International Journal of Research in Medical Sciences
Molina CDC et al. Int J Res Med Sci. 2025 May;13(5):2066-2072
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20251312

Systematic Review

Surgical strategies and perioperative management in patients with acute mesenteric ischemia: impact on survival and intestinal function - a systematic review

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Received: 31 March 2025
Revised: 21 April 2025
Accepted: 22 April 2025

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ABSTRACT

Acute mesenteric ischemia (AMI) is a fetal condition caused by an acute diminution of mesenteric flow with subsequent bowel necrosis and extremely high mortality. Early identification and immediate action are essential in enhancing outcomes. This systematic review assesses surgery and perioperative care in patients with AMI, determining how they affect survival and bowel function. A systematic search was performed in PubMed, Embase, and Cochrane Library with the use of pertinent MeSH terms and keywords. Included were studies comparing surgical and endovascular treatments, postoperative complications, survival, and bowel viability. Data extraction and quality assessment adhered to PRISMA. Among the studies that were reviewed, endovascular treatments showed superior survival when compared to surgery, with mortality at 15.6% compared to 38.6% for surgery. Early diagnosis, multidisciplinary care, and revascularization greatly improved outcomes. Comorbidities, lactate levels, and age were excellent predictors of mortality. Reoperation within 30 days was observed in 30%, and prolonged hospital stay was seen in 14% of the patients. AMI still has high mortality and morbidity rate, despite these improvements and there needs to be further optimization of surgical methods and perioperative approaches. Early imaging integration, early surgical or endovascular treatment and multidisciplinary management can optimize AMI outcomes. Optimizing management protocols and predictive markers for improved patient stratification and treatment choice should be the focus of future research.

Keywords: Acute mesenteric ischemia, Surgical management, Endovascular intervention, Survival, Bowel viability, Systematic review

INTRODUCTION

Acute mesenteric ischemia (AMI) is a life-threatening syndrome resulting from an acute decline in blood flow to the mesenteric vessels.[1] Intestinal necrosis, sepsis, and death will result from it if immediate treatment is not given. Its high mortality of 60% to 80% is largely due to the non-specificity of the symptoms and the way it

progresses swiftly. Early treatment and diagnosis are essential to help enhance survival.[1] AMI is divided into occlusive mesenteric ischemia (OMI) and nonocclusive mesenteric ischemia (NOMI). OMI is comprised of acute thromboembolism and acute thrombosis, while NOMI has vasospasm and hypoperfusion.[2] The severity of the condition mandates that a high level of suspicion must be used in order to initiate intervention promptly. Improvements in imaging, surgical methods, and interprofessional relationships are instrumental in minimizing mortality and morbidity.[3]

Epidemiology

Acute mesenteric ischemia is an uncommon but fatal illness disease which is seen in 1 per 1,000 admissions. Arterial embolism is responsible for 40% to 50%, while arterial thrombosis for 25% to 30% and NOMI for 20%. Females and elderly and those with multiple comorbidities are at increased risk. Even with advances in medical therapy, mortality rates are still startlingly high. A 56% rate of 30-day morbidity was reported by Gupta et al. with severe postoperative complications like ventilator dependence, septic shock, pneumonia or sepsis. Thirty percent of the patients also needed additional surgical procedures within 30 days, and 14% had prolonged hospital stays for more than one month. The high rates of mortality and complications indicate the importance of better early detection, vigorous management, and further research to improve patient outcomes.[1]

METHODS

Search strategy and databases

Systematic search of literature was conducted on PubMed, Embase, and Cochrane Library for studies related to surgical management and perioperative care in patients with acute mesenteric ischemia. MeSH terms and the following keywords were used in the search: "acute mesenteric ischemia," "surgical management," "endovascular intervention," "mortality," and "intestinal function." Boolean operators AND and OR were used to restrict the search to all the studies related to the topic. Only English-language peer-reviewed articles were included.

Inclusion criteria

Adult patients diagnosed with AMI (both occlusive and nonocclusive types). Studies focusing on surgical and endovascular interventions. Clinical outcomes related to survival, bowel viability, and postoperative complications. Systematic reviews, meta-analyses, randomized controlled trials (RCTs), cohort studies, and case series with a minimum sample size of 50 patients.

Exclusion criteria

Studies focusing exclusively on conservative or medical management without surgical intervention. Non-human studies, conference abstracts, and case reports with fewer than 10 patients. Studies lacking quantitative outcome measures.

Data extraction and quality assessment

A systematic search of literature was conducted on PubMed, Embase and Cochrane Library for studies related to surgical management and perioperative care in patients with acute mesenteric ischemia. Selected keywords were used in the search: "acute mesenteric ischemia," "surgical management," "endovascular intervention," "mortality," and "intestinal function." Boolean operators AND and OR were used to restrict the search to all the studies and only English-language peer-reviewed articles were included.[4]

Table 1: Study characteristics.

Author(s)	Year	Study design	Population characteristics	Sample size / range	Duration / follow-up	Intervention	Methodology
Takashi Sakamoto, Tadao Kubota, Hiraku Funakoshi, Alan Kawarai Lefor[5]	2021	Minireview	Patients with acute mesenteric ischemia (AMI)	Not explicitly stated	Not applicable (review article)	Surgery and endovascular intervention	Review of cutting-edge studies and treatment strategies
Hossam E.M.A. Elfiki, Mahmoud Z.A. Elganzoury, Ramez M.	2024	Systematic review and meta-analysis	Patients with acute mesenteric ischemia (AMI)	9,164 patients	Studies from 2010 to 2022	Not applicable (observational study)	Systematic review and meta-analysis of case-control, case report, prospective cohort, and

Continued.

Author(s)	Year	Study design	Population characteristics	Sample size / range	Duration / follow-up	Intervention	Methodology
Wahba, Abdelrahman Magdy Ahmed [6]							retrospective studies
S. Acosta, S. Salim[7]	2021	Systematic review	Patients with acute mesenteric venous thrombosis (MVT)	604 patients	Studies from 2015 to 2020	Anticoagulation, endovascular therapy, surgery	Systematic review of 11 studies using PubMed search
Klaus Stahl, Nina Rittgerodt, Sascha David, et al[8]	2019	Systematic review and meta-analysis	ICU patients with nonocclusive mesenteric ischemia (NOMI)	335 patients (245 received local vasodilatory therapy)	Studies from 1977 to 2018, follow-up not specified	Intra-arterial local vasodilatory therapy (LVT)	Retrospective studies; comparison of LVT vs. standard care
Miklosh Bala et al[9]	2017	Guidelines and systematic review	Patients with acute mesenteric ischemia (AMI)	Not specified (review of multiple studies)	Not specified (review-based)	Surgical and endovascular revascularization, damage control surgery	Evidence-based recommendations from the World Society of Emergency Surgery (WSES)
Monjur Ahmed[10]	2021	Review article	Patients with ischemic bowel disease	Not specified	Not applicable	Surgical revascularization, endovascular treatment, conservative management	Literature review of diagnostic and treatment strategies

Table 2: Study results and statistics.

Author(s)	Primary outcome(s)	Secondary outcomes	Quantitative data	Main findings / key takeaways	Limitations / biases
Takashi Sakamoto et al.	Endovascular intervention improves prognosis when combined with surgery.	Lower mortality with endovascular intervention (15.6% vs. 38.6% in surgery).	Endovascular mortality: 15.6%, Surgical mortality: 38.6%, p-values: Not provided	Endovascular intervention is superior to surgery in reducing mortality and bowel resection.	Retrospective observational studies with potential selection bias.
Hossam E.M.A. Elfiki et al.	Clinical predictors of mortality in AMI (e.g., age OR 1.19, 95% CI 1.09-1.29; p<0.00001).	Gender (OR 0.96, 95% CI 0.85-1.07; p=0.46), comorbidities (e.g., chronic renal disease OR 2.25, 95% CI 0.97-5.21; p=0.06).	Age (OR 1.19, 95% CI 1.09-1.29; p<0.00001), Lactate (OR 1.40, 95% CI 1.23-1.60; p<0.00001).	Age, lactate, and comorbidities significantly predict AMI mortality. Gender was not significant.	Heterogeneity in study designs and reporting (I^2 up to 94%).
S. Acosta, S. Salim	Bowel resection rate (43.9%), 30-day mortality (9.5%).	Endovascular procedure rate (12.7%), Short bowel syndrome (5.9%-40%).	Bowel resection (43.9%, 95% CI), 30-day mortality (9.5%, 95% CI).	Early diagnosis and anticoagulation reduce mortality. Bowel resection correlates with higher mortality.	Heterogeneity in study designs, publication bias, lack of high-quality Continued. comparative studies.

Continued.

Author(s)	Primary outcome(s)	Secondary outcomes	Quantitative data	Main findings / key takeaways	Limitations / biases
Klaus Stahl et al.	Mortality: 40.3% in LVT patients (95% CI: 28.7%-53%).	Odds ratio for mortality reduction: 0.261 (95% CI: 0.095-0.712, P = .009).	Success rate: 75.9% (95% CI: 55.1%-89%, P = .017), Adverse event rate: 2.9% (95% CI: 1.3%-6.6%, P = .983).	LVT shows potential benefit but lacks randomized trials for confirmation.	All studies retrospective; no randomized trials available.
Miklosh Bala et al.	Reduction in mortality through early diagnosis and intervention.	Improved bowel viability, reduced complications, and better survival rates.	Mortality rates: 50-80% without treatment, reduced with early intervention.	Early CTA, prompt laparotomy, and revascularization improve outcomes. Damage control surgery is essential.	Lack of high-quality randomized trials, reliance on observational studies and expert opinions.
Monjur Ahmed	Improved outcomes with early intervention (p-values not provided).	Increased interest in percutaneous endovascular treatment.	Incidence: 0.09%-0.2% (AMI), 1/1000 hospital admissions.	Early diagnosis, multidisciplinary management, evolving endovascular approaches.	Lacks specific patient-level data and randomized trials.

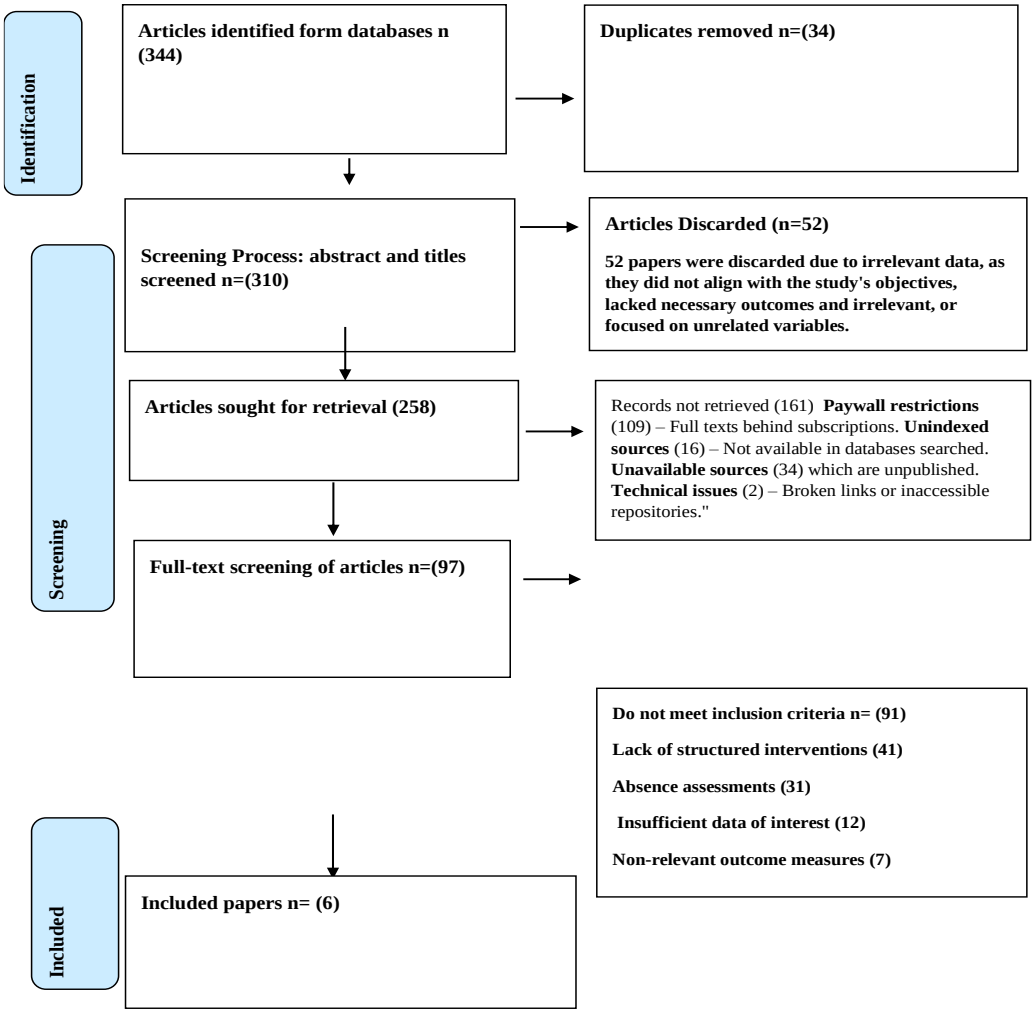

Figure 1: Study flow chart.

RESULTS

Acute mesenteric ischemia (AMI) is a fetal disease that needs immediate intervention so recent studies have emphasized importance of a multidisciplinary approach while integrating surgical and endovascular techniques to optimize patient outcomes. Sakamoto et al. (2021) conducted comprehensive review of surgical and endovascular interventions for AMI and emphasized hybrid approaches significantly enhance prognosis. Findings revealed a stark contrast in mortality rates: 15.6% for patients receiving endovascular interventions versus 38.6% for those undergoing surgery alone, while these results advocate for shift toward minimally invasive techniques but study acknowledged limitations stemming from retrospective data and potential selection bias. Another study, a meta-analysis by Elfiki et al. (2024) explored clinical predictors of mortality in AMI where they analyzed data from 9,164 patients across multiple studies spanning 2010–2022. Age (OR 1.19, $p<0.00001$) elevated lactate levels (OR 1.40, $p<0.00001$) and chronic renal disease emerged as key mortality predictors while gender showed no significant association. Elfiki et al. reinforced critical role of early diagnosis and aggressive management in reducing AMI mortality but cautioned against the variability in study methodologies which limits generalizability.

Acosta and Salim (2021) summarized 11 studies on 604 patients with mesenteric venous thrombosis (MVT) where they emphasized the importance of urgent diagnosis and early anticoagulation. The analysis indicated a 30-day mortality of 9.5% and bowel resection rate of 43.9%. Of interest, bowel resection was associated with higher mortality which emphasized the need for early intervention to avoid irreversible bowel necrosis. Endovascular therapy was used in 12.7% of patients which showed potential but failed to achieve broad acceptance. This evidence emphasized the critical role of CT imaging for early identification and stressed about the use of individualized treatment approaches for AMI treatment. Stahl et al. (2019) conducted a systematic review and meta-analysis on surgical and perioperative management in AMI while focusing on interventional local vasodilatory therapy (LVT). Among 335 patients, LVT achieved a 75.9% success rate and a 40.3% mortality rate while odds ratio for mortality reduction in LVT-treated patients was 0.261 ($p = .009$) which is suggesting a significant survival benefit. Despite promising findings, all included studies were retrospective but the absence of randomized controlled trials (RCTs) prevented definitive conclusions regarding LVT's long-term efficacy.

Bala et al. (2017) published guidelines in the World Journal of Emergency Surgery advocate for early diagnosis and aggressive intervention to mitigate AMI's notoriously high mortality rates (50–80%) so their recommendations included prompt CT angiography (CTA) for diagnosis, immediate fluid resuscitation, broad-spectrum antibiotics as well as anticoagulation with unfractionated heparin. Surgical strategies emphasized revascularization and necrotic bowel resection and damage control techniques with planned re-laparotomy. These guidelines endorse multidisciplinary model involving acute care surgeons, radiologists and vascular specialists to improve outcomes.

Ahmed (2021) discussed current surgical approaches and perioperative care of AMI with emphasis on the growing use of percutaneous endovascular intervention in combination with traditional surgical revascularization. For low frequency of about 0.09%–0.2% of acute surgery admissions of AMI, high degree of clinical suspicion is still indispensable for prompt treatment so conservative measures might be viable in individual situations but the study again supported that urgent surgical or endovascular revascularization is the mainstay of treatment. Consistent scarcity of high-quality RCTs ensures that the development of an optimal strategy remains elusive and this changing picture in AMI management reflects the increasing prominence of endovascular therapies, multidisciplinary treatment and early diagnosis. Although hybrid surgical-endovascular therapies have consistently better survival rates, gaps persist with study heterogeneity and no definitive robust randomized trials. Subsequent studies need to concentrate on standardizing treatment regimens and establishing the long-term effectiveness of new interventions to improve the management model for AMI patients.

DISCUSSION

Acute mesenteric ischemia (AMI) is a very fatal disease that necessitates prompt intervention. The etiology, stability of the patient, and institutional preference decide whether the intervention is open versus endovascular. Open surgical methods in the form of embolectomy, thrombectomy, and bypass grafting have been the long-standing standard, providing definitive reestablishment of blood supply in those with high thrombotic burden or vessel occlusion.[11] However, open approaches carry significant morbidity, prolonged recovery, and higher operative risk, particularly in elderly and comorbid patients. In contrast, endovascular interventions—angioplasty, stenting, and catheter-directed thrombolysis—have revolutionized treatment by providing minimally invasive alternatives with reduced perioperative complications, shorter hospital stays, and improved early survival.[12] Nonetheless, the delayed recognition of bowel necrosis remains a key limitation, potentially necessitating secondary open surgery. The decision between primary bowel resection and second-look surgery remains contentious. Immediate bowel resection minimizes ischemic burden and systemic inflammatory response but risks excessive resection in borderline ischemic regions. Second-look laparotomy allows reassessment, potentially sparing viable bowel and reducing the incidence of short bowel syndrome (SBS). Hybrid surgical strategies, combining initial revascularization with planned re-exploration, have gained

traction in optimizing bowel preservation and survival outcomes. The integration of indocyanine green fluorescence imaging and near-infrared spectroscopy offers real-time perfusion assessment, yet their routine adoption remains limited by availability and cost. Resuscitation and hemodynamic optimization are paramount in AMI management.[13] Adequate volume resuscitation with crystalloid or colloid solutions, judicious use of vasopressors to maintain splanchnic perfusion, and early initiation of broad-spectrum antibiotics mitigate sepsis and multi-organ failure. The role of anticoagulation remains critical, with systemic heparinization serving as the cornerstone in thromboembolic AMI. Novel anticoagulants, including direct thrombin and factor Xa inhibitors, hold promise but lack robust clinical validation in AMI. Postoperative nutritional support is pivotal in determining long-term functional outcomes.[14] The choice between total parenteral nutrition (TPN) and early enteral feeding hinges on bowel viability and postoperative ileus. While TPN is often indispensable in extensive bowel resections, early enteral nutrition fosters gut integrity, reduces infectious complications, and enhances mucosal recovery. Advances in gut rehabilitation, including intestinal lengthening procedures and autologous reconstruction, are reshaping the management of SBS, yet dependency on long-term parenteral support remains a significant burden. Infection control strategies and targeted antibiotic therapy are essential given the high risk of bacterial translocation and sepsis. Empirical broad-spectrum antibiotics with gram-negative and anaerobic coverage should be initiated promptly, with de-escalation based on cultures.[15] The emergence of multidrug-resistant organisms necessitates antimicrobial stewardship, particularly in recurrent or prolonged hospitalizations. Short-term outcomes in AMI remain dismal, with 30-day mortality exceeding 50% in many series. Hospital stay is frequently prolonged, driven by complications such as anastomotic leaks, prolonged ileus, and secondary infections. Long-term functional outcomes largely depend on bowel preservation; extensive resections lead to chronic malabsorption, dehydration, and lifelong dependency on parenteral nutrition.[16-18] The burden of SBS underscores the need for innovative reconstructive strategies and multidisciplinary intestinal rehabilitation programs. Predictors of poor prognosis include delayed presentation, extensive bowel infarction, persistent lactate elevation, and hemodynamic instability. Risk stratification tools integrating clinical, biochemical, and imaging parameters could enhance early identification of high-risk patients, guiding personalized therapeutic decisions. However, no universal prognostic model has been validated to date, necessitating further refinement of predictive algorithms. Comparisons of surgical and perioperative strategies reveal no single superior approach, underscoring the need for individualized decision-making. Open surgery remains indispensable in complex cases with extensive thrombosis or failed endovascular attempts, whereas minimally invasive techniques are preferable in select patients with localized embolic occlusions. Hybrid strategies may bridge the gap, offering tailored solutions to optimize both survival and functional outcomes. Current evidence, though expanding, remains limited by retrospective designs, small sample sizes, and heterogeneity in patient selection. High-quality, randomized trials comparing open, endovascular, and hybrid techniques are urgently needed to establish definitive management guidelines. The future of AMI management lies in precision medicine—leveraging artificial intelligence (AI) for real-time risk prediction, optimizing anticoagulation strategies with novel agents, and refining bowel salvage techniques through regenerative medicine approaches. The integration of machine learning in clinical decision-making, coupled with emerging biomarkers and advanced imaging modalities, holds the potential to revolutionize AMI treatment paradigms, ultimately improving survival and quality of life.[19]

Updated guidelines by the World Society of Emergency Surgery (WSES) for the treatment of Acute Mesenteric Ischemia (AMI) emphasize high priority on early diagnosis, early intervention, and multidisciplinary treatment to improve patient outcomes. AMI, characterized by an acute interruption of blood supply to the intestines, is a potentially life-threatening condition with high mortality if untreated. The guidelines emphasize high priority on clinical suspicion, particularly in patients with severe and out-of-proportion abdominal pain and no physical examination findings, and immediate computed tomography angiography (CTA) as the gold standard for diagnosis. Initial fluid resuscitation, correction of electrolyte imbalance, and broad-spectrum antibiotics are crucial. Surgery, in the form of laparotomy or laparoscopy, is indicated in patients with peritonitis or bowel necrosis, with priority on re-establishing blood supply and avoiding resection of viable bowel. Endovascular techniques, such as stenting or thrombolysis, are favored as first-line therapy for arterial occlusion when expertise is available because they are associated with reduced mortality and bowel resection rates compared to open surgery.[20] Temporary closure of the abdomen with damage control surgery (DCS) is recommended for critically ill patients to allow repeated assessment of the viability of the bowel. Post-operative management should optimize intestinal perfusion, avoid multiorgan failure, and treat any complications like short bowel syndrome. The guidelines emphasize the need for long-term anticoagulation and surveillance imaging in patients who are revascularized. Multidisciplinary care which encompasses general surgeons, vascular surgeons, interventional radiologists, and intensivists is essential for the best outcomes and guidelines recommend the organization of specialized "intestinal stroke centers" to increase efficiency and enhance survival rates. Revised WSES guidelines offer a thorough methodology for diagnosing, treating and caring for AMI, with a focus on early intervention, personalized care and multidisciplinary treatment to decrease mortality and enhance patient outcomes.[20]

CONCLUSION

Acute mesenteric ischemia (AMI) is still a very lethal disease and urgent diagnosis and early intervention are necessary to enhance survival and intestinal function. We emphasized the important role of surgical and endovascular therapy in the treatment of AMI. Endovascular therapy especially when it is used with surgery showed better outcomes through the reduction of mortality and rates of bowel resection. Early diagnosis by advanced imaging, early laparotomy and revascularization can significantly improve patient prognosis. Despite all these advances, high post-operative morbidity and recurrence rates indicate the necessity of standardized protocols as well as an interdisciplinary approach and results bring into focus early intervention, intensively aggressive perioperative care, and ongoing study to optimize treatments. Randomized controlled trials of the future need to be there to develop evidence-based guidelines to enhance long-term outcomes. By incorporating new therapeutic strategies and optimizing perioperative treatment, clinicians can improve survival rates and maintain intestinal function in AMI patients and thereby improving the overall prognosis and quality of life of such patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Molina CDC, Valero AEC, Rodriguez ISR, Denisse MTL, Martínez PS, Gastelum JLR, et al. Surgical strategies and perioperative management in patients with acute mesenteric ischemia: impact on survival and intestinal function – a systematic review. Int J Res Med Sci 2025;13:2066-72.