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Original Research Article

Mesenteric vascular ischemia: an observational prospective study

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ABSTRACT

Background: Mesenteric ischemia is a rare but life-threatening condition with high morbidity and mortality. Variable aetiology and nonspecific presentation frequently delay management. This study evaluated morbidity and mortality outcomes in patients with mesenteric vascular ischemia at a tertiary care centre.
Methods: A prospective observational study was conducted with patients with mesenteric ischemia, categorised as acute, acute-on-chronic, or chronic. Demographic, clinical, radiological, and treatment data were analyzed, with outcomes compared between arterial and venous ischemia. Follow-up was performed at 2 and 6 months post-discharge.
Results: Thirty-three patients were included (25 males, 8 females), with 46% aged 30–45 years. Acute mesenteric ischemia was most common (n=27), followed by acute-on-chronic (n=4) and chronic ischemia (n=2). Diabetes mellitus was the most common comorbidity, and smoking was the most common risk factor. Abdominal pain was present in 96.9% of patients, while one-third presented with peritonitis. Leucocytosis was observed in 76%, and elevated D-dimer levels in 91%. Computed tomography (CT) angiography identified arterial thromboembolism in 25 patients, venous thrombosis in 5, volvulus-related SMA occlusion in 1, and median arcuate ligament syndrome in 2. Mortality was 85.7% in patients requiring >200 cm bowel resection and 70% in those with <100 cm resected. Overall, 6-month mortality was 48.48%, with a mean hospital stay of 19.3 days.
Conclusions: Mesenteric ischemia requires a high index of suspicion for early diagnosis. CT angiography is the diagnostic modality of choice. Outcomes are better in chronic ischemia, while acute-on-chronic presentations have the worst prognosis.

Keywords: Mesenteric ischemia, Acute, Chronic, Mortality, Morbidity

INTRODUCTION

Mesenteric ischemia occurs due to inadequate blood flow to the gastrointestinal tract, either acutely or chronically. Acute mesenteric ischemia (AMI) is a serious and potentially fatal condition with a high mortality rate of up to 80%.[1] Chronic mesenteric ischemia (CMI), although a less severe form of the disease, can cause severe weight loss and impact quality of life. 20% of CMI patients can develop AMI, highlighting the importance of early diagnosis and treatment to prevent the progression to life-threatening AMI. Unfortunately, many patients present with bowel infarction, making early identification challenging.[2]

Acute mesenteric ischemia can be due to arterial embolism (40-50%, atrial fibrillation, myocardial infarction, cardiac valvular vegetation) or arterial thrombosis (20-30%, atherosclerosis) or venous thrombosis (5-15%, hypercoagulability, oral contraceptives, cancer, liver cirrhosis, pancreatitis, portal venous hypertension, venous injury) or non-occlusive mesenteric ischemia (25%, sepsis, systemic vasoconstrictor use, hypovolemia, haemodialysis).

Chronic mesenteric ischemia is a result of atherosclerosis and atheroma, due to diabetes, hypertension, hyperlipidaemia and smoking. Other potential causes include celiac artery compression syndrome, median

arcuate ligament syndrome (MALS), fibrovascular dysplasia, various vasculitis such as Takayasu's arteritis, thromboangitis obliterans, and radiation-induced vascular injury, and heritable disorders of coagulation. Pancreatitis, inflammatory bowel disease, cirrhosis, portal hypertension, paraneoplastic disorders, postoperative status, and trauma are also documented causes.

Because of such diverse causes for CMI and the severity of AMI, early diagnosis with a high index of suspicion is necessary.

The objective of this study was to evaluate the clinical profile, management strategies, and morbidity and mortality outcomes of patients with mesenteric vascular ischemia presenting to a tertiary care centre.

METHODS

Study design and setting

This prospective observational study was conducted at Sir JJ Group of Hospitals, Mumbai, from June 2023 to December 2025.

Participants

All patients aged ≥18 years of either gender presenting with mesenteric vascular ischemia were included. Patients with non-vascular causes of bowel ischemia were excluded.

Grouping and procedure

Patients were categorized into three groups: acute mesenteric ischemia (symptoms ≤15 days with radiological evidence of arterial or venous thrombosis), acute-on-chronic mesenteric ischemia (symptoms >15 days with acute abdominal pain), and chronic mesenteric ischemia (symptoms >15 days with postprandial pain and no acute features). Data collected included demographics, clinical presentation, laboratory parameters, radiological findings, operative details, and postoperative outcomes. Patients were followed up for six months, and early (≤7 days), one-month, and six-month mortality were assessed. Quality of life was evaluated based on weight gain, the absence of complications, and the potential for stoma reversal.

Sample size and sampling technique

Due to the rarity of mesenteric vascular ischemia, no formal sample size calculation was performed, and all consecutive eligible patients presenting during the study period were included using a non-probability consecutive sampling technique.

Statistical analysis

Data were analyzed using descriptive statistics, with $p<0.05$ considered significant.

RESULTS

In this prospective observational study at a single tertiary care centre, 33 patients with mesenteric ischemia were included. 27 patients presented with acute mesenteric ischaemia (group 1), 4 cases had acute presentation of chronic mesenteric ischemia (group 2), and 2 cases were diagnosed with chronic mesenteric ischemia (group 3).

The mean age group was 48.7 years, with almost half of the patients from the middle age group of 30-45 years (n=15, 46%). Three-fourths of patients were male (n=25). 91% of patients had elevated D-dimer levels, 76% had leucocytosis, 30% had acidosis, 39% had deranged renal functions, and 21% had deranged liver function (Table 1). 50% of patients with deranged renal function succumbed, and two-thirds of patients (66.6%) with abnormal LFT did not survive in this study.

Most patients (79%) had no comorbidities. Among those presenting with a comorbid illness, the commonest was diabetes mellitus (n=4, 12.1%), followed by hypertension (n=2, 6%) and interstitial heart disease (n=2, 6%). The most common addiction history was of smoking (18.18%). A history of COVID-19 illness was seen in 2 cases, of which one was vaccinated post-COVID infection.

Pain in the abdomen was the most common presenting complaint seen in all but one patient (n=32, 96.9%), and 12% of patients (n=4) had fever at presentation. Other less common complaints included abdominal distention, postprandial pain, constipation and/ or obstipation, per rectal bleed, jaundice, and anuria.

Table 1: Descriptive analysis of lab parameters and age.

Characteristics	Age (years)	WBC count (cells/mm^3)	pH	Creatinine (mg/dl)	Total bilirubin (mg/dl)	D-dimer (mg/l)
Mean	48.70	15.0367	7.3633	1.8303	1.142	1731.52
Standard deviation	14.795	4.88422	0.06273	2.03863	0.5298	1504.491
Minimum	19	4.20	7.30	0.64	0.3	300
Maximum	76	25.00	7.54	12.00	2.5	8500
Standard error of mean	2.576	0.85023	0.01092	0.35488	0.0922	261.898

Two-thirds of the patients (n=22, 67%) had tachycardia, and one-third of the patients (n=12, 34%) presented with shock, of which 5 patients required ionotropic support on admission. Only 33% had features of peritonitis on clinical examination.

X-rays were not diagnostic of mesenteric ischaemia but identified complications such as perforation (n=4), obstruction (n=13), and pneumatosis intestinalis (n=2). Doppler ultrasonography of the abdomen detected superior mesenteric artery thrombosis and superior mesenteric vein thrombosis in 4 cases each. Computed tomography angiography detected arterial thromboembolism in 25 patients, venous thrombosis in 5 patients, volvulus compressing the superior mesenteric artery in one patient, and median arcuate ligament syndrome in two patients. It also revealed additional artery involvement (renal, aorta, splenic, and even right ventricular thrombus) in 14 cases and pneumatosis in 13 cases, indicating late-stage disease and high mortality risk (Figures 1-3).

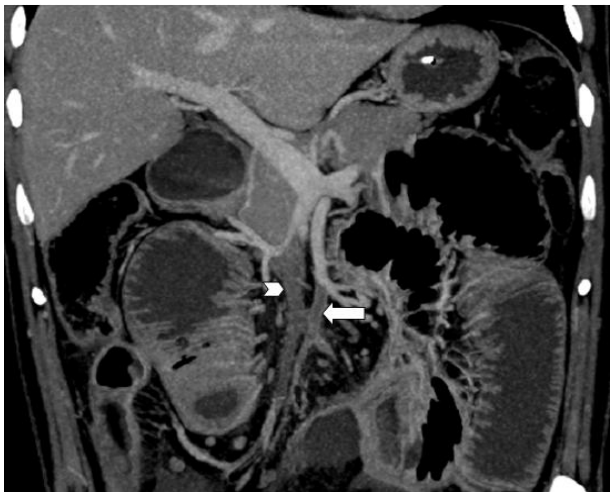

Figure 1: Coronal section of porto venous phase CT scan showing non-enhancing filling defects in distal superior mesenteric artery (white arrow) and superior mesenteric vein (arrowhead).

Intraoperatively, four patients had perforation at one site along with a gangrenous bowel segment. Length of gangrenous segment ranged from 40 cm to 420 cm. In 14 patients (42%), more than 200 cm of bowel was resected with mortality of 85.7%, and in 18 patients (54%), length beyond DJ flexure was less than 100 cm leading to short bowel syndrome and a very high mortality rate (72.2%) as evidenced by 13 deaths out of these 18 patients. 11 patients underwent primary anastomoses after resection of the gangrenous segment, out of which five patients developed a leak postoperatively, which was managed by repeat exploratory laparotomy and formation of stoma in four patients, and a re-anastomosis of bowel in one patient. 61% of patients underwent ostomy primarily, with 2 patients developing blackening of the stoma postoperatively. These 2 patients underwent repeat exploratory laparotomy with resection of the gangrenous segment and refashioning of the stoma (Table 2).

Two patients in group 3 underwent laparoscopic median arcuate ligament release with no mortality. In the present study, none of the patients underwent any revascularization procedures as presentation was late. The average duration of surgery was 5.7 hours/342 min (2–9 hours). The average number of days on ventilatory support postoperatively was 1.54 days (0–3 days), and the average number of days in ICU was 3.27(0–7 days). The average duration of hospital stay (DOS) was 19.33 days (min 2–max 90 days), the average DOS of non-survivors was 17.3 (2–90 days) days, and of survivors was 20.5 days (3–90 days).

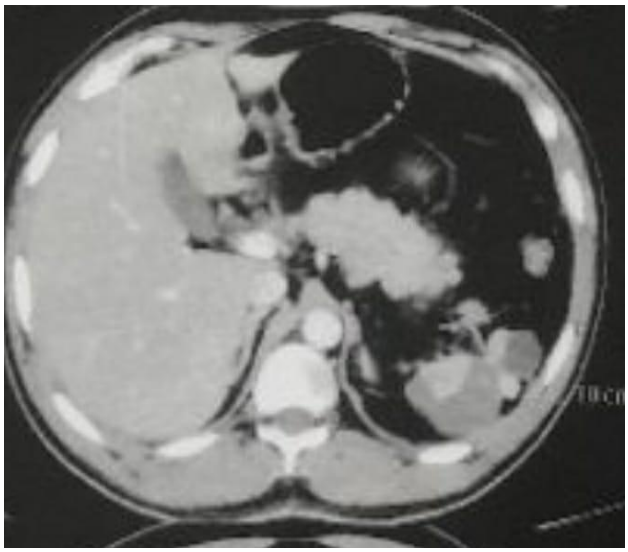

Figure 2: CT showing thrombus at celiac trunk (white arrow).

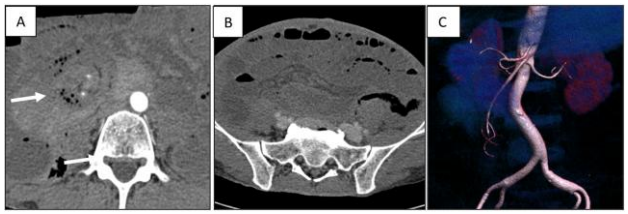

Figure 3: (a) Duodenal volvulus is seen with bowel twisting around the SMA (whirlpool sign), (b) CECT axial image showing thinned out, non-enhancing walls with paucity of vessels, and (c) VRT showing twisting of the SMA, with absent opacification of distal SMA branches.

One-third of the patients (n=11) succumbed in the first week postoperatively, while one-month mortality was 36.36% (n=12). Four patients died after 30 days during the six-month follow-up; thus, in the present study, we observed a total mortality in almost half of the patients (n=16, 48.48%) (Table 3). Postoperatively, 28 patients received anticoagulation, of whom 18 patients survived.

Average days on ventilatory support due to respiratory complications were 1.54 days, and in the intensive care unit because of multi-organ dysfunction syndrome, were 3.27 days. Pain assessment with a visual analogue scale on POD 7 had an average of 6.1. The average duration of hospital stay was 19.33 days. Average weight loss in one month was 5.2 kg, with a minimum of 2 kg and a maximum of 9 kg.

Table 2: Outcome with primary anastomosis and stoma reversal.

Primary anastomosis (N=number of patients, i.e. total 11)	Leak	5	Managed with re-exploration and ostomy	4	Death	2
			Managed with re-anastomosis	1	Death	1
	No leak	6	Alive	3		
			Death	3		
Stoma reversal (N=number of patients) (out of the total 24 cases of stoma, including both post-primary anastomosis leak (4) and stoma made during first exploration (20))			Done	8	Alive	7
					Death	1
			Not done	16	Alive	4
					Death	12

Table 3: Mortality.

Type	Number of cases	Number of deaths in one month	One–month mortality (5)	Number of deaths in six months	6-month mortality (%)
Acute mesenteric ischemia (group 1)	27	11	33.3	13	48
Acute on chronic mesenteric ischemia (group 2)	4	1	25	3	75
Chronic mesenteric ischemia (group 3)	2	0	0	0	0
Total (acute and chronic)	33	12	36.3	16	48.48

At two months follow-up, 20 patients were alive, 14 patients had functioning stoma, 13 patients had significant weight loss, and 8 patients complained of pain. On follow-up CT angiography, only two patients had normal flow in vessels, while eight patients had minimal resolution, and ten patients had no resolution of thrombosis. Stoma reversal was done for eight out of the 14 patients at variable intervals, but only after adequate weight gain. At 6 months follow-up, a little over half the patients (n=17, 51.51%) survived, with four patients having a functioning stoma, four patients still complaining of pain, and seven patients with weight gain and improved quality of life. On Doppler/CT angiography, two patients had normal flow, four patients had 50% resolution of thrombus, six patients had minimal resolution, and five patients had no resolution.

DISCUSSION

Mesenteric ischemia is a disease that occurs predominantly but not exclusively in the elderly age group.[5,6] Acute mesenteric ischemia is commonly found in the elderly, while chronic mesenteric ischemia is seen in the young population. Although in the present study, the age group of 30-45 years, i.e., middle age, had the highest incidence of mesenteric ischaemia (n=15, 46%). In the study by Beaulieu et al, the mean age was 70.5 years.[7] Old Age is associated with a poor prognosis in these patients with a doubling of mortality risk seen with every 18-year increase in age.[5,8]

There is no known gender predilection for acute cases, but chronic mesenteric ischemia is commonly seen in females.[2] In the present study, most patients were male (79%), with 100% of chronic mesenteric ischemia cases with median arcuate ligament syndrome (n=2) being females.

Previous history of comorbidities such as diabetes mellitus, hypertension, cardiovascular events or thromboembolic events, or atrial fibrillation is a proven risk factor of thrombotic/ embolic type of acute arterial mesenteric ischemia, but not associated with other types of acute mesenteric ischemia (AMI).[5] Furthermore, AMI can be the first presentation of this disease and not necessarily preceded by these events.[9] In the present study, mortality in cases who presented with comorbidity was 57% and without any comorbidity was 46%.

Tobacco and smoking have been associated with an increased incidence of thrombosis and, hence, associated with a higher incidence of mesenteric ischemia.[6] In the present study, 18% of patients had a history of smoking, 15% had tobacco consumption, while in the study by Kassahun et al, 50% of patients were smokers.[11]

COVID-19 infection can have atypical presentations, particularly arterial or venous occlusion, including stroke, myocardial infarction, acute limb ischemia, mesenteric ischemia, deep venous thrombosis, and pulmonary

embolism.[12] COVID-19 has been associated with an increased risk of hypercoagulability and, hence, increased instances of thrombosis and vasculitis.[12] In the present study, only two patients had a history of COVID-19 infection, and thus, we are unable to comment on the increase in the incidence of mesenteric ischemia post-COVID-19 infection.

In the present study, almost all of the patients (96.9%) had abdominal pain, two-thirds had vomiting, one-third had abdominal distention, and constipation, 15% had rectal bleeding, and 6.1% had diarrhoea. Kassahun et al's study correlated with the present study in the sense that all patients had abdominal pain, and also presented with nausea (95%), vomiting (85%), and bloody diarrhoea (40%). Prolonged symptom duration predicts higher mortality, as seen in the present study, where 75% of patients with acute on chronic mesenteric ischemia (group 2) died within six months.[11]

Late presentation of mesenteric ischemia is with tachycardia and hypotension due to the development of SIRS. In the present study, two-thirds of patients had tachycardia, and a fourth of the patients had hypotension, with 5 requiring inotropic support preoperatively. Inotropes, particularly norepinephrine, are linked to poor outcomes as they cause splanchnic vasoconstriction and worsening ischemia.[16,17] Signs of peritonitis (guarding, rigidity, abdominal distension, reduced urine output) indicating transmural bowel involvement and poor outcome were observed in one-third of patients in the present study.

Kougias et al found renal insufficiency and metabolic acidosis associated with mortality.[15] In the present study, mortality with deranged renal function was 50 % and with deranged liver function was 66.6%. Elevated D-dimer levels were noted in 91% of patients in the present study, useful for excluding thromboembolic disease but less specific for chronic ischemia (normal levels were observed in both cases of group 3 in the present study). A meta-analysis showed D-dimer sensitivity of 96% and specificity of 40% in AMI.[18]

CTA is the preferred method for diagnosing mesenteric ischemia, with a sensitivity of 89.4% and specificity of 99.5% as per Henes et al.[4] CTA identifies the type and location of thrombosis (arterial or venous), involvement of other arteries, and complications like pneumatosis and portal venous gas. In the present study, we diagnosed 100% of the cases with CTA, hence indicating it as the diagnostic modality of choice.

The length of intestine resected and the remaining length beyond the DJ flexure influenced patient outcomes regarding mortality and morbidity due to short bowel syndrome. Two patients with chronic mesenteric ischemia (group 3) due to median arcuate ligament syndrome underwent laparoscopic ligament release with zero mortality. A meta-analysis by Salsano et al found a pooled mortality prevalence of 19% for endovascular revascularization versus 34% for surgical resection alone, highlighting the benefits of revascularization in reducing bowel resection and second-look laparotomy.[20] However, no revascularization procedures were performed at our centre.

Early restoration of mesenteric flow is crucial to reduce morbidity and mortality in mesenteric ischemia. For acute arterial mesenteric occlusion, a noninferior alternative to open laparotomy is the endovascular first approach, as suggested by retrospective studies. Mesenteric venous thrombosis is primarily treated with systemic anticoagulation, with catheter-directed thrombectomy or thrombolysis as discretionary options.[22]

Immediate and potentially life-long anticoagulation is essential, particularly for thromboembolic patients, to prevent recurrence and manage the risk of coronary thrombosis. Patients with venous thrombosis should be investigated for thrombophilia and treated accordingly. Unfractionated heparin is advantageous in acute settings due to its titrability and reversibility.[23] In the present study, 84% of patients received a combination of anticoagulation (injection heparin/tablet warfarin/tablet dabigatran), antiplatelets(aspirin/clopidogrel), statins, and vasodilators (pentoxyphyllin /cilastazole). Those without postoperative anticoagulation had a mortality rate of 57.4%, underscoring the importance of postoperative anticoagulation for improving survival rates.

The present study had a 30-day mortality of 36.3%, compared to other studies with a mortality of 47% in Cudnik et al 30% in the study by Park et al, and 27.9% in Gupta et al.[18,24,25]

Limitations

A single-centre study was done with a small sample size.

CONCLUSION

Mesenteric ischemia is difficult to diagnose clinically and CTA is diagnostic modality of choice; outcomes are better in chronic mesenteric ischemia due to MALS (0% mortality) while chronic ischemia with acute presentation has the worst outcome (75% mortality) and acute mesenteric ischemia has overall mortality of 48.48%. In the present study younger population was more commonly involved, and whether it was due to the post-COVID-19 era cannot be commented on. To improve outcomes in AMI a prompt diagnosis should be achieved. Resection of non-viable bowel should be performed without delay. length of resected bowel >200 cm and <100 cm from DJ flexure is associated with poor outcome. The benefits of extensive small bowel resection should be balanced against the resultant quality of life, morbidity and mortality especially in elderly patients. Restoration of bowel continuity following extensive resection will improve functional results and may avoid the need for long term TPN. Anastomosis should be avoided in patients with shock or multiple organ dysfunction. More multi-centre

comparative studies involving large sample are required to validate these results for use in clinical practice.

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