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REVIEW ARTICLE

Integrated prognostic markers in acute mesenteric ischaemia – a narrative review

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ABSTRACT

INTRODUCTION: Acute mesenteric ischaemia (AMI) remains a surgical emergency with persistently high mortality, often attributable to delayed diagnosis and limited early prognostic clarity. Although advances in imaging and intervention have improved outcomes in selected cases, timely risk stratification remains critical to guide management and improve survival.

METHODS: A literature review was conducted using PubMed to identify studies published between 2015 and 2025 that examined early prognostic indicators for AMI. Key biochemical, clinical, radiological, and scoring-based predictors of mortality were extracted and analysed.

RESULTS: Nine studies met the inclusion criteria. A multifactorial prognostic framework emerged. Biochemical markers, including elevated lactate, a reduced bicarbonate-to-lactate ratio, high red cell distribution width, and a CRP/albumin ratio, were associated with increased mortality. Clinical factors—including advanced age, comorbid cardiovascular disease, haemodynamic instability, and the need for vasopressors—also showed substantial predictive value. Imaging findings (e.g., arterial occlusion, colonic involvement) and scoring systems, such as the Mannheim Peritonitis Index and the ASA classification, further enhanced risk stratification.

CONCLUSION: Effective early risk assessment for AMI patients requires a multimodal approach integrating biochemical, clinical, and radiological data. Composite indices—such as the bicarbonate-to-lactate ratio—show promise in improving prognostic accuracy and guiding timely intervention. Prospective validation of these tools is essential to optimize outcomes and resource allocation in this high-risk population.

Keywords: Acute mesenteric ischaemia; mortality; prognostic factors.

INTRODUCTION

Acute mesenteric ischaemia (AMI) is a life-threatening emergency with persistently high mortality despite advances in imaging and surgical techniques. Although it accounts for only about 1% of acute abdomen presentations overall, and up to 10% in patients over 70 years old, its true incidence is likely underreported because of frequent misdiagnosis or delayed recognition.[1,2] Arterial thromboembolism accounts for the majority of cases (up to 68%), followed by venous thrombosis (28%) and non-occlusive ischaemia (7%)[3,4] In 1926, Cokkinis characterised acute mesenteric ischaemia as presenting insurmountable diagnostic challenges, a dismal prognosis, and ineffective therapeutic options.[5] Despite significant advances in revascularisation techniques, contemporary series continue to report persistently high post-intervention

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mortality.[6] Early identification of prognostic factors at admission is therefore critical to stratify risk, prioritise interventions, and ultimately improve survival.

The objective of this narrative review is to summarise recent literature on early prognostic factors that could assist clinical decision-making in patients with AMI.

METHODS

A literature review was conducted using the PubMed database to identify studies published between 2015 and 2025 with the search terms "prognostic acute mesenteric ischemia". Eligible studies included original research articles and case series that evaluated admission-level prognostic indicators in patients with acute mesenteric ischemia (AMI). Studies were screened based on titles and abstracts, and full texts were reviewed when necessary to determine eligibility. Only human studies published in English were included.

RESULTS

Nine retrospective studies were identified and included in this study. They represent a multifactorial framework with potential prognostic value and are summarised in Table 1.

Biochemical predictors of mortality in AMI

Biochemical markers were the most frequently reported. Studer et al. demonstrated that elevated lactate levels measured within 24 hours before surgery were independently associated with increased mortality (r^2 = 0.329), particularly in patients with small- or large-bowel ischaemia.[7] This was observed in 46.2% of patients with a fatal outcome, compared with 13.5% in survivors (p = 0.001). Complementing this, Pinelo et al. proposed the bicarbonate-to-lactate ratio as a more robust prognostic index, with a hazard ratio of 0.792 (p = 0.002), highlighting the importance of acid–base balance in risk assessment. Additionally, Bilgiç et al. identified the red cell distribution width (RDW) as a predictor of mortality, with an area under the curve (AUC) of 0.713 (95% CI 0.584–0.841)[9] Kaçer et al. further supported the utility of inflammatory markers by showing that a CRP/albumin ratio greater than 1.32 was associated with high prognostic accuracy (sensitivity 93.65%, specificity 69.57%, AUC = 0.782, p < 0.0001)[10]

Clinical predictors of mortality in AMI

Clinical and intensive care parameters also have predictive value. Caluwaerts et al. reported that the maximum vasopressor dose (OR = 1.20; 95% CI 1.08–1.33, p < 0.001) and arterial lactate change within the first 24 hours (OR = 1.24; 95% CI 1.05–1.48, p = 0.012) were significant predictors of mortality in ICU-managed AMI cases, whereas anticoagulation therapy was protective (OR = 0.19; 95% CI 0.043–0.84, p = 0.029).[11] De Pietro et al. emphasised age and comorbidities as key risk factors, showing that patients over 70 years had a seven-fold increased risk of mortality (OR = 7; 95% CI 1.4–37, p = 0.02), while those with coronary artery disease had a thirteen-fold increase (OR = 13; 95% CI 1.7–93, p = 0.01).[12] Schwartner et al. highlighted that a lower skeletal muscle index (SMI), indicative of sarcopenia, was significantly more prevalent among non-survivors (mean 37.5 vs. 44.1 cm^2/m^2, p = 0.01), reinforcing the relevance of nutritional and frailty status.[13]

Predictive scores and radiologic predictors of mortality in AMI

Predictive scoring systems and radiologic findings were also used in risk stratification for AMI. Yıldırım et al. identified a Mannheim Peritonitis Index (MPI), which includes age, gender, malignancy, organ failure, origin, extent, duration of peritonitis, and type of exudate), higher than 26 as significantly associated with mortality (p = 0.004).[14]

Sinz et al. reported that higher ASA scores (4–5) were strongly predictive of poor outcomes (OR = 4.58, p = 0.014), as were elevated creatinine (OR = 1.01, p = 0.029), severe acidosis (OR = 0.00, p = 0.005), and radiologic features such as arterial occlusion (OR = 6.62, p = 0.001), atherosclerosis on CT-scan (OR = 6.62, p = 0.001), and colonic involvement (OR = 3.02, p = 0.021).[15]

DISCUSSION

Despite advances in imaging and critical care, the diagnosis of acute mesenteric ischaemia (AMI) often remains delayed until irreversible transmural injury has occurred, contributing to persistently high mortality rates. Computed tomography angiography, while highly sensitive for detecting advanced bowel infarction, frequently fails to identify early, potentially reversible ischaemia and thus offers limited guidance for timely intervention.[17] Moreover, radiological indicators such as extensive vascular occlusion or colonic involvement, though associated with poorer survival, reflect late-stage pathology.[15]

Biochemical markers have been extensively studied to improve early outcome prediction. Serum lactate levels correlate with the degree of hypoperfusion, yet their diagnostic sensitivity is limited in the early phase, often rising only after substantial tissue injury.[7,18] Serial arterial lactate measurements over the first 24 hours post-admission may predict mortality (OR 1.24; 95% CI 1.05–1.48; p = 0.012), but reliance on lactate alone overlooks the patient's buffering capacity, which is critical for metabolic compensation.[11] Our centre's data indicate that the bicarbonate-to-lactate ratio, with a cutoff value ≤ 10, outperforms lactate alone in predicting in-hospital mortality: it achieved 90.6% sensitivity and 75% specificity overall, rising to 100% specificity (with 83% sensitivity) when acute-on-chronic presentations were excluded.[8] By integrating markers of both hypoperfusion (lactate) and acid-base buffering (HCO_3^-), this composite index more accurately reflects the dynamic interplay between ischemic severity and the body's compensatory mechanisms.

In addition to acid-base disturbances, renal dysfunction is a key prognostic factor. Elevated creatinine, both at baseline and over time, has been independently linked to worse outcomes, likely reflecting the severity of multiorgan hypoperfusion.[16] Similarly, inflammatory markers such as the C-reactive protein/albumin ratio have prognostic utility: a cutoff > 1.32 predicts in-hospital mortality with

Table 1. Summary of studies on admission-level prognostic factors in acute mesenteric ischaemia, included in this scoping review.

Ref / year	Design	N	Main findings
Studer 2015[7]	R	91	Elevated lactate prior to surgery (r^2 = 0.329, p = 0.001) Concomitant colonic ischaemia (MR 46.2% vs. MR 13.5 % if only small bowel ischemia, p = 0.001) ASA score (survivor 3.47±0.67 vs. non-survivor 3.97±0.72, p = 0.003)
Bilgiç 2015[9]	R	61	RDW > 14.85 (AUC = 0.713; 95% CI: 0.584–0.841)
Yidirim 2017[14]	R	46	Mannheim Peritonitis Index score ≥26 (p=0.004)
Caluwaerts 2019[11]	R	214	Maximal dose of vasopressor (OR = 1.20; p < 0.001) Elevated lactate (OR=1.24; p = 0.012)
Sinz 2022[15]	R	125	ASA score 4-5: (OR = 4.58; p = 0.014) Creatinine (OR = 1.01; p = 0.029) pH (OR = 0.00; p = 0.005) Imagiological findings: 1) atherosclerosis (OR = 6.62; p = 0.001), 2) arterial occlusion (OR = 6.62; p = 0.001), 3) colonic involvement (OR = 3.02; p = 0.021)
Kaçer 2023[10]	R	132	CRP-to-albumin ratio >1.32 (AUC, .782; p < 0.001)
De Pietro 2023[12]	R	173	Age >70 (OR = 7; p = 0.02) Coronaropathy (OR = 13; p = 0.01)
Schwartner 2023[13]	R	137	Lower SMI (survivors: 37.5 ± 12.4 cm2/m2 vs. non-survivors: 44.1 ± 13.9 cm2/m2; p = 0.01)
Pinelo 2025[8]	R	60	HCO3-to-lactate ratio ≤10 (AUC 0.832; p < 0.001)

R: Retrospective; **ASA:** American Society of Anesthesiology; **RD:** Red Cell Distribution Width; **SMI:** Skeletal Muscle Index; **CRP:** C-Reactive Protein; **OR:** Odds Ratio; **AUC:** Area Under the Curve.

high sensitivity (93.7%) and moderate specificity (69.6%), underscoring the role of systemic inflammation and nutritional status in AMI progression.[10]

Clinical variables further refine risk stratification. Advanced age (> 70 years; OR 7; 95% CI 1.4–37; p = 0.02) and pre-existing coronary artery disease (OR 13; 95% CI 1.7–93; p = 0.01) significantly increase mortality risk, as do haemodynamic instability requiring vasopressors (OR 1.20; 95% CI 1.08–1.33; p < 0.001)[11,12] Delays in diagnosis - often averaging 24 hours- exponentially raise mortality, reaching up to 100% when revascularisation is postponed beyond this window.[19-21]

Although timely surgical or endovascular reperfusion can reduce post-procedural mortality (26–48%), such interventions may be rendered futile by advanced ischaemic injury at presentation.[22,23] Sumbal et al. provided a meta-analysis of prognostic markers in over 10,000 patients.[16] They confirmed that advanced age, chronic kidney disease, functional dependency, arrhythmias, heart failure, hypotension, delayed surgery, and use of inotropes all significantly increased the risk of mortality.

Additional indices, including the Mannheim Peritonitis Index (MPI ≥ 26; p = 0.004)[14] a low skeletal muscle index,[13] and elevated red cell distribution width (RDW > 14.85%; ~70% predictive accuracy),[9] have all been associated with poorer survival, suggesting that a multimodal prognostic approach - combining clinical, biochemical, radiological, and nutritional parameters - may offer the most reliable means of identifying patients at highest risk. Such a comprehensive strategy could inform not only the urgency and aggressiveness of surgical management but also the early recognition of cases where palliative care may be more appropriate, thereby avoiding futile interventions and optimising resource allocation.

CONCLUSION

Although individual markers provide valuable insights into disease severity, composite indices that capture multiple facets of pathophysiology appear promising for early risk stratification in AMI. Prospective validation of these integrated prognostic tools, alongside efforts to streamline diagnostic pathways and minimise treatment delays, will be essential to improve outcomes.

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REFERENCES

1. Klar E, Rahmanian PB, Bücker A, Hauenstein K, Jauch KW, Luther B. Acute mesenteric ischemia: a vascular emergency. Dtsch Arztebl Int. 2012;109:249-56.

2. Khan A, Hsee L, Mathur S, Civil I. Damage-control laparotomy in nontrauma patients: review of indications and outcomes. J Trauma Acute Care Surg. 2013;75:365-8.

3. Acosta S, Ogren M, Sternby NH, Bergqvist D, Björck M. Clinical implications for the management of acute thromboembolic occlusion of the superior mesenteric artery: autopsy findings in 213 patients. Ann Surg. 2005;241:516-22.

4. Kärkkäinen JM, Lehtimäki TT, Manninen H, Paajanen H. Acute Mesenteric Ischemia Is a More Common Cause than Expected of Acute Abdomen in the Elderly. J Gastrointest Surg. 2015;19:1407-14.

5. Cokkinis AJ. Mesenteric Vascular Occlusion. London Lock Hospital. Demy 8vo. Pp. 159 + xii, with 5 illustrations. 1926. London: Baillière, Tindall & Cox. 10s. 6d.

6. Adaba F, Askari A, Dastur J, Patel A, Gabe SM, Vaizey CJ, et al. Mortality after acute primary mesenteric infarction: a systematic review and meta-analysis of observational studies. Colorectal Dis. 2015;17:566-77.

7. Studer P, Vaucher A, Candinas D, Schnüriger B. The value of serial serum lactate measurements in predicting the extent of ischemic bowel and outcome of patients suffering acute mesenteric ischemia. J Gastrointest Surg. 2015;19:751-5.

8. Pinelo A, Loureiro L, Pires M, Mendes D, Almeida H, Queirós M, et al. Prognostic Value of the HCO3-to-Lactate Ratio in Acute Mesenteric Ischemia: A Retrospective Analysis. Ann Vasc Surg. 2025;117:19-27.

9. Bilgiç I, Dolu F, Şenol K, Tez M. Prognostic significance of red cell distribution width in acute mesenteric ischemia. Perfusion. 2015;30:161-5.

10. Kaçer İ, Çağlar A, Akıllı NB. The Prognostic Value of C-Reactive Protein/Albumin Ratio in Acute Mesenteric Ischemia. Am Surg. 2023;89:1661-7.

11. Caluwaerts M, Castanares-Zapatero D, Laterre PF, Hantson P. Prognostic factors of acute mesenteric ischemia in ICU patients. BMC Gastroenterol. 2019;19:80.

12. De Pietro R, Martin J, Tradi F, Chopinet S, Barraud M, Gaudry M, et al. Prognostic factors after acute mesenteric ischemia: which patients require specific management? Int J Colorectal Dis. 2023;38:242.

13. Schwartner C, Mehdorn M, Gockel I, Struck MF, Leonhardi J, Rositzka M, et al. Computed Tomography-Defined Body Composition as Prognostic Parameter in Acute Mesenteric Ischemia. Dig Surg. 2023;40:225-32.

14. Yıldırım D, Hut A, Tatar C, Dönmez T, Akıncı M, Toptaş M. Prognostic factors in patients with acute mesenteric ischemia. Turk J Surg. 2017;33:104-9.

15. Sinz S, Schneider MA, Graber S, Alkadhi H, Rickenbacher A, Turina M. Prognostic factors in patients with acute mesenteric ischemia-novel tools for determining patient outcomes. Surg Endosc. 2022;36:8607-18.

16. Sumbal R, Ali Baig MM, Sumbal A. Predictors of Mortality in Acute Mesenteric Ischemia: A Systematic Review and Meta-Analysis. J Surg Res. 2022;275:72-86.

17. Zeng Y, Yang F, Hu X, Zhu F, Chen W, Lin W. Radiological predictive factors of transmural intestinal necrosis in acute mesenteric ischemia: systematic review and meta-analysis. Eur Radiol. 2023;33:2792-9.

18. Koelemay MJ, Geelkerken RH, Kärkkäinen J, Leone N, Antoniou GA, de Bruin JL, et al. Editor's Choice - European Society for Vascular Surgery (ESVS) 2025 Clinical Practice Guidelines on the Management of Diseases of the Mesenteric and Renal Arteries and Veins. Eur J Vasc Endovasc Surg. 2025;70:153-218.

19. Reintam Blaser A, Mändul M, Björck M, Acosta S, Bala M, et al. Incidence, diagnosis, management and outcome of acute mesenteric ischaemia: a prospective, multicentre observational study (AMESI Study). Crit Care. 2024;28:32.

20. Kühn F, Schiergens TS, Klar E. Acute Mesenteric Ischemia. Visc Med. 2020;36:256-62.

21. Luther B, Moussazadeh K, Müller BT, Franke C, Harms JM, Ernst S, et al. Die akute mesenteriale Ischämie - unverstanden oder unheilbar? [The acute mesenteric ischemia - not understood or incurable?]. Zentralbl Chir. 2002;127:674-84.

22. Kärkkäinen JM, Acosta S. Acute mesenteric ischemia (part I) - Incidence, etiologies, and how to improve early diagnosis. Best Pract Res Clin Gastroenterol. 2017;31:15-25.

23. Block TA, Acosta S, Björck M. Endovascular and open surgery for acute occlusion of the superior mesenteric artery. J Vasc Surg. 2010;52:959-66.