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# Surgical Management of Acute Mesenteric Ischemia; Review Article

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***Authors' contributions***

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

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## ABSTRACT

Mesenteric ischemia is a condition in which the amount of oxygen available is insufficient to meet the needs of the intestines. The small intestine, colon, or both can be affected by ischemia. The most common cause of occlusive ischemia is an abrupt obstruction of a major artery, which causes

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a considerable drop in intestinal blood flow. Early diagnosis is one of the most essential components in achieving a favorable outcome. The most prevalent treatment is surgical management. However, there are minimally invasive therapy alternatives that have been shown in observational studies. For arterial thrombosis, endovascular stenting is an option, and anticoagulation is an option for venous thrombosis. Endovascular aspiration, mechanical embolectomy, and local thrombolysis are all possibilities for patients with arterial embolism.

*Keywords: Mesenteric ischemia; arterial embolism; surgical management; heart failure.*

## 1. INTRODUCTION

Mesenteric ischemia is a condition in which the amount of oxygen available is insufficient to meet the needs of the intestines. The small intestine, colon, or both can be affected by ischemia. It can be both acute and chronic in nature. The most common classifications for mesenteric ischemia are occlusive and non-occlusive. Strangulation is probably the most common cause of acute occlusive mesenteric ischemia [1].

A cardiac-related arterial embolism is responsible for around half of all cases of acute mesenteric ischemia. The others are caused by arterial thrombosis (which is usually caused by atherosclerosis), venous thrombosis (which is usually caused by clotting disorders), and nonocclusive ischemia. Splanchnic vasoconstriction, which can be produced by hypovolemia, hypotension, decreased cardiac output, and exogenous vasopressors, causes nonocclusive ischemia [2].

Other critical diseases, such as shock and heart failure, can cause acute non-occlusive mesenteric ischemia. Digitalis and other vasoactive medications, for example, can cause non-occlusive intestinal ischemia. Atherosclerosis, fibromuscular dysplasia, inflammatory illness (Takayasu), and radiation exposure can all lead to chronic ischemia. It's also possible that it's congenital as part of aortic coarctation [1].

Because of its cryptic presentation and fluctuating physical examination findings, a clear diagnosis of acute mesenteric ischemia is frequently impossible to make clinically. With a sensitivity and specificity of nearly 95%, computed tomography angiography is usually the most appropriate diagnostic technique in stable patients with a high level of clinical suspicion. The diagnosis is usually made by diagnostic laparoscopy or laparotomy in patients with peritoneal findings [2-6]. This review aims of highlight recent updated in epidemiology, pathogenesis, diagnosis and surgical management of acute mesenteric ischemia.

## 2. EPIDEMIOLOGY

Acute mesenteric ischemia is a rare occurrence. According to reports, acute mesenteric ischemia accounts for less than 1% of all acute laparotomies performed. The two most common occlusive causes of acute mesenteric ischemia are arterial thrombosis and embolus (approximately 50 and 33 percent, respectively). Atrial fibrillation is the most common cause of a mesenteric embolus in patients. In roughly 10%–15% of all cases, venous mesenteric thrombosis is the cause of acute mesenteric ischemia. In some patients with venous thrombosis, the onset of ischemia can take a lengthy time [1].

AMI affects around one in every 1000 hospital admissions. Arterial embolism accounts for 40 percent to 50 percent of all AMI instances, arterial thrombosis for 25 percent to 30 percent, and NOMI for 20 percent. Women, the elderly, and individuals with several severe comorbidities are more likely to develop AMI.

## 3. ETIOLOGY AND PATHOGENESIS

The most common cause of occlusive ischemia is an abrupt obstruction of a major artery, which causes a considerable drop in intestinal blood flow. It is not uncommon, however, to find two of the three major supplying arteries occluded without signs of mesenteric ischemia. That implies that the process took some time to allow collateral blood flow to emerge and that the surviving vessels are in good condition. A sudden obstruction of blood flow by an embolus in the superior mesenteric artery in an elderly patient with atherosclerotic arteries, which is a common occurrence in the western world, is likely to decrease blood flow enough to produce bowel infarction. Transmural infarction takes 8–16 hours to develop if ischemia is total or near total. As a result, this is the time window in which the diagnosis must be made and proper

interventions taken in order to prevent bowel infarction. After this time, surgical removal of dead bowel is the only option, and the prognosis is determined by the extent of bowel necrosis [1].

The following are the most common causes of mesenteric ischemia:

- **Mesenteric Arterial Embolism:** The superior mesenteric artery (SMA), which supplies the small intestine, is where most emboli lodge. This results in an immediate start of pain. Cardiomyopathy, atrial fibrillation, recent angiography, underlying vasculitis, and valvular diseases are all risk factors.
- **Mesenteric Arterial Thrombosis**: Acute arterial thrombosis is most commonly caused by atherosclerosis, either as a result of an acute plaque rupture or as a result of a progressive build-up to critical stenosis. Patients with atherosclerosis, peripheral artery disease, hypercoagulability, oestrogen medication, and persistent hypotension are all predisposing factors.
- **Mesenteric Venous Thrombosis**: The resistance of mesenteric venous blood flow increases as a result of mesenteric venous thrombosis. Local intra-abdominal inflammatory conditions (such as inflammatory bowel disease) put patients at a higher risk. Hypercoagulable patients (those with heritable and acquired thrombophilias and malignancies, for example) are also at a higher risk.
- **Nonocclusive Mesenteric Ischemia (NOMI):** A “spasm” of the SMA is generally present in these circumstances, which can lead to hypoperfusion of the small intestine and colon. Peripheral artery disease, septic shock, vasoconstrictive drugs (such as digoxin), cocaine usage, and hemodialysis, to name a few, are all risk factors [11].

When it come to the etiology of the disease, a study looked at etiologies of acute intestinal ischemia Nonthrombotic was found to be (60%) of the causes and thrombotic (34%) and the remaining six percent was the etiologies of unknown causes. Arterial embolism was responsible for 38% of the cases when it come to thrombotic causes, arterial thrombosis for 36%, and venous thrombosis for 26%. Patients with venous thrombosis were in their early twenties. Men were more likely to have venous thrombosis, whereas women were more likely to get arterial thrombosis [7].

In a study that looked at 170 cases. A vascular thrombotic etiology was responsible for about a third of AII cases. However, one-quarter of these individuals had mesenteric venous thrombosis, which was significantly greater than expected. Patients of all ages were afflicted by arterial thromboembolic events, which were characterised by a high prevalence of smoking, hypertension, and a history of cardiac disease. Those with venous thrombosis, on the other hand, were mostly men under the age of 50 [7-10].

## 4. DIAGNOSIS

Early diagnosis is one of the most essential components in achieving a favourable outcome. Intestinal ischemia is found in 1 to 2 out of 1,000 hospital admissions, or 14 to 2% of all gastrointestinal illness patients admitted. Because of its rarity, clinicians may miss the early vague signs and symptoms, causing the patient's complaints to be attributed to other causes [7].

Acute mesenteric artery occlusion still has a high mortality rate. Before ischemia leads to intestinal gangrene, timely identification and revascularization are critical for patient survival. Because of its ability to characterise artery anatomy and evaluate secondary indications of mesenteric ischemia, biphasic computed tomography angiography has surpassed angiography as the diagnostic test of choice [11].

A definitive laboratory test to determine acutely ischemic bowel is currently unavailable. Elevated serum pH and abnormal serum pH Lactate levels are a sign of a heart attack. Bowel, although it does not develop aberrant until later in life. The disease's progression Abdominal films that are plain and simple CT scans can be used to rule out certain conditions. A variety of intraabdominal processes "Thumb printing" and "pneumatosis" on a plain roentgenogram The use of a CT scan can aid in the diagnosis, although Late in the procedure, this happens once again [12].

Any patient suspected of having an AMI should get a computed tomography angiography (CTA) as soon as possible. Despite extensive clinical expertise and awareness of this entity, the most common cause of death is a delay in diagnosis, which accounts for mortality rates as high as 30–70%. Formal angiography has been replaced as

the diagnostic investigation of choice by the multi-detector CTA. MDCT scanners are critical for the early identification of AMI, however they often necessitate the use of expert personnel to execute and interpret the results. The use of 3D reconstruction is frequently beneficial. Many CT machines now have volume rendering as a semi-automatic workflow component. These can be beneficial to distant areas with inexperienced personnel [13].

## 5. TREATMENT

The most prevalent treatment is surgical management. However, there are minimally invasive therapy alternatives that have been shown in observational studies. For arterial thrombosis, endovascular stenting is an option, and anticoagulation is an option for venous thrombosis. Endovascular aspiration, mechanical embolectomy, and local thrombolysis are all possibilities for patients with arterial embolism [2].

Acute intestinal ischemia (AII) has been linked to a poor prognosis in a number of surgical studies. Early diagnosis, resection of infarcted bowel, targeted surgical or nonsurgical restoration of blood supply to ischemic gut, second-look laparotomy, and supportive critical care have traditionally been the cornerstones of treatment for this illness [7,14-25].

Acute arterial mesenteric ischemia, whether embolic or thrombotic, is treated largely surgically, unlike chronic mesenteric ischemia. This is owing to an immediate requirement for revascularization as well as a thorough examination of the intestines. Endovascular procedures, on the other hand, are still beneficial and can save time in the treatment of these difficult patients when used in conjunction with definitive surgical treatment. The authors present a unique hybrid endovascular-surgical treatment for acute mesenteric thrombosis [11].

For a successful outcome, aggressive management is also required. Fluid resuscitation, invasive hemodynamic monitoring, prophylactic antibiotics, and systemic anticoagulation with heparin are all common treatments. In patients with mesenteric venous thrombosis, these principles are especially significant. Heparin is required to avoid thrombus propagation, and warfarin is required for long-term anticoagulation to prevent recurrence, which occurs in more than one-third of patients. Because considerable intestinal congestion can occur in individuals with venous thrombosis, close monitoring of fluid status is essential. This can lead to the sequestration of huge amounts of fluid [7].

The nature, intensity, and severity of mesenteric ischemia all influence how the disease is managed. Resection of nonviable bowel, restoration of blood supply to the ischemic gut, and supportive care are all part of early intervention. Operative embolectomy has been the standard treatment for acute thromboembolic events, with good short and long-term results. Shaw et al described surgical revascularization for visceral ischemia caused by an obstructed SMA for the first time in 1958, when they reported two successful cases of mesenteric thromboendarterectomy. When revascularization is explored for chronic occlusive illness, single-vessel bypass to the superior mesenteric artery has proven to be quite successful, even in patients with multiple-vessel occlusions. At 5 years after surgical revascularization, Cunningham et al reported an 86 percent symptom-free rate [26-28].

Early surgical laparotomy with embolectomy is used to treat mesenteric artery blockage caused by an embolism. Some patients with a very early diagnosis of mesenteric artery embolism (without indications of peritonitis) can be treated with a local infusion of a thrombolytic drug, though this is still under investigation. Surgical revascularization or stenting is frequently required for mesenteric artery thrombosis. Systemic anticoagulation can be used to treat mesenteric venous thrombosis in some cases, however this is contingent on the severity of the condition. The goal of NOMI treatment is to address the underlying cause of ischemia, such as removing vasoconstrictive medicines that cause the mesenteric artery to spasm. Patients are routinely treated with systemic anticoagulation after surgical intervention if there are no contraindications [29].

**Laparotomy:** For Patients with overt peritonitis as soon as possible.

When physical symptoms suggestive of an acute intraabdominal catastrophe are present, bowel infarction has already occurred, and the patient's likelihood of survival in this patient population with considerable comorbidity is drastically decreased. There is substantial evidence in the literature that peritonitis caused by intestinal necrosis necessitates immediate surgery. The

following are some of the objectives of surgical intervention for AMI:

1. Blood supply to the ischemic bowel must be restored.
2. All non-viable areas are resected.
3. All viable bowel is preserved [13].

Following initial resuscitation, a midline laparotomy should be performed, followed by an examination of all sections of the intestine and the choice to remove all plainly necrotic areas. Intraoperative Doppler may be useful in circumstances of doubt, as the existence of Doppler signals over distal branches of SMA promotes bowel conservation and avoids long-term impairment. Placing fingers behind the root of the mesentery makes it easy to feel the SMA [13].

For poor-risk individuals, antegrade aortoceliac bypass and transaortic endarterectomy have been successful, and are usually sufficient for repeated outflows. Low mortality and morbidity rates have also been linked to antegrade mesenteric bypass grafts from the distal thoracic aorta. Although an antegrade bypass from the supraceliac aorta can reduce kinking, compression, turbulence, and thrombosis, it has been linked to renal ischemia and is technically difficult. Although retrograde bypass via the infrarenal aorta or iliac artery is technically simpler and avoids renal ischemia, it has been linked to decreased input and graft kinking. If one graft fails, revascularization of the superior mesenteric artery and celiac axis has been used to reduce the risk of recurrence of symptoms and organ infarction. Males have been found to have a greater rate of graft failure. While anticoagulant medication can help most individuals with chronic venous mesenteric ischemia, the source of the thrombus must be identified and treated [26].

Other surgical and treatment recommendations:

1. Endovascular revascularization procedures for patients with partial arterial occlusion.
2. Damage control surgery (DCS) is an important adjuvant for patients who require intestinal resection to reassess bowel viability or who have persistent sepsis. Re-laparotomy is an important element of AMI treatment.
3. A continuous infusion of unfractionated heparin can commonly be used to treat mesenteric venous thrombosis [13].

## 6. DISCUSSION

In a previous study; the operative method had a 3% perioperative death rate, a 61 percent 5-year survival rate, and a 79 percent 9-year aided primary graft patency rate in one trial. Those who favour multiple vessel revascularization claim that single-vessel revascularization has a higher rate of graft failure and symptom recurrence. At the Mayo Clinic, 5-year graft patency rates for three-vessel, two-vessel, and one-vessel bypasses were 90 percent, 54 percent, and 0 percent, respectively [26].

Patients with suspected acute mesenteric ischemia should be treated more aggressively, according to Boley et al.6 in 1977. Rapid angiography, visceral vascular perfusion with papavarine, and emergency surgery were all part of their plan. Patients with rapid onset stomach pain lasting more than 2-3 hours and who were suspected of having acute mesenteric ischemia were started on a therapy strategy that included supportive care to enhance hemodynamics and mesenteric flow first. Following that, a roentgenographic examination of the abdomen was performed to rule out any other possible causes of stomach pain. If this did not prove to be diagnostic, the patient was taken to the hospital for emergency angiography. A selective catheter was left in place and papavarine was administered if suitable pathology was discovered. Following that, surgery was performed on the relevant patients. Even in this group, however, more than half of the patients experienced a wait of more than several hours before starting treatment [12].

When there is a low suspicion of intestinal necrosis, endovascular treatment may be used as a first-line therapy for some patients. Open surgery should only be used in the event of an emergency that necessitates an exploratory laparotomy. The hybrid strategy may be a highly effective treatment for AMI, with minimal morbidity and mortality, while more research comparing it to OS and ET is needed [30].

## 7. CONCLUSION

Acute Mesenteric ischemia is life threatening disease that if often linked with high mortality rate, the key to treatment of such cases seems to be early diagnosis, the problem with diagnosis is that clinical presentation is often common with other conditions. So, development of well reliable diagnosis protocol is needed. The treatment is

largely surgical, that's because of the necessity for fast intervention, For a successful outcome, aggressive management is also required. Fluid resuscitation, invasive hemodynamic monitoring, prophylactic antibiotics, and systemic anticoagulation with heparin are all common treatments. We hope for more advancement in diagnosis and treatment protocols and specially protocols because misdiagnosed cases has up to 100% fatality rate according to some sources.

## CONSENT AND ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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