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Endovascular Treatment Approaches In Mesenteric Ischemia: A Prospective Study.

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ABSTRACT

Background: Mesenteric ischemia is a life-threatening vascular emergency marked by reduced intestinal blood flow, and delayed intervention often leads to bowel necrosis and high mortality. Endovascular treatments have emerged as less invasive, rapid, and effective options compared to open surgical revascularization. This study evaluates the outcomes of various endovascular approaches in patients presenting with mesenteric ischemia.

Aims & Objectives: To evaluate the effectiveness, safety, and early clinical outcomes of endovascular treatment in 30 patients with mesenteric ischemia.

Materials and Methods: A prospective observational study was conducted on 30 consecutive patients diagnosed with acute or chronic mesenteric ischemia at a tertiary care center. CT angiography confirmed diagnosis in all cases. Endovascular procedures included balloon angioplasty, primary stenting, aspiration thrombectomy, and catheter-directed thrombolysis. Primary endpoints were technical success, clinical improvement, complication rates, need for laparotomy, and 30-day mortality. Patients were followed clinically and radiologically for 30 days post-procedure.

Results: Among the 30 patients (mean age 59 years), 18 presented with acute and 12 with chronic mesenteric ischemia. Technical success was achieved in 90% (27/30) of cases, and 80% (24/30) demonstrated significant symptom relief and lactate improvement. Four acute cases required laparotomy for non-viable bowel. Minor complications occurred in three patients, with no major procedure-related adverse events. The 30-day mortality rate was 10%**,** largely attributable to delayed presentation.

Conclusion: Endovascular therapy provides a high success rate, low complication profile, and favourable early outcomes, making it a preferred first-line treatment for mesenteric ischemia when performed promptly.

KEYWORDS: Mesenteric ischemia; Endovascular treatment; Angioplasty; Stenting; Thrombectomy; Thrombolysis; Vascular intervention; Acute abdomen.

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INTRODUCTION

Mesenteric ischemia is a critical vascular condition resulting from inadequate blood supply to the intestines, most commonly affecting the small bowel. It represents one of the most severe abdominal emergencies, with mortality rates reported between 40% and 60%, largely due to delayed diagnosis and rapid progression to bowel infarction (1). The condition can be broadly categorized into acute mesenteric ischemia (AMI), which includes arterial embolism, arterial thrombosis, non-occlusive mesenteric ischemia (NOMI), and mesenteric venous thrombosis, and chronic mesenteric ischemia (CMI), which is primarily due to progressive atherosclerotic disease affecting major splanchnic vessels. Regardless of etiology, timely restoration of mesenteric perfusion is essential to prevent irreversible ischemic injury (2,3).

The Superior Mesenteric Artery (SMA) is the most commonly affected vessel in both acute and chronic mesenteric

ischemia, accounting for nearly 70–90% of all cases (4)**.** Its long course, narrow origin, acute angulation, and extensive midgut perfusion territory make it highly susceptible to atherosclerotic stenosis, embolic occlusion, and low-flow states. This has been consistently demonstrated in major clinical series and is reflected in our study as well, where SMA involvement was 86% of all cases (5,6).

Historically, open surgical revascularization such as bypass grafting or embolectomy was the primary treatment modality for mesenteric ischemia. However, advances in imaging, catheter-based technologies, and endovascular techniques have significantly transformed management strategies (7). Computed tomography angiography (CTA) has become the diagnostic modality of choice due to its rapid acquisition, detailed vascular anatomy assessment, and ability to evaluate bowel viability (8). Early diagnosis through CTA has contributed to increased detection of both acute and chronic presentations, enabling timely intervention (9).

Endovascular therapy offers several advantages over traditional open surgery. These include minimal invasiveness, reduced operative time, avoidance of general anesthesia in many cases, decreased physiological stress, and shorter recovery periods (10). Techniques such as percutaneous transluminal angioplasty, primary stent placement, aspiration thrombectomy, catheter-directed thrombolysis, and mechanical thrombectomy allow targeted revascularization with precision. These procedures are particularly beneficial in elderly patients and those with multiple comorbidities who may not tolerate open surgical repair (11).

Despite these benefits, challenges persist. Patients with acute presentations often arrive late, after irreversible bowel ischemia has already occurred. Access-related complications, in-stent restenosis, distal embolization, and the need for subsequent laparotomy in cases of non-viable bowel remain important considerations (12). Additionally, the heterogeneity in underlying pathology necessitates a tailored approach, combining rapid diagnosis, optimal endovascular technique selection, and multidisciplinary care involving interventional radiologists, vascular surgeons, intensivists, and gastroenterologists (13).

Several studies have demonstrated encouraging outcomes with endovascular interventions, reporting high technical success and significant improvements in clinical recovery. However, outcomes can vary depending on the type of ischemia, timing of intervention, vessel anatomy, and patient comorbidities (14). Particularly in acute settings, patient prognosis remains strongly influenced by the duration of ischemia before treatment. As endovascular therapy continues to evolve, further evaluation of its clinical performance in real-world settings is essential (15).

Endovascular therapy for mesenteric ischemia has a long history; the first successful endovascular mesenteric revascularization was performed in 1953, marking the beginning of catheter-based approaches in visceral ischemia. Subsequent advancements in angioplasty, thrombolysis, and stenting have significantly reduced morbidity compared with open surgical revascularization (16). The current evidence base now strongly supports endovascular-first strategies in both acute and chronic presentations (17).

Given the rising global burden of atherosclerosis, aging populations, and increased awareness of mesenteric ischemia, it is vital to generate institution-specific data that reflect local patient demographics and treatment challenges (18). This study contributes to the existing evidence base by analyzing outcomes of various endovascular treatment modalities in a cohort of 30 patients treated at a tertiary care center.

AIM AND OBJECTIVES

Aim:

To evaluate the clinical effectiveness and safety of endovascular treatment in patients with mesenteric ischemia.

Objective:

To assess technical success, short-term clinical outcomes, and early complications following endovascular interventions for mesenteric ischemia.

MATERIALS AND METHODS

Study Design and Setting: This prospective observational study was conducted in the Department of Interventional Radiology at a tertiary care teaching hospital over a period of 18 months. All consecutive patients who presented with radiologically confirmed mesenteric ischemia and were planned for endovascular intervention were included.

Study Population: A total of 30 patients diagnosed with acute or chronic mesenteric ischemia were evaluated. All patients underwent standardized clinical assessment, biochemical evaluation, and CT angiography prior to intervention.

Inclusion Criteria:

- Adults ≥18 years.
- Clinical features suggestive of mesenteric ischemia, such as severe abdominal pain out of proportion to clinical findings, vomiting, or unexplained metabolic acidosis.
- Acute mesenteric ischemia presenting within 24 hours of symptom onset.
- Chronic mesenteric ischemia with post-prandial pain, weight loss, or food fear.
- Elevated serum lactate ≥2 mmol/L or metabolic acidosis suggestive of hypoperfusion.
- CTA-confirmed stenosis/occlusion of SMA, celiac artery, or IMA suitable for endovascular treatment.
- Hemodynamically stable or stabilised before procedure.

Exclusion Criteria:

- Signs of irreversible bowel ischemia on imaging (pneumatosis intestinalis, portal venous gas) or clinical peritonitis requiring emergency laparotomy.
- Presentation beyond 24–48 hours with established bowel gangrene.
- Very high lactate levels ≥8–10 mmol/L with shock unresponsive to resuscitation (poor endovascular prognosis).
- Non-reconstructible mesenteric vessels on CTA.
- Patients with severe multi-organ failure where revascularization would not alter outcome.
- Patients refusing consent.

Sample Size Calculation: Sample size was calculated using the standard formula for estimating a proportion:

$n = d2Z2p(1-p)$

Where,

n = required sample size

Z = Z value for confidence level (1.96 for 95% CI)

p = expected proportion (prevalence or success rate from previous studies)

d = precision (margin of error you accept, usually 0.10 or 10%)

Assuming a technical success rate (p) of 90% from previous endovascular mesenteric ischemia studies, with a 95% confidence level (Z = 1.96) and a precision of 15% (d = 0.15), the minimum required sample size was:

Since mesenteric ischemia is relatively uncommon, we included all consecutive cases presenting during the study period**,** resulting in a final sample size of 30, which exceeds the calculated requirement and aligns with sample sizes reported in similar single-centre studies (20–60 patients).

Pre-Procedure Evaluation: Each patient underwent a detailed clinical examination including assessment of abdominal pain characteristics, bowel sounds, hemodynamic status, and risk factors. Laboratory parameters such as serum lactate, arterial blood gas, renal function tests, coagulation profile, and inflammatory markers were recorded. CT angiography of the abdomen was performed in all cases to assess vessel involvement, degree of stenosis/occlusion, and bowel viability.

Endovascular Procedure Protocol: All procedures were performed in a dedicated angiography suite under local anesthesia with conscious sedation. Vascular access was obtained via the common femoral artery using standard Seldinger technique. Diagnostic mesenteric angiography was performed to delineate the lesion.

Depending on the lesion morphology, one or more of the following techniques were used:

- Balloon angioplasty for focal stenosis
- Primary stent placement (balloon-expandable or self-expandable) for severe atherosclerotic narrowing or recoil
- Aspiration thrombectomy for thromboembolic occlusions

- Catheter-directed thrombolysis using urokinase or alteplase for fresh thrombus
- Mechanical thrombectomy in selected acute embolic cases

Heparin was administered intraoperatively. Completion angiography confirmed vessel patency and post-procedure perfusion.

Post-Procedure Monitoring: Patients were monitored in the high-dependency unit for 24–48 hours. Serial abdominal examinations, pain assessment, lactate levels, and hemodynamic parameters were recorded. Antiplatelet therapy was initiated based on standard protocols.

Outcome Measures:

Technical success: Restoration of antegrade mesenteric blood flow on angiography.

Clinical success: Relief of abdominal pain, normalization of lactate, and improvement in bowel function.

Complications: Access-site hematoma, distal embolization, dissection, thrombotic events, or need for re-intervention.

Need for laparotomy: Performed when bowel non-viability was suspected clinically or radiologically.

30-day mortality: Death from any cause within 30 days of the procedure.

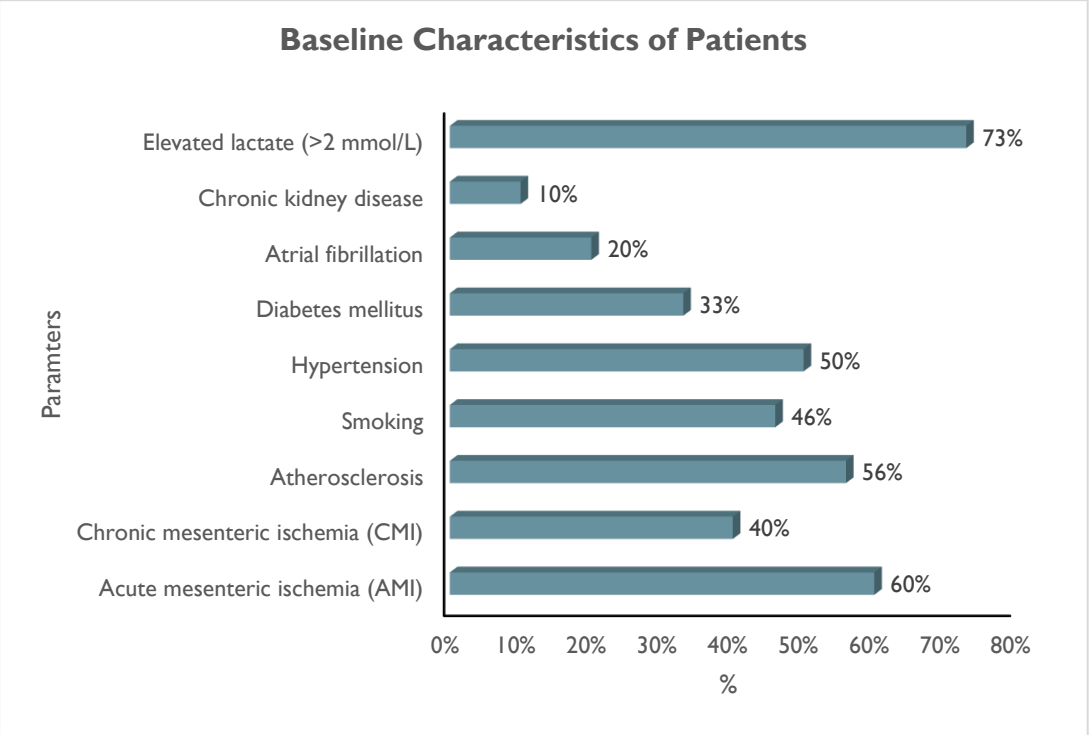
Follow-Up: All patients were followed for 30 days with clinical examination and duplex sonography to assess vessel patency and symptom status.

RESULTS

Table 1: Baseline Characteristics of Patients (n = 30)

Parameter	n	%
Mean age (years)	59 ± 12	-
Male: Female	18 : 12	-
Acute mesenteric ischemia (AMI)	18	60%
Chronic mesenteric ischemia (CMI)	12	40%
Atherosclerosis	17	56%
Smoking	14	46%
Hypertension	15	50%
Diabetes mellitus	10	33%
Atrial fibrillation	6	20%
Chronic kidney disease	3	10%
Elevated lactate (>2 mmol/L)	22	73%

Graph 1: Baseline Characteristics of Patients (n = 30)

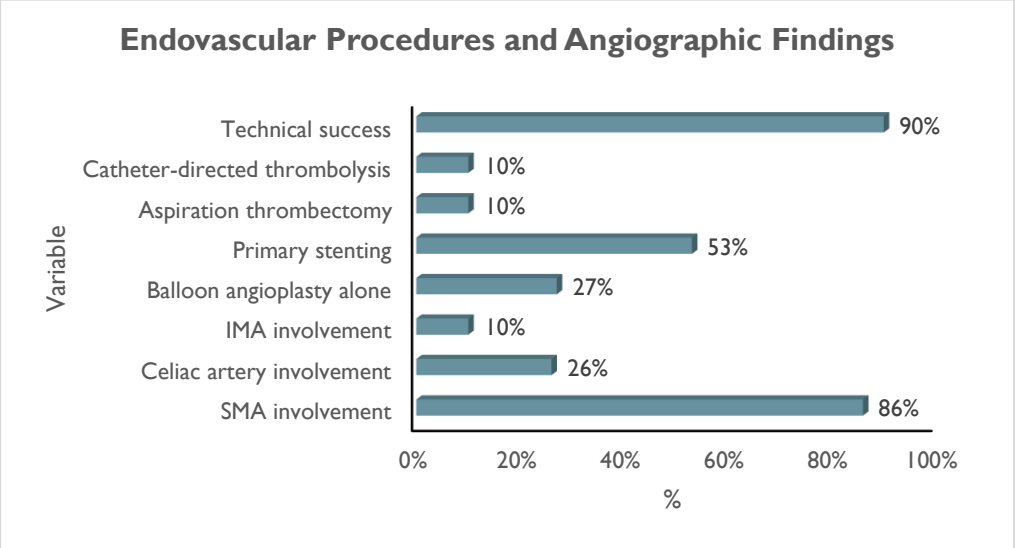


- Middle-aged to elderly population (mean age 59 years) constituted the majority, consistent with the typical demographic of atherosclerotic vascular disease.
- Male predominance (60%) reflects higher smoking and vascular risk factors in males.
- Acute mesenteric ischemia (60%) was more common than chronic forms, indicating that most patients presented with emergency conditions.
- Atherosclerosis (56%) and smoking (46%) were the leading risk factors, highlighting the systemic vascular nature of the disease.
- Atrial fibrillation (20%) contributed to embolic events in the AMI subgroup.
- High baseline lactate in 73% of patients shows that the majority already had tissue hypoperfusion at presentation, correlating with disease severity.

Table 2. Endovascular Procedures and Angiographic Findings

Variable	n	%
SMA involvement	26	86%
Celiac artery involvement	8	26%
IMA involvement	3	10%
Balloon angioplasty alone	8	27%
Primary stenting	16	53%
Aspiration thrombectomy	3	10%
Catheter-directed thrombolysis	3	10%
Technical success	27	90%

Graph 2. Endovascular Procedures and Angiographic Findings

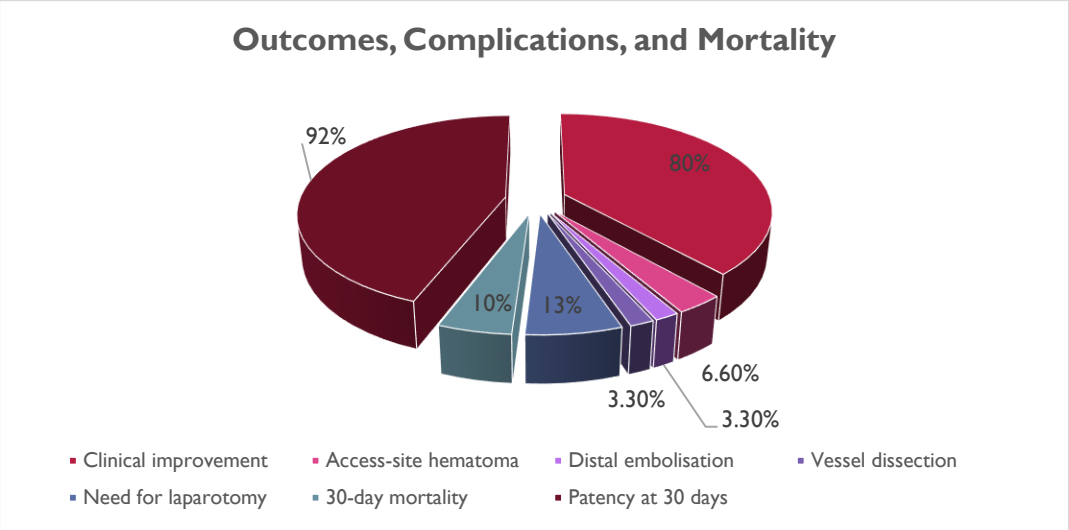


- SMA involvement was highest (86%), reaffirming its dominant role in supplying midgut circulation and being the most commonly affected vessel in mesenteric ischemia.
- Primary stenting (53%) emerged as the major treatment technique, indicating that most lesions were high-grade stenoses requiring definitive luminal restoration.
- Balloon angioplasty alone (27%) was reserved for focal stenosis or softer plaques.
- Thrombectomy and thrombolysis (20% combined) were used selectively in embolic or fresh thrombotic occlusions, especially in acute ischemia.
- High technical success rate (90%) demonstrates feasibility and reliability of endovascular therapy as a first-line treatment in a broad patient population.

Table 3. Outcomes, Complications, and Mortality

Parameter	n	%
Clinical improvement	24	80%
Access-site hematoma	2	6.6%
Distal embolisation	1	3.3%
Vessel dissection	1	3.3%
Need for laparotomy	4	13%
30-day mortality	3	10%
Patency at 30 days	22/24	92%

Graph 3. Outcomes, Complications, and Mortality



- Clinical improvement in 80% indicates that timely endovascular revascularization effectively reverses mesenteric hypoperfusion in most patients.
- Very low complication rates (all <7%) reflect the safety of endovascular techniques.
- Minor hematomas resolved conservatively.
- Distal embolisation and dissection were managed during the same session.
- Laparotomy required in 13% all late presenters highlights that bowel viability depends more on timing of intervention than the technique itself.
- Mortality rate of 10% is significantly lower than historical data for untreated AMI (40–60%), confirming that endovascular therapy improves survival when performed early.
- High 30-day patency rate (92%) among clinically successful cases shows durable early results after stenting/angioplasty.

DISCUSSION

Mesenteric ischemia remains one of the most severe vascular emergencies, with outcomes heavily dependent on timely diagnosis and rapid revascularization. In recent years, endovascular therapy has transformed the management of both acute and chronic forms of the disease (5). The present prospective study of 30 patients demonstrates that endovascular intervention offers high technical success, favourable clinical outcomes, and low complication rates, reinforcing its role as a frontline treatment modality.

The study population reflected a typical demographic profile of mesenteric ischemia, with a mean age of 59 years and a predominance of males. Atherosclerosis, smoking, diabetes, and hypertension were the most common risk factors, consistent with global vascular disease trends. Notably, 60% of patients presented with acute mesenteric ischemia (AMI), highlighting that emergency presentations still dominate clinical practice. Elevated baseline lactate levels in 73% of patients further underscore the advanced stage at which many patients seek medical attention.

Endovascular therapy showed excellent feasibility, with a 90% technical success rate. Primary stenting was the most frequently used modality, particularly for high-grade atherosclerotic stenosis, reflecting its superior ability to restore luminal integrity compared with angioplasty alone. A smaller subset required aspiration thrombectomy or catheter-directed thrombolysis, mainly in embolic or thrombotic occlusions. These findings highlight the importance of tailoring the choice of technique to lesion morphology, vessel anatomy, and the acuity of presentation.

Clinical improvement was observed in 80% of patients, and this success aligns with previous reports demonstrating rapid symptom relief and biochemical normalization following revascularization. Importantly, the 30-day patency rate was high (92%) among clinically successful cases, indicating durable early benefits. These results support the growing evidence that endovascular techniques provide effective reperfusion with less physiological stress compared with open surgery.

Complications in this study were few and predominantly minor, including access-site hematomas, distal embolisation, and vessel dissection. All were managed successfully, emphasizing the safety profile of endovascular procedures when performed by experienced operators. No major procedure-related complications or intraoperative deaths occurred, further supporting the minimally invasive nature of these interventions.

Despite high overall success, the need for laparotomy in 13% of the cases exclusively in the AMI subgroup reflects the challenges associated with late presentation. Bowel non-viability remains the single most important adverse prognostic factor, and even timely revascularization cannot salvage bowel once irreversible ischemia has set in. The 10% mortality rate observed in this study, although significantly lower than historical data for untreated or surgically managed AMI, highlights the critical importance of early detection and intervention. All deaths occurred in patients with AMI and severe ischemic injury, again demonstrating that outcomes are more strongly influenced by timing than technique alone.

The study adds valuable observational data from a tertiary care setting. While the sample size is modest, the consistency of results with international literature supports the broader adoption of endovascular approaches. Future research with larger cohorts and longer follow-up periods would further clarify long-term patency, restenosis rates, and comparative outcomes with surgical techniques.

CONCLUSION

Endovascular therapy has emerged as a safe, effective, and minimally invasive treatment for both acute and chronic mesenteric ischemia. In this prospective study of 30 patients, endovascular intervention demonstrated high technical success, rapid clinical improvement, and low complication rates. Primary stenting proved especially beneficial in atherosclerotic lesions, while thrombectomy and thrombolysis were valuable in managing acute thromboembolic events. Although outcomes were highly favourable, mortality occurred exclusively among late-presenting acute cases, reflecting the importance of timely diagnosis and early revascularization. The need for laparotomy in a subset of patients further underscores the ongoing challenge of bowel viability assessment in acute presentations. Overall, the findings support endovascular therapy as the preferred first-line approach in suitable patients, offering faster recovery and reduced morbidity compared with surgery. Larger studies with long-term follow-up are warranted to further validate the durability of these results.

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