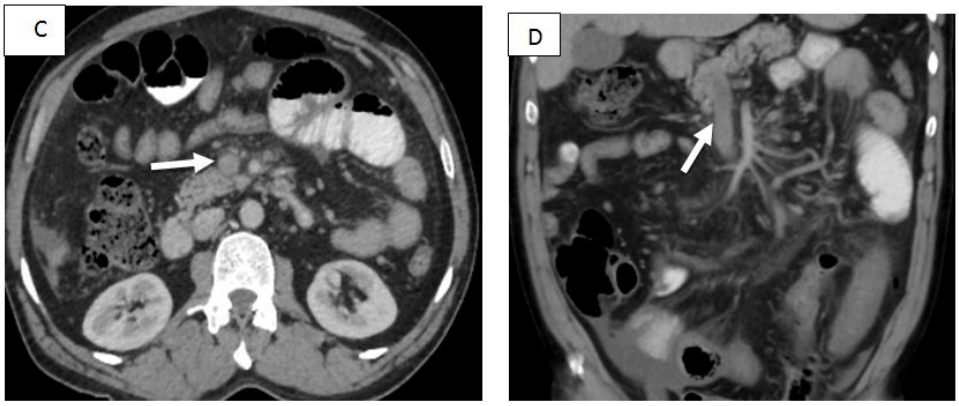

Fig. 2. Contrast enhanced CT portal venous phase axial (c), coronal MIP (d) showed non-opacified superior mesenteric vein

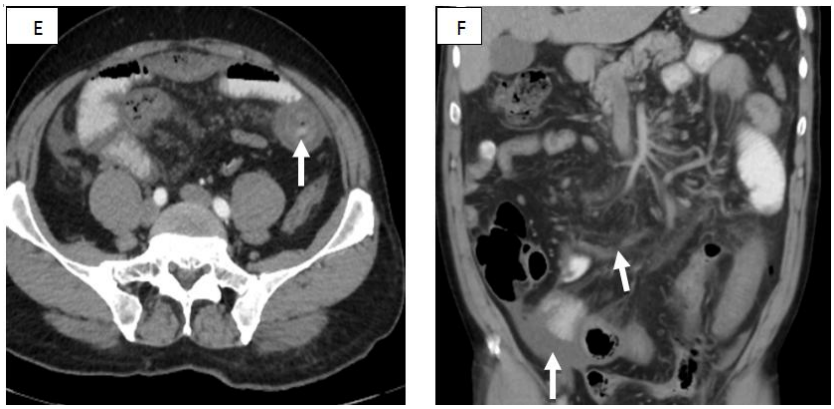

Fig. 3. (e) axial Contrast enhanced CT arterial phase showed target sign (f) coronal MIP showed mesenteric fat stranding and also noted free fluid

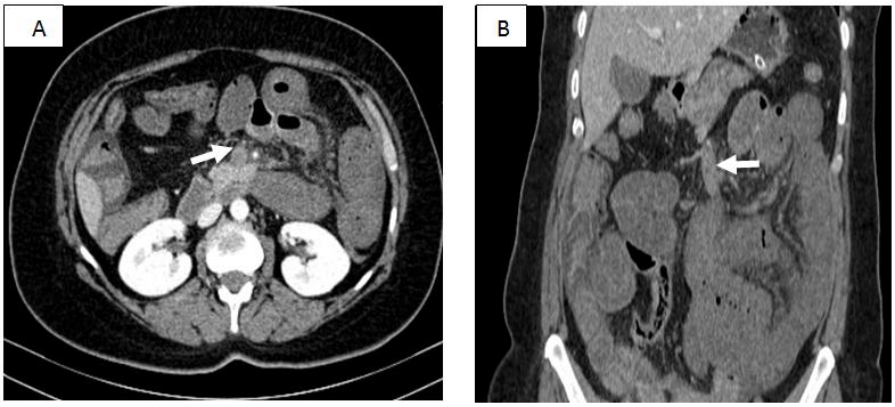

Fig. 4. Contrast enhanced CT late arterial phase axial (a), coronal MIP (b) showed non opacified SMV

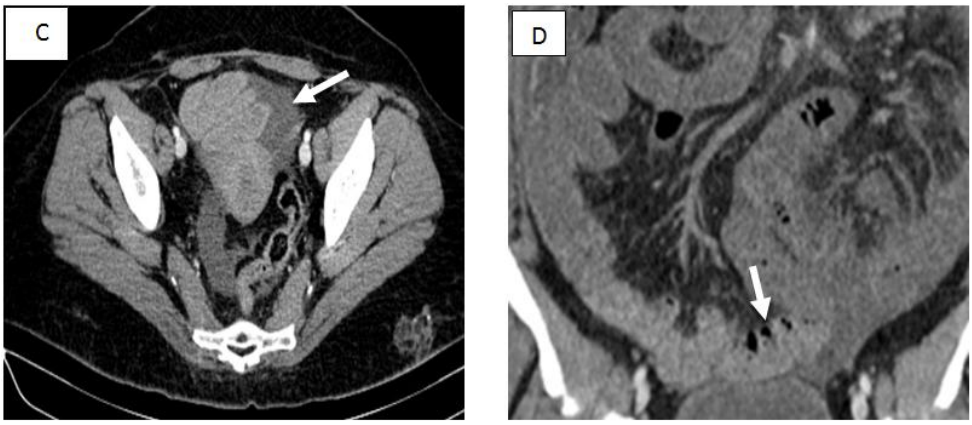

Fig. 5. Contrast enhanced CT portal venous phase c) axial intra peritoneal free fluid, (d) coronal MIP air within bowel wall (pneumotosis intestinalis) white arrow

MDCT uses volume scanning to produce isotropic images that have been widely used for axial, coronal, and sagittal reformations in clinical radiology. The axial and coronal reformation post-processing protocols have been the standard for MDCT examination of abdominal diseases. MDCT has been equipped with many kinds of image post-processing techniques with a wide range of clinical applications in human vascular disease diagnosis. For many non-vascular diseases, if the axial, coronal, and sagittal images provide poor resolution of the anatomic details of a lesion, radiologists could add one or more post-processing techniques to improve diagnostic accuracy[14].

Multidetector computed tomography (MDCT) has high sensitivity and specificity for diagnosing acute primary mesenteric ischemia. MDCT findings vary widely depending on the cause and underlying pathophysiology. MDCT findings of mesenteric ischemia should be characterized on the basis of the cause [15].

In addition, the severity of bowel ischemia (i.e., superficial mucosal or transmural bowel wall necrosis), the location (i.e., small or large bowel), and the presence and degree of hemorrhage or subsequent superinfections may affect MDCT appearance. The classification and management strategy of spontaneous isolated superior mesenteric artery dissection[16].

Our results were supported by study of Mohamed and Mohey in 2020 [17] as they reported that their prospective study included 58 consecutive patients (30 males and 28 females), their average age was 65 years (range: 52-77 years).

In the study of Ali et.al in 2017 [18] they included 40 patients, 11 females (27.5%) and 29 males

(72.5%). Ranging in age from 14 to 93 years and the mean age was 49.6 years.

The multiphasic MDCT imaging protocol includes both arterial and portal venous phase acquisitions: the arterial phase is required for optimal assessment of the mesenteric arterial supply, as thromboembolic disease may account for 60–80% of acute mesenteric ischemia cases, and the venous phase is used for assessing bowel wall enhancement and venous drainage. Typical contrast media is as follows: 120 ml of non-ionic iodinated contrast material is power injected at a rate of 3–5 ml/s, followed by a saline chaser; 120 kVp; 270–300 mAs with automatic tube current modulation whenever possible; as thin a collimation as possible (e.g. 0.625 mm in 64-slice scanners) because of the small size of mesenteric branches[19].

The present study showed that as regard imaging procedures included that 12 patients (60%) were acute, 8 patients (40%) were Chronic, SMA in 5 patients (25%), SMV in 15 patients (75%), PORTAL V in 8 patients (40%), thick bowel wall in 14 patients (70%), thin bowel wall in 5 patients (25%), hyper dense bowel wall in 4 patients (20%), hypo dense bowel wall in 6 patients (30%), hyper enhancement in 5 patients (25%), no enhancement in 1 patient (15%), target sign in 8 patients (40%), pneumointestinalis in 10 patients (50%), mesenteric fat stranding in 14 (70%), intra peritoneal free fluid in 12 patients (60%), intestinal obstruction in 2 patients (10%), organ infarction in 2 patients (10%), along its length in 14 patients (70%).

Our results were supported by study of Emara et.al in 2018 [20] as they revealed that their study was carried out on 30 patients with clinically suspected mesenteric vascular occlusion. According to their clinical status and the onset of pain the current study showed 24 patients with acute mesenteric vascular occlusion and six patients with chronic mesenteric vascular occlusion. This low incidence of chronic MVO was mentioned in many published studies conducted by Shih et.al in 2007 [21] which stated that chronic mesenteric ischemia is relatively uncommon.

In Emara's study [20], the most prevalent MSCT intestinal findings in 30 patients with positive CT angiographic findings were bowel wall thickening in 16 patients (53.3%). These findings more or less matched with those reported by Serpa et.al in 2010 [22] followed by diminished wall enhancement was described in the contrast enhanced CT (CECT) series of 15 patients representing (50%) of cases, which is matched with Wong.[23].

Furthermore, Al-Azzazy et.al in 2012 [24] demonstrated that suspected acute MI cases were 28 patients, while chronic MI cases were 10 patients. The most common finding of MI regarding the intestine is mural bowel wall thickening (89.2%), followed by bowel distension (71.4%).

In the study of Metwally et.al in 2019 [25] out of 40 patients, 16 (40%) patients were diagnosed with acute mesenteric ischemia acute mesenteric ischemia (AMI) while 24 (60%) patients were diagnosed with chronic mesenteric ischemia chronic mesenteric ischemia (CMI). In this study, 40 (66.7%) patients out of 60 patients showed abnormal MDCT findings which explained the cause of mesenteric ischemia in these patients. These findings agree with Barmase et.al in 2011 [26] who performed a study on 31 patients with clinically suspected mesenteric ischemia and report that 16 (53.3%) patients out 31 patients showed abnormal CT angiographic findings which explained the cause of mesenteric ischemia.

Mesenteric ischemia (MI) is an uncommon medical condition that accounts 0.1% of all hospital admissions, with high mortality rates ranging from 24%-94%. MI includes inadequate blood supply, inflammatory injury and eventually necrosis of the bowel wall. The disease can be divided into acute and chronic MI (CMI), with the first being subdivided into four categories[27].

In the study in our hands, comparing between Acute and Chronic MVO according to demographic data revealed no statistically significant difference between Acute and Chronic as regard sex and age.

Our results were supported by study of [17] as they reported that there was no statistically significant difference between acute and chronic MI regarding age and sex.

The American College of Radiology Appropriateness Criteria advocates computed tomography angiography (CTA) as the first-line imaging modality to evaluate both acute and chronic mesenteric ischemia. In the last few years there was development in CT using fast

technique with high spatial resolution, rapid IV contrast injection with adequate timing for arterial and venous phases together. Accurate diagnosis of MVO and its associated findings of the affected bowel are essential for proper management to decrease the morbidity and mortality and also to improve the patient's outcome.[20].

The present study showed that there is no statistically significant difference between acute and chronic mesenteric vascular occlusion according to imaging procedures outcomes.

In the study of Mohamed and Mohey in 2020 [17] their findings were matching with that as the most frequent CT finding in AMI was bowel wall thickening (n=12, 85.7%), while it was detected in 4 of CMI cases (40%). However, absence of bowel wall thickening should not exclude the diagnosis of mesenteric ischemia as in transmural infarction of acute arterioocclusive and the bowel wall may be very thin. In their study 10 of 14 (71.2%) cases with AMI showed bowel distension, bowel distension as a common finding and attributed to a peristalsis due to ischemic changes or contractility dysfunction in transmural infarction. Two cases of AMI (14.28%) displayed hyperattenuation in pre-contrast study which could be explained by submucosal bleeding while low attenuation could be due to edema and inflammation.

According to Metwally et.al 2019 [25] in this study eight of 16 (50%) patients with AMI showed pneumatosis intestinalis and surgical exploration showed bowel infarction and resection anastomosis was done, thus this CT finding is extremely specific and is considered late onset finding and this result was in agreement with different published studies as that of Karkkainen et.al in 2016 [28] 67% patients showed ischemia-specific CT findings (decreased bowel wall enhancement and pneumatosis).

The current study showed that there was no statistically significant difference between acute and chronic occlusion as regard predisposing factors except as regard portal hypertension which is more frequent in chronic type.

In the study of Emara et.al in 2018 [20] MSCT angiography detected accurately the cause of acute MVO, where portomesenteric venous thrombosis represented (70.8%) of acute MVO, however arterial occlusion was the cause in (20.8%) of patients and combined MAO and MVT (8.4%). SMA thromboembolism was described in all patients with acute MAO.

Furthermore, Al-Azzazy et.al in 2012 [24] revealed that arterial stenosis was the most common cause of the CMI cases (66.6%). CTA properly diagnosed eight cases in whom the final diagnosis was confirmed by conventional angiography in seven of them. Follow up for a stented SMA aneurysm case, CTA clearly identified occluded stent. In chronic SMV thrombosis case with bowel loops pneumatosis underwent resection of infracted loops.

Regarding Metwally et.al in 2019 [25] CTA showed abnormal findings consistent with CMI and explained the cause in 24 patients; arterial atherosclerosis of the splanchnic arteries with variable degrees and combinations of stenosis or occlusion was the most common cause. These results were in agreement with this study of Dhatt in 2015 [29] which reported that atherosclerosis of splanchnic arteries with subsequent stenosis or occlusion was the cause of CMI in nine patients.

Arterial occlusion may present lack of enhancement of the vessels, but unlike embolic infarction, thrombosis of the SMA occurs more commonly in the origin of the vessel. In MVT, CT scans may demonstrate an enlarged mesenteric or portal vein with sharp definition of the venous wall and low density within the vessel. Magnetic resonance imaging (MRI) along with MRA yields similar findings to those of CT scanning in AMI.[3].

In the study in our hands, there was no statistically significant difference between SMA and SMV as regard sex and age. There is no statistically significant difference between SMA and SMV according to imaging findings except as regard thick bowel wall which was more in SMV, and thin bowel wall more in SMA.

In the study of Emara et.al in 2018 [20] regarding the decreased bowel wall thickening which was detected in four cases, three cases with acute SMA thrombosis and one case due to mixed SMA and SMV thrombosis, the usual findings is marked thinning out of the bowel wall as compared to the adjacent normal bowel which means that it became paper like and even difficult to be measured. This was matching with Dhatt [29] who described thinning out of the ischemic bowel in cases mainly of arterial

occlusion which is affecting the vasculature and muscle tone of the wall itself with consequent trans mural infarction.

Our results were supported by study of Mohamed and Mohey in 2020 [17] as they revealed that for AMI: CTA pointed out the cause of AMI in 14 patients (dominant cause was arterial thromboembolism which was detected in 10 patients (71.4%), the most frequent site was SMA (n=7, 70% of thromboembolic cases) while 3 cases with AMI had porto-mesenteric venous thrombosis (21.4%). One case had shock bowel syndrome 2ry to perforated stomach showed thickened hyper enhanced bowel wall. This patient had also associated rectal mass. For CMI: CTA diagnosed relevant signs and found out the reason of pain in 10 patients (atherosclerosis of the splanchnic arteries with significant stenosis or occlusion was the dominant reason (n=7, 70%) and the SMA showed significant stenosis or occlusion with collateralization among those patients. On the other hand, MDCT showed SMV thrombosis in 2 patients (20%) and PV and SMV thrombosis in one patient (10%).

5. CONCLUSION

The present study showed that the final diagnosis of the studied suffering acute MVO and SMA thromboembolism were surgically proven. However, patients with porto-mesenteric venous thrombosis were treated conservatively and serial CT scans showed improved bowel appearance as the venous thrombosis decreased in size after anticoagulant therapy. Patients with chronic MVO were successfully treated conservatively by anticoagulant.

6. RECOMMENDATIONS

Further studies on larger sample size and on large geographical scale to emphasize our conclusion.

Future studies may show whether multidetector scanners with more rows and higher image resolution (perhaps approaching angiography-like resolution) can provide diagnostic accuracy similar to or even greater than that reported here. The results of such studies may also indicate which types of scanner and scan protocols are sufficient to diagnose the AMI.

Future research on primary AMI aims at reducing the high mortality rate by improving diagnosis and therapy. In diagnosis, different markers of thrombosis and ischemia that could help to identify patients with AMI early are being studied. New research on therapy is addressing the prevention of post ischemic bowel reperfusion injury.

CONSENT

After approval from institutional ethical committee, an informed consent was taken from each patient.

ETHICAL APPROVAL

The study was approved by ethical committee number 32257.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/73742