IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ACUTE MESENTERIC ISCHEMIA – MULTIDETECTOR COMPUTED TOMOGRAPHY FINDINGS

[1]Dr. Ananya K, [2]Dr. Dayananda Kumar R, [3]Dr. Yathish B M, [4]Dr. Preethi B V, [5]Dr. Aromal Raj J

[1]Radiology Resident, [2]Professor and HOD, [3]Radiology Resident, [4]Radiology Resident, [5]Radiology Resident

[1]Radio-diagnosis,

[1]M.V.J Medical College and Research Hospital, Bangalore, India

Abstract:

Background:

Acute mesenteric ischemia although uncommon is a life-threatening condition. Patients usually presents with severe abdominal pain. Early diagnosis by contrast-enhanced Computed Tomography can reduce the high morbidity and mortality associated with this disease.

Materials and Methods:

A retrospective study was conducted from December 2020 to November 2022 in MVJ Medical College and Research Hospital, Bangalore. A total of 10 such cases were found and included in this study. The predominant sign was presence of occlusion in the mesenteric vessels including the arteries and the veins. The other signs included consequent bowel wall thickening or thinning, reduced or absent bowel wall enhancement, pneumatosis intestinalis, dilatation of bowel loops with air-fluid levels, mesenteric edema, ascites and pneumoperitoneum. Follow-up of patients was done for confirmation with intra-operative findings wherever possible.

Results:

10 patients were included in the study ranging from 38 years to 80 years age group. The mean age was 56 years. 80 % of the study population were males and 20 % were females.

All the cases showed evidence of occlusion in the mesenteric arteries or mesenteric veins and its branches, with or without collaterals formation. Mesenteric arterial occlusion was seen in 60% of cases and mesenteric venous occlusion in 40% of cases.

Consequently, bowel wall thickening was seen in 90% of cases, absence of bowel wall enhancement in 60% of cases, bowel wall thinning in 10% of cases, pneumatosis intestinalis in 30% of cases, dilatation of bowel loops with air-fluid levels in 40% of cases, mesenteric edema and ascites in 100% of cases, pneumoperitoneum in 20% of cases.

Conclusion:

Contrast-enhanced Computed Tomography is the best modality for assessment of acute mesenteric ischemia, gives accurate diagnosis and plays a pivotal role in timely management of the disease.

Key words: **acute mesenteric ischemia, CT, emergency radiology, mesenteric arterial occlusion, mesenteric venous occlusion, nonocclusive mesenteric ischemia, bowel obstruction.**

I. INTRODUCTION

Mesenteric ischemia is defined as vascular compromise of the bowel and its mesentery. Mesenteric ischemia can be acute or chronic. Acute mesenteric ischemia is much more common than the chronic variety. Mesenteric ischemia is uncommon ranging about 0.09 to 0.2% of surgical admissions. [1] However it has associated high morbidity and mortality, with mortality rates ranging from 30 to 90%. [2] Therefore this disease is categorized under critical or emergency radiological diagnoses.

The clinical presentation is variable. The classic presentation of acute mesenteric ischemia is severe abdominal pain which is disproportionate to examination findings and does not reduce with analgesics. However, the more common clinical symptoms are non-specific including nausea, abdomen distention, vomiting and diarrhoea. Chronic mesenteric ischemia is insidious in onset and patients present with loss of appetite, loss of weight, 'food fear'. Laboratory evaluation is also non-specific for mesenteric ischemia.

The diagnosis of mesenteric ischemia is challenging owing to the rarity of the disease and the non-specific clinical as well as laboratory findings. Earlier catheter angiography was the gold standard in assessment of cases of suspected bowel ischemia. Now, contrast enhanced CT imaging has replaced it and is the investigation of choice in diagnosis of mesenteric ischemia. CT also has the added advantage of ruling out other causes of abdominal pain. It is vital for radiologist to know the various imaging features associated with this disease.

The mesenteric vasculature includes arterial supply and venous drainage. The celiac axis (CA), Superior Mesenteric Artery (SMA) and Inferior Mesenteric Artery (IMA) arise from the aorta at the levels of T12, L1 and L3 vertebral bodies respectively. The celiac axis further gives rise to Common Hepatic Artery, Splenic Artery, Left Gastric Artery and its branches which supply the liver, stomach, pancreas and spleen. SMA gives rise to jejunal and ileal branches, the Inferior Pancreaticoduodenal Artery, the Ileocolic artery, the Right Colic Artery and Middle Colic Artery which supply the pancreas, duodenum, jejunum, ileum, ascending colon and the transverse colon upto the splenic flexure. IMA gives rise to the Left Colic Artery, sigmoidal branches and terminates as the Superior Rectal Artery which supplies the descending colon, sigmoid colon and rectum. [3-5]

Variant anatomy can exist in the mesenteric arterial vasculature and is important to identify. Also, numerous collateral pathways can develop between the vascular territories in the setting of arterial occlusion. The CA and SMA collateralizes primarily via the Gastroduodenal and Pancreaticoduodenal arteries, arc of Barlow (anastomosis between the Left and Right Gastroepiploic Arteries) and arc of Buhler (persistent communication between embryonic ventral segmental arteries). The SMA and IMA collateralize via the arc of Riolan (connection between the Middle and Left Colic Arteries) and the marginal artery of Drummond (branches of the Ileocolic, Right, Left, and Middle Colic Arteries). [3-5]

The superior and inferior mesenteric veins follow their respective arterial territories. The superior mesenteric vein drains into the portal vein at the portosplenic confluence, while the inferior mesenteric vein first drains into the splenic or superior mesenteric vein or their confluence. [3-5]

II. AIMS AND OBJECTIVES

The aim of this study is to assess the spectrum of imaging findings in acute mesenteric ischemia to ensure early diagnosis of the disease and its prompt treatment.

III. MATERIALS AND METHODS

A retrospective study was conducted from December 2020 to November 2022 in MVJ Medical College and Research Hospital, Bangalore. With computer-assisted search all contrast enhanced CT studies of Abdomen and Pelvis of patients who presented with abdominal pain and other non-specific abdominal complaints performed in the above-mentioned time period were reviewed. A total of 10 cases of acute mesenteric ischemia were found and included in the study.

The subjects included patients of both sexes with no specific age criteria. Inclusion criteria included patients who presented to the Department of Radiodiagnosis, MVJ Medical College and Hospital for contrast enhanced CT scan with complaints of acute abdominal pain. Patients who presented with other non-specific abdominal complaints such as nausea, vomiting, distention of abdomen, loss of appetite, weight loss and diarrhoea were also in the study. Patients who did not give valid consent and pregnant women were excluded from the study. Patients who presented with acute abdominal pain but were unfit for contrast workup were included under emergency basis with high risk consent. Relevant clinical evaluation was carried out at the time of presentation.

Ultrasound Abdomen and Pelvis reports, laboratory investigation reports were also reviewed if taken. After relevant examination and informed consent, CT scan was performed as follows.

The study of the patients was done using GE Brivo 16 slice CT scanner and after eliminating all artifacts from the scanning area. Firstly, a scout view was obtained of the abdomen and pelvis region with 100 kvp and 60 mA as voltage and current. Plain CT images were obtained from the dome of the liver to the level of the perineum to cover the entire course of the intestine. Voltage and current settings of 120 kvp and 200 mA were used respectively. Axial images with section thickness of 5 mm were obtained and reconstructed in multiplanar coronal and sagittal planes using thin sections of 1.2 mm. A positive iodinated contrast agent diluted with water was used as oral contrast agent. For dual-phase contrast-enhanced CT, 1ml/kg body weight of iodinated contrast material namely Iohexol injection (300 mg I/ml) was administered IV at a rate of 3.5 mL/s, scans were obtained with delay time of 35-40 seconds for arterial phase and 80-100 seconds for venous phase respectively.

The predominant sign was occlusion of the mesenteric vessels including the arteries and the veins. Other signs included consequent bowel wall thickening or thinning, reduced or absent bowel wall enhancement, pneumatosis intestinalis, dilatation of bowel loops with air-fluid levels, mesenteric edema, ascites and pneumoperitoneum. Follow-up of patients was done for confirmation with intra-operative findings wherever possible.

Statistical Analysis: All the data obtained were recorded in a tabulated form and analysed on MS Excel.

IV. RESULTS

A total of 10 patients diagnosed with mesenteric ischemia on contrast enhanced CT were found and included in the study. The age group was ranging from 38 years to 80 years. The mean age was 56 years. 80 % (n = 8) of the study population were males and 20 % (n = 2) were females (Table 1).

All 10 of the cases showed evidence of occlusion of the mesenteric arteries or mesenteric veins and its branches. Mesenteric arterial occlusion was seen in 60% (n = 6) of cases and mesenteric venous occlusion in 40% (n = 4) of cases (Table 2). Out of 6 cases of arterial occlusion, celiac axis and its branches were occluded in 66 % (n = 4) of cases, SMA and its branches were occluded in 100% (n =6) of cases, IMA was occluded in 16% (n = 1) of cases. Formation of collaterals between the arterial territories was seen in 66% (n = 4) of cases. Out of 4 cases of venous occlusion, SMV was occluded in 75% (n =3) of cases, splenic vein was occluded in 0% (n = 0) of cases, portal vein was occluded in 50% (n =2) of cases and IMV was occluded in 0% (n = 0) of cases. Non-occlusive mesenteric ischemia with shock bowel features was not observed in any of the 10 cases (Table 3).

Bowel wall thickening was seen in 90% (n = 9) of cases, absence of bowel wall enhancement in 60% (n = 6) of cases, pneumatosis intestinalis in 30% (n = 3) of cases, bowel wall thinning in 10% (n = 1) of cases, dilatation of bowel loops with air-fluid levels in 40% (n = 4) of cases, mesenteric edema and mesenteric fat stranding in 100% (n = 10) of cases, ascites in 100% (n = 10) of cases, pneumoperitoneum was seen in 20% (n = 2) of cases (Table 4).

All 10 patients underwent emergent open laparotomy for re-establishment of blood flow and resection of non-viable intestine. The collected data of intra-operative findings were in agreement with the imaging findings.

Table 1. Distribution of cases based on age and sex

Age interval	Male	Female	Total
30 – 40 years	0	1	1
40 – 50 years	3	1	4
50 – 60 years	1	0	1
60 – 70 years	2	0	2
70 – 80 years	2	0	2
Total	8	2	10

Table 2. Distribution of cases based on etiology of acute mesenteric ischemia

Etiology	No. of cases
Arterial occlusive mesenteric ischemia	6
Venous occlusive mesenteric ischemia	4
Non-occlusive mesenteric ischemia	0
Strangulated obstruction	0
Other rare causes	0
Total	**10**

Table 3. Distribution of cases based on mesenteric arterial and venous occlusion

Vessel occluded	No. of cases
Mesenteric Arterial occlusion:	
Celiac axis	4
Superior Mesenteric Artery	6
Inferior Mesenteric Artery	1
Mesenteric venous occlusion:	
Superior Mesenteric Vein	3
Splenic Vein	0
Inferior Mesenteric Vein	0
Portal vein	2

Table 4. Distribution of cases based on imaging features of bowel ischemia.

Imaging features	No. of cases
Bowel wall thickening	9
Bowel wall thinning	1
Bowel wall hypoenhancement	6
Bowel dilatation	4
Ascites	10
Mesenteric edema and fat stranding	10
Pneumatosis intestinalis	3
Pneumoperitoneum	2

V. DISCUSSION

Contrast-enhanced Computed Tomography is the modality of choice for diagnosis of acute mesenteric ischemia. As per the American College of Radiology (ACR) Appropriateness Criteria, computed tomographic angiography (CTA) is the first-line diagnostic modality for mesenteric ischemia. Rapid, widely available, and relatively inexpensive, CTA has a sensitivity of 96% and a specificity of 94% in the diagnosis of both the acute and chronic forms of mesenteric ischemia. [6] Magnetic resonance angiography (MRA) is best suited for assessment of chronic mesenteric ischemia, for which it has been shown to have high sensitivity and specificity. [6] Doppler Ultrasound can be used to evaluate chronic mesenteric ischemia, however has many limitations. Conventional abdominal radiographs are neither sensitive nor specific for assessment of mesenteric ischemia. [6]

Acute mesenteric ischemia based on its etiology can be broadly classified as occlusive or non-occlusive. Occlusive mesenteric ischemia can be further subcategorised into arterial occlusive mesenteric ischemia and veno-occlusive mesenteric ischemia. Arterial occlusion can be thrombotic or embolic in nature whereas venous occlusion is always due to thrombosis. SMA is

the most commonly affected in arterial mesenteric ischemia and SMV is the most commonly affected in veno-occlusive mesenteric ischemia. [7]

Furukawa A et al in their study state that 60-75% of mesenteric ischemia is due to arterial occlusion and 5 to 10% of mesenteric ischemia is due to venous occlusion. In arterial occlusion, 40-50% is due to arterial embolism and 20-30% is due to arterial thrombosis. [8] Similar incidence ranges is also quoted in a study done by Olson et al. [7] This was comparable with our study in which 60% of the cases were due to arterial mesenteric ischemia. However, in our study there is higher incidence of venous mesenteric ischemia accounting for 40% of the patients.

In sepsis or shock, intestinal hypoperfusion leads to features of 'shock bowel' known as non-occlusive mesenteric ischemia. According to Furukawa A et al, NOMI comprises 20-30% of mesenteric ischemia. [8] Another study by Clair DG et al, states than NOMI comprises 5 to 15% of cases of mesenteric ischemia. [9] However in our study, there was no case of NOMI.

Closed-loop bowel obstruction can lead to ischemia of the mesentery and mesenteric vessels known as strangulation. This can be seen in 10% of patients with bowel obstruction as stated by Furukawa A et al. [8] However in our study, no case of closed loop bowel obstruction was seen. Other rare causes of mesenteric ischemia include vasculitis such as polyarteritis nodosa, Henoch-Schonlein purpura etc, blunt or penetrating trauma to the abdomen, post invasive procedures, sickle-cell disease and radiation enteritis.

Irrespective of etiology of mesenteric ischemia, the affected organ is bowel. Bowel findings manifest after the vascular findings. Bowel wall thickening upto 15 mm can occur due to submucosal edema or hemorrhage, it is the most sensitive indicator of ischemia however is least specific. In venous occlusion, target or halo appearance of the bowel wall is seen due to hypodense edema in the submucosal layer. Reduced or absent bowel wall enhancement can be seen in both arterial and venous occlusion, and is a highly specific finding. Arterial occlusion leads to 'pale ischemia' of the bowel wall. Prolonged occlusion of artery can lead to thinning of the bowel wall giving rise to 'paper-thin' bowel appearance. Re-perfusion leads to hyperenhancement of the bowel wall due to mural hyperaemia. Dilatation of bowel loops is also a frequent finding occurring due to disruption of peristalsis; however it is a non-specific finding. Mesenteric stranding and ascites are seen more commonly in strangulating obstruction or venous occlusion due to infiltration of fluid into the mesentery. Pneumatosis intestinalis meaning presence of air within the bowel wall, porto-mesenteric gas and free intraperitoneal air are seen in end-stage of ischemia and has high specificity.

Mesenteric ischemia presents with a vast array of imaging features, with varying degrees of specificity. [10] The mimickers of mesenteric ischemia and bowel ischemia includes bowel wall thickening due to infections or inflammatory processes, bowel wall dilatation due to ileus or pseudo-obstruction, bowel wall hyperenhancement due to IBD or radiation.

The limitations of this study were a small sample size and retrospective nature of the study inherent to selection bias and lack of follow-up.

VI. CONCLUSION

Acute mesenteric ischemia is a life-threatening condition. Contrast-enhanced Computed Tomography is the best modality for assessment of acute mesenteric ischemia. It gives accurate diagnosis and hence plays a pivotal role in timely management of the disease. Therefore, the overall morbidity and mortality associated with acute mesenteric ischemia can be reduced. Mesenteric ischemia encompasses a broad array of conditions causing insufficient blood flow and a spectrum of imaging features. It is important for the radiologist to be familiar with the imaging findings of mesenteric ischemia to warrant rapid diagnosis of the disease.

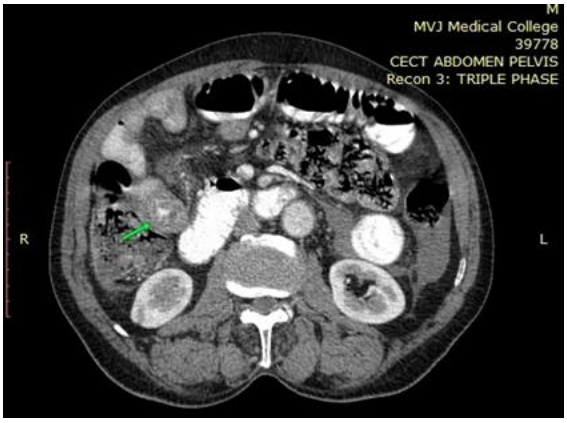
VII. ACKNOWLEDGEMENT

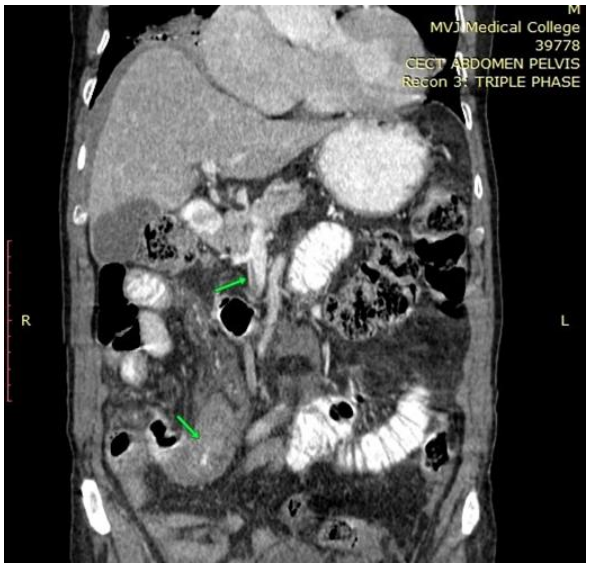
I sincerely thank, Dr. Dayananda Kumar R, Professor and HOD, Department of Radiodiagnosis, M.V.J. Medical College and Research Hospital, Bangalore for his continuous encouragement and help in doing this study. I would also like to thank my respected teachers and my colleagues for their support. I also thank the CT technicians for their invaluable help in performing the CECT studies on patients. Last but not the least, I thank the patients for their cooperation.

VIII. REFERENCES

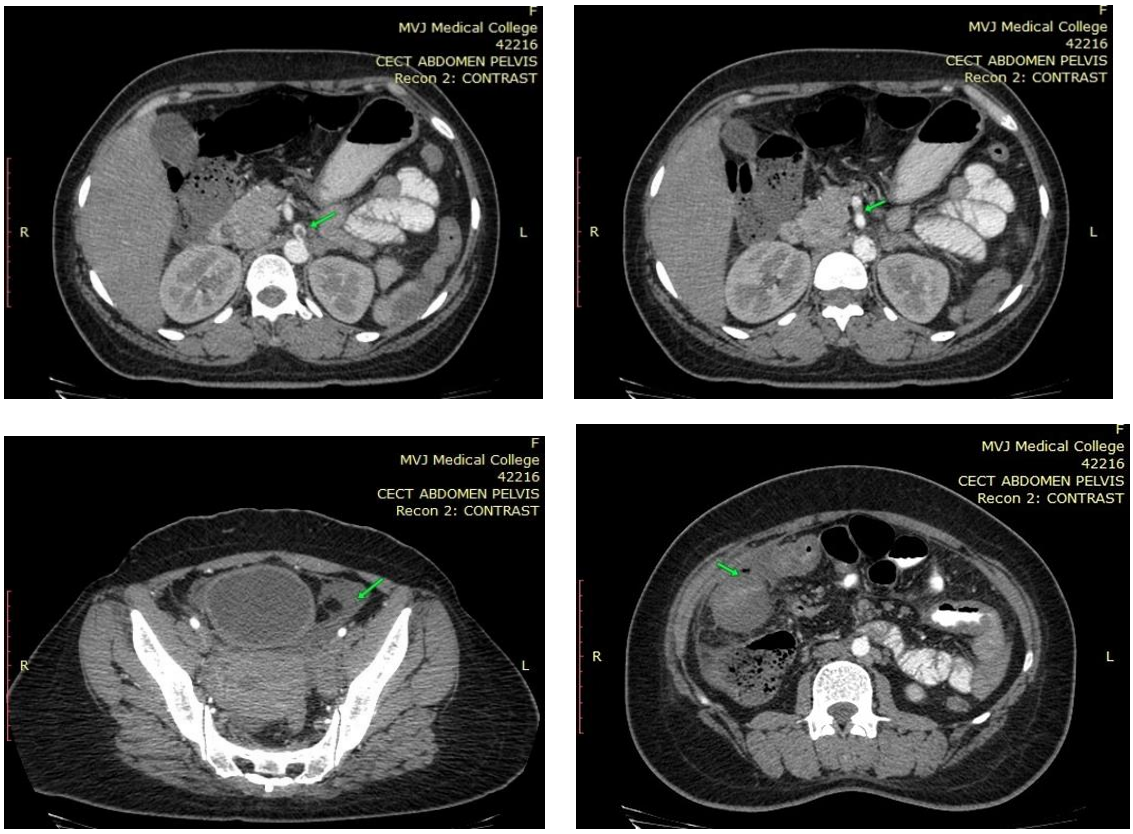
1. Bala M, Kashuk J, Moore EE, et al. Acute mesenteric ischemia: guidelines of the World Society of Emergency Surgery. World J Emerg Surg. 2017;12:38.
2. Herbert GS, Steele SR. Acute and chronic mesenteric ischemia. Surg Clin North Am. 2007;87:1115-34, ix.
3. Costa AF, Chidambaram V, Lee JJ, et al. Multidetector computed tomography of mesenteric ischaemia. Insights Imaging. 2014;5:657-66.
4. Horton KM, Fishman EK. CT angiography of the mesenteric circulation. Radiol Clin North Am. 2010;48:331-45, viii.
5. Rosenblum JD, Boyle CM, Schwartz LB. The mesenteric circulation. Anatomy and physiology. Surg Clin North Am. 1997;77:289-306.
6. Oliva IB, Davarpanah AH, Rybicki FJ, et al. ACR Appropriateness Criteria (R) imaging of mesenteric ischemia. Abdom Imaging. 2013;38:714-9.
7. Olson MC, Fletcher JG, Nagpal P, Froemming AT, Khandelwal A. Mesenteric ischemia: what the radiologist needs to know. Cardiovasc Diagn Ther. 2019 Aug; 9:S74-S87.
8. Furukawal A, Kanasaki S, Kono N, Wakamiya M, Tanaka T, Takahashi M, Murata K. CT Diagnosis of Acute Mesenteric Ischemia from Various Causes. American Journal of Roentgenology. 2009; 192:2: 408-416
9. Clair DG, Beach JM. Mesenteric Ischemia. N Engl J Med. 2016;374:959-68.
10. Umphrey H, Canon CL, Lockhart ME. Differential diagnosis of small bowel ischemia. Radiol Clin North Am.2008;46:943-52, vi-vii.

IX. REPRESENTATIVE CASES



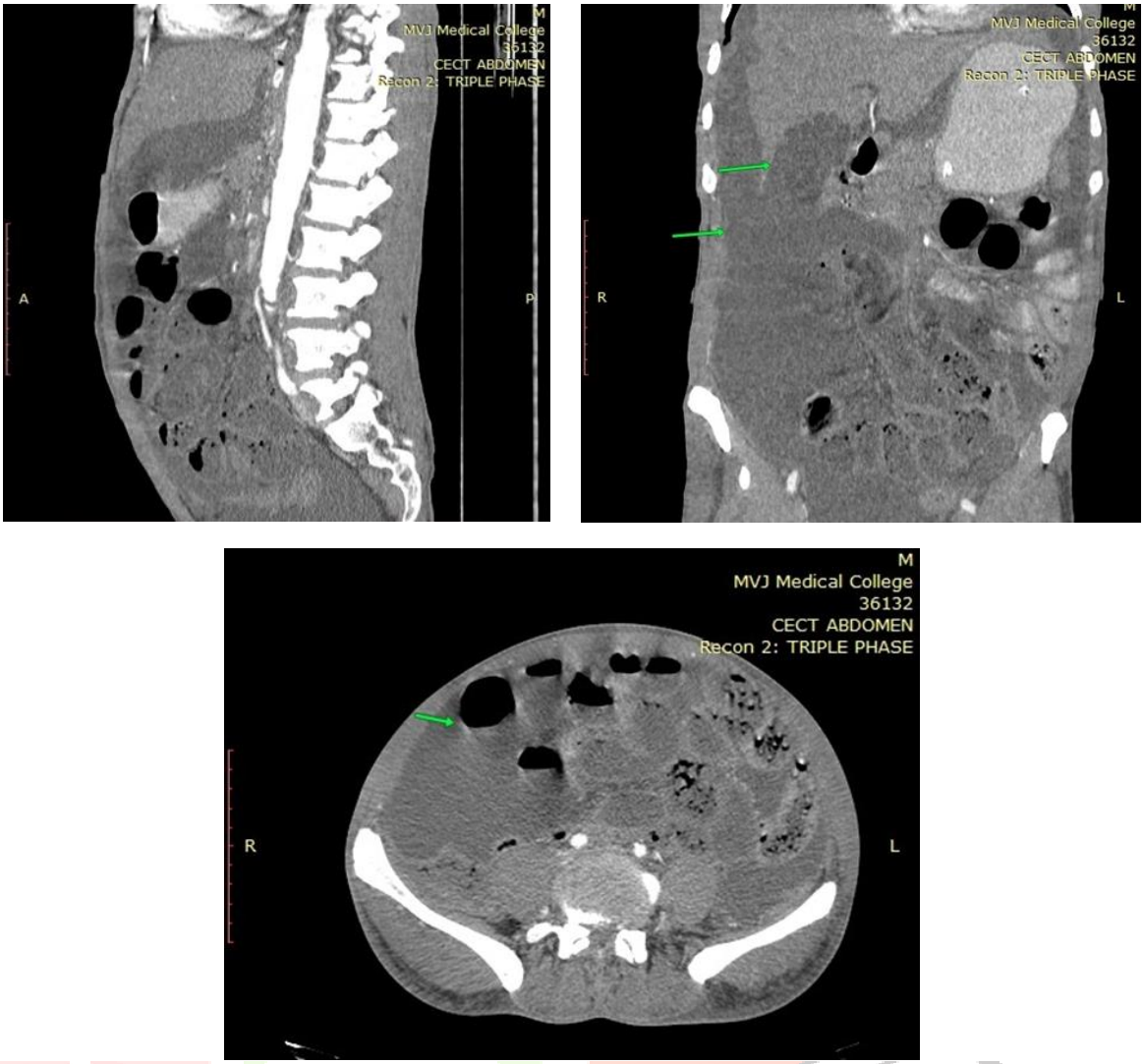


Case 1. (a) Axial and (b) Coronal reformatted images of CECT Abdomen and Pelvis of an 80y/M with partial veno-occlusive mesenteric ischemia. There is non-enhancing hypodense partial thrombus in SMV with smooth non enhancing wall thickening of mid and distal jejunal loops. Mild ascites and mesenteric fat stranding present.



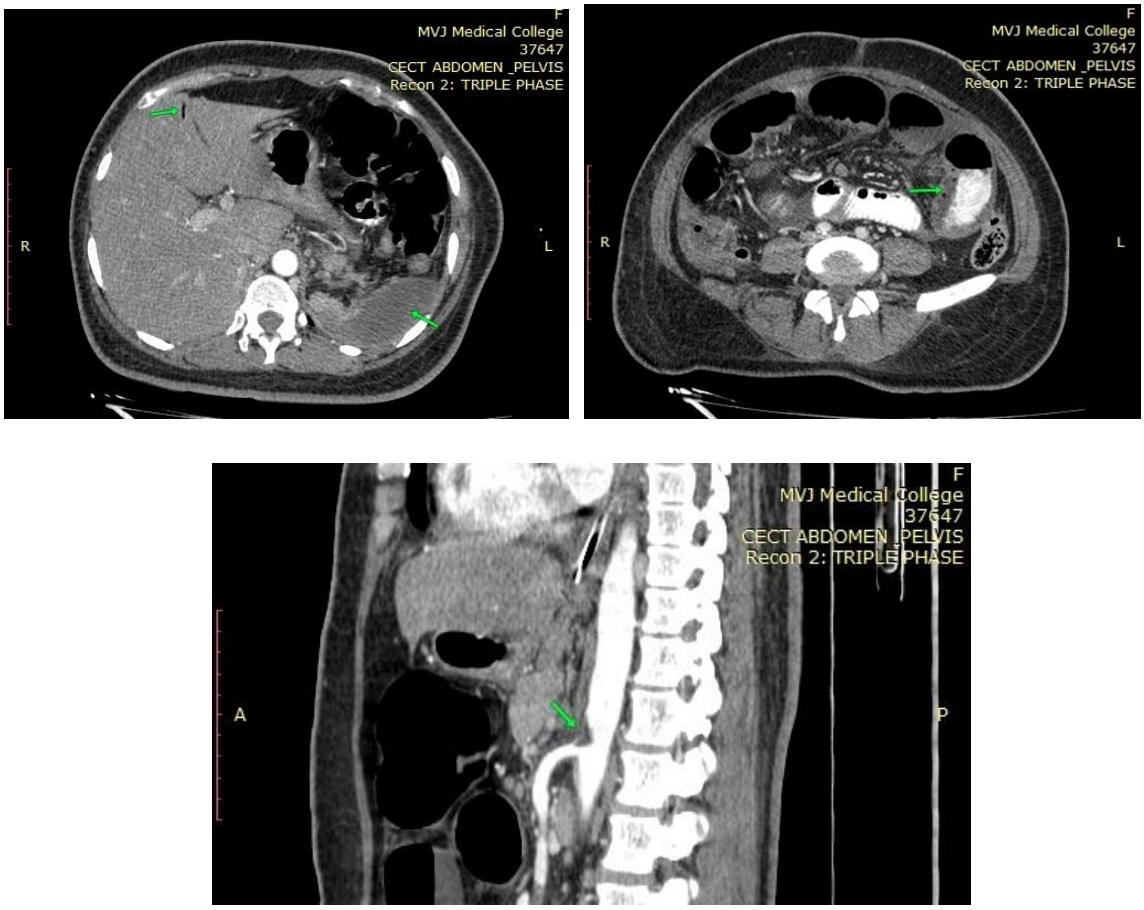
Case 2. Axial images of CECT Abdomen and Pelvis of a 38y/F with arterial occlusive mesenteric ischemia showing

(a) Partial occlusion of celiac axis upto its bifurcation. Occlusion of splenic artery with wedge shaped splenic infarct.
(b) Non-enhancing hypodensity in Superior Mesenteric Artery
(c) Mild to moderate ascites
(d) Circumferential non-enhancing wall thickening involving mid and distal ileal loops with presence of pneumatosis intestinalis and adjacent mesenteric fat stranding



Case 3. (a) Sagittal reformatted, (b) Coronal reformatted and (c) Axial images of CECT Abdomen and Pelvis of a 55y/M with arterial occlusive mesenteric ischemia showing

(a) Non-visualisation of celiac axis and SMA at its origin from abdominal aorta. Branches are visualized likely reformed by collaterals.
(b) Gross ascites with peritonitis. Imaging features of overdistended gall bladder with gross thinning of its wall – likely gallbladder perforation.
(c) Dilated small bowel loops with thin imperceptible walls of distal jejunal and proximal ileal loops.



Case 4. (a,b) Axial and (c) Sagittal reformatted images of CECT Abdomen and Pelvis of a 42y/F with arterial occlusive mesenteric ischemia.

(a) Non visualization of celiac axis and its main branches – suggestive of arterial occlusion. Branches of hepatic artery and left gastric artery visualized – likely reformed by collaterals. Large splenic infarct due to splenic artery occlusion. Presence of free air along branches of portal vein.
(b) Circumferential non-enhancing bowel wall thickening involving jejunal and ileal loops with pneumatosis intestinalis. Minimal ascites and mesenteric edema.
(c) Non-enhancing hypodensity in the abdominal aorta at the level of origin of SMA extending into SMA.