

MANAGEMENT STRATEGIES AND OUTCOMES OF ACUTE LIMB ISCHEMIA IN A TERTIARY CARE HOSPITAL: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Acute limb ischaemia (ALI) is a sudden reduction in limb blood flow due to embolism, thrombosis, or trauma, leading to tissue ischemia and risk of limb loss if not treated urgently. Prompt recognition and treatment are critical to prevent limb loss and death. This study aimed to evaluate the clinical features, management strategies, and short-term outcomes of ALI. **Materials and Methods:** This retrospective study included 148 patients at the Tirunelveli Medical College between January 2020 and December 2024. Data on clinical profiles, imaging (Duplex, CTA, MRA, DSA), management, and outcomes were collected. Treatment included anticoagulation, endovascular thrombolysis, surgical revascularisation, and supportive care. **Result:** The mean age was 51.7±12.1 years, with 81.4% males. Lower limbs were involved in 85.1% and the aetiologies included were vascular injury (62%) and embolism (24%). Comorbidities included smoking/tobacco use (43.2%), hypertension (27%), and diabetes mellitus (14.8%). Definitive treatments included endovascular thrombolysis in 25 (16.9%) with 89% limb salvage, surgical revascularisation (embolectomy/bypass) in 108 (73%) with 81% limb salvage, anticoagulation alone in 5 (3.4%) and primary amputation in 15 (10.1%). Major complications were wound infection in 18 (12%), post-revascularisation secondary amputation in 4 (2.7%), reperfusion injury in 5 (3.4%) and major bleeding in 6 (4%). Overall, limb salvage was achieved in 129 (87.1%), and amputation occurred in 19 (12.9%). Early presenters (≤12 h, n=89) had 96.6% limb salvage and 3.4% amputation, while delayed presenters (>12 h–14 days, n=59) had 72.9% limb salvage and 27.1% amputation. **Conclusion:** Middle-aged men with ALI commonly had smoking, hypertension, or diabetes. Lower limbs, especially femoropopliteal segments, were mainly affected. Early surgical or endovascular intervention ensured high limb salvage, while delayed presentation raised amputation risk.

INTRODUCTION

According to the Society for Vascular Surgery (SVS), acute limb ischemia (ALI) is a sudden decrease in limb perfusion, commonly caused by a blood clot (embolism), arterial thrombosis, or trauma. It results in a quick reduction of blood flow to the affected limb, leading to tissue ischemia and limb loss if immediate treatment is not provided.^[1] Globally, the incidence of ALI is estimated to be 10-12 per 100,000 person-years.^[2] The term “ischemia” comes from the Latin words ischo, meaning restrain,

and haemia, meaning blood. Ischaemia occurs when the blood supply is insufficient to meet the metabolic demands of tissues. When tissue oxygen levels fall below a critical threshold, cells shift from aerobic to anaerobic metabolism, leading to lactate accumulation and increased fat breakdown.^[3] ALI commonly results from embolism, thrombosis, trauma, or iatrogenic causes such as vascular procedures. Risk factors include smoking, hypertension, diabetes, atrial fibrillation, and prior vascular disease, which increase susceptibility to sudden arterial blockage.^[4]

Different tissues tolerate ischaemia for varying periods. In the lower extremities, nerve tissue is the most sensitive and can suffer permanent damage after 4–6 hours of total ischaemia.^[5] Sensory nerves are affected first, causing numbness or tingling, followed by motor nerves, resulting in muscle weakness. As ischaemia progresses, the skin and muscles become affected.^[6] The extent and speed of tissue injury depend on the adequacy of collateral blood flow and duration of ischaemia. If the blood supply is not restored promptly, the risk of limb loss rises rapidly.^[7,8]

ALI typically presents with sudden pain, pallor, pulselessness, numbness, weakness, and coldness of the limb, commonly described as the “Five Ps.” Most patients seek medical attention soon after symptom onset.^[5] The consensus definition of ALI includes patients with symptoms lasting less than 14 days.^[9] Despite advances in surgical and endovascular treatment options, ALI remains associated with significant morbidity and mortality, and early recognition and intervention are critical for improving outcomes.^[10] The severity of ALI is often assessed using classification systems like the Rutherford grading, which categorises ALI by clinical signs, perfusion, and limb threat, guiding treatment and predicting outcomes.^[11]

Despite advancements in revascularisation, ALI continues to pose a major burden in developing countries due to delayed presentation and limited access to vascular care. This study aimed to describe the clinical features, management strategies, and short-term outcomes of ALI in a high-volume tertiary care hospital. By analysing patient presentation, treatment approaches, and early results, this study seeks to provide a clear understanding of current management patterns and highlight factors influencing patient outcomes. This information can help guide timely interventions and improve care for patients presenting with this urgent and potentially limb-threatening condition in the future.

MATERIALS AND METHODS

Study design and setting

This retrospective study included 148 patients from the department of vascular surgery, Tirunelveli Medical College, between January 2020 and December 2024. The study protocol was approved by the Institutional Research Ethics Committee. As data were collected from anonymised medical records, informed consent was not obtained from the patients.

Inclusion Criteria

Patients aged >18 years who presented to the emergency department with a clinical or radiological diagnosis of ALI classified according to Rutherford categories I, IIa, IIb, or III and ALI secondary to arterial thrombosis-trauma, thromboembolism were included.

Exclusion Criteria

Patients aged < 18 years, those with chronic limb ischaemia (including diabetic foot or advanced peripheral arterial disease), a history of prior lower limb revascularisation (angioplasty, stenting, or bypass surgery) and those with incomplete medical records were excluded.

Methods

Demographic data, comorbidities (diabetes, hypertension, prior myocardial infarction, atrial fibrillation, peripheral arterial disease, cardiomyopathies, valvular disease, tobacco use, family history, bleeding/clotting disorders), aetiology, clinical presentation (the “6Ps”: pain, pulselessness, pallor, poikilothermia, paraesthesia, paralysis), time from symptom onset to presentation, management strategies, and outcomes (limb salvage or amputation) were recorded.

Clinical classification was performed using the Rutherford system, considering sensory and motor deficits and Doppler indices. Duplex ultrasonography is the first-line imaging modality for identifying occlusion level, severity, chronicity, and aetiology. Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) were used when needed for detailed anatomical assessment or in cases of allergy or chronic kidney disease. Digital subtraction angiography (DSA) was performed when an intervention was planned.

Management included systemic anticoagulation with heparin, catheter-directed thrombolysis, surgical embolectomy using a Fogarty catheter, bypass grafting, and supportive care, including fasciotomy or amputation, when indicated. Data were expressed as frequencies and percentages.

RESULTS

Most patients were aged 51–60 years (32.9%), predominantly male (81.4%). Common comorbidities included smoking/tobacco use (43.2%), hypertension (27%), and diabetes (14.8%). The majority (60.1%) presented within 12 hours of symptom onset, while 39.9% had delayed presentation (>12 hours–14 days). [Table 1]

Table 1: Demographic characteristics and comorbidities of patients with acute limb ischemia

Variable	Subcategory	N (%)
Age (years)	<30	1 (0.6%)
	31–40	15 (10.2%)
	41–50	45 (30.5%)
	51–60	49 (32.9%)
	61–70	28 (19.2%)
	>70	10 (6.5%)
Sex	Male	120 (81.4%)
	Female	28 (18.6%)

Comorbidities	Hypertension	40 (27%)
	Diabetes mellitus	22 (14.8%)
	Smoking/Tobacco use	64 (43.2%)
	Coronary artery disease	9 (6.1%)
	Atrial fibrillation	5 (3.7%)
Time to presentation	<12 hours	89 (60.1%)
	>12 hours – 14 days	59 (39.9%)

Footer: Data were presented as frequencies and percentages.

Among 148 patients, the lower limb was predominantly affected (85.1%). The main aetiologies were vascular injury from trauma (62%), embolism (24%), and in-situ thrombosis (14%). Occlusions were most commonly femoropopliteal (48.6%), followed by iliac/femoral (27.7%),

brachial/axillary (14.9%), and tibial/distal (8.8%). According to the Rutherford classification, 16.9% were Class I (viable), 33.8% Class IIa (marginally threatened), 37.8% Class IIb (immediately threatened), and 11.5% Class III (irreversible). [Table 2]

Table 2: Limb Involvement, aetiology, level of occlusion, and Rutherford classification

Variable	Subcategory	N (%)
Limb involved	Lower limb	126 (85.1%)
	Upper limb	22 (14.9%)
Aetiology	Vascular injury (RTA/Trauma)	92 (62%)
	Embolism (cardiac/atrial fibrillation)	36 (24%)
	In-situ thrombosis (atherosclerotic)	20 (14%)
Level of occlusion	Femoropopliteal	72 (48.6%)
	Iliac/Femoral	41 (27.7%)
	Brachial/Axillary	22 (14.9%)
	Tibial/Distal	13 (8.8%)
Rutherford classification	Class I (Viable)	25 (16.9%)
	Class IIa (Marginally threatened)	50 (33.8%)
	Class IIb (Immediately threatened)	56 (37.8%)
	Class III (Irreversible)	17 (11.5%)

Footer: Data were presented as frequencies and percentages.

Definitive treatment included endovascular thrombolysis in 20 (13.5%) with a limb salvage rate of 89%, surgical revascularisation (embolectomy/bypass) in 108 (73%) with 81% limb salvage, anticoagulation alone in 5 (3.4%) and primary amputation in 15 (10.1%). Major

complications were wound infection in 18 (12%), major bleeding in 6 (4%), post-revascularisation secondary amputation in 4 (2.7%), and reperfusion injury (AKI) in 5 (3.4%) patients. Overall, limb salvage was achieved in 129 (87.1%) patients, whereas 19 (12.9%) underwent amputation. [Table 3]

Table 3: Definitive treatment, major complications, and limb salvage outcomes in acute limb ischemia

Variable	Subcategory	N (%)	Limb salvage (%)
Definitive treatment	Endovascular thrombolysis	20 (13.5%)	89
	Surgical revascularisation (embolectomy/bypass)	108 (73%)	81
	Anticoagulation alone	5 (3.4%)	—
	Primary amputation	15 (10.1%)	—
Major complications	Wound infection	18 (12%)	—
	Major bleeding	6 (4%)	—
	Post-revascularisation secondary amputation	4 (2.7%)	—
	Reperfusion injury (AKI)	5 (3.4%)	—
Overall outcomes	Limb salvage (total)	129 (87.1%)	—
	Amputation rate	19 (12.9%)	—

Footer: Data were presented as frequencies and percentages; limb salvage rates are shown where applicable.

Among the 89 (60.1%) patients who presented within 12 h, 3 (3.4%) underwent amputation, and 86 (96.6%) achieved limb salvage. In 59 (39.9%)

patients with delayed presentation (>12 hours–14 days), 16 (27.1%) required amputation, whereas 43 (72.9%) achieved limb salvage.[Table 4]

Table 4: Effect of time to presentation on amputation and limb salvage in acute limb ischemia

Presentation time	N (%)	Amputations N (%)	Limb salvage N (%)
≤ 12 h (Early presentation)	89 (60.1%)	3 (3.4%)	86 (96.6%)
> 12 h – 14 days (Delayed presentation)	59 (39.9%)	16 (27.1%)	43 (72.9%)

Footer: Data were presented as frequencies and percentages.

DISCUSSION

In our study, most patients were middle-aged, and males were the predominant gender. Common comorbidities included smoking or tobacco use, hypertension, and diabetes mellitus, with fewer patients having coronary artery disease or atrial fibrillation. Most patients presented early, whereas a significant proportion presented late. Similarly, **Parashari et al.** reported that most patients with ALI were young males (92.5%) and primarily had traumatic vascular injuries.^[11] **Almadwahi et al.** found in a retrospective study of 91 patients, the mean age was 55.9 ± 11.5 years, with 61.5% males. Common comorbidities included hypertension (83.5%), ischemic heart disease (67%), and diabetes mellitus (61.5%).^[12] However, **Umetsu et al.** evaluated an older population (mean age 72 ± 15 years), with 57 males, and higher rates of hypertension (70.1%), atrial fibrillation (55.8%), dyslipidaemia (36.3%), and diabetes (18.2%).^[13]

Likewise, **Maldonado et al.** reported a cohort with a mean age of 66.3 ± 13.3 years, a higher proportion of females (55/119, 46.2%), and more prevalent comorbidities including hypertension (103/119, 86.6%), diabetes (45/119, 37.8%), atrial fibrillation (25/119, 21%), coronary artery disease (39/119, 32.8%), and tobacco use (64/119, 53.8%).^[14] Our findings align with previous studies, showing that middle-aged males with comorbidities such as smoking, hypertension, and diabetes are most commonly affected by ALI.

In the present study, lower limb ischaemia was more common than upper limb ischaemia. The leading cause was vascular injury due to trauma, followed by embolism and in situ thrombosis. The femoropopliteal segment was the most common site of occlusion. According to the Rutherford classification, patients ranged from viable to irreversible, with most falling into the categories of immediately threatened and marginally threatened. **Parashari et al.** reported that 75% of ALI cases were due to vascular injury from road traffic accidents and 25% were thrombotic, with one stage 3 case requiring below-knee amputation.^[11] Similarly, **Hemingway et al.** found that lower limb involvement was predominant, with femoropopliteal occlusion being the most common (thrombotic 36/92, 39%; embolic 9/20, 45%) and Rutherford IIb being the most frequent (thrombotic 37/92, 40%; embolic 11/20, 55%).^[15]

Likewise, **Umetsu et al.** reported that all patients underwent surgical thrombectomy, embolectomy, or bypass, with some receiving endovascular therapy; three patients (3.2%) required major amputation, mainly due to prolonged ischaemia or comorbidities. Most Rutherford IIa and IIb patients recovered well, whereas Class III cases had poor outcomes.^[13] Across studies, trauma-related lower limb ischaemia predominates, often involving the femoropopliteal segment, with Rutherford IIa–IIb patients showing

favourable recovery and Class III cases having poorer outcomes.

In our study, most patients underwent surgical revascularisation, while others received endovascular thrombolysis, anticoagulation therapy alone or required primary amputation. Limb salvage was achieved in most patients, with higher rates in the thrombolysis group. The major complications included wound infection, post revascularization secondary amputation, reperfusion injury (AKI) and significant bleeding. Similarly, **Barac et al.** used thrombolysis with additional procedures or open surgical revascularisation, reporting major amputation rates of 8.86–10.36% and in-hospital mortality of 8.22–12.04%.^[16] **Hemingway et al.** noted limb salvage in 75% of thrombotic and 85% of embolic cases, with initial treatments including open, endovascular, or hybrid approaches; complications included fasciotomy in 11% of thrombotic and 40% of embolic cases, and 9% of thrombotic cases required amputation.^[15] Most patients benefit from surgical or thrombolytic interventions, highlighting the importance of early revascularisation to maximise limb salvage while monitoring for potential complications.

In the present study, early presentation was associated with improved outcomes. Patients presenting within 12 h had a higher rate of limb salvage, whereas delayed presentation led to more amputations, highlighting the importance of timely intervention in ALI. Likewise, **Parashari et al.** observed that 60% of patients presenting within 24 h underwent vascular repair, whereas 40% presenting after 24 h developed irreversible ischaemia requiring amputation.^[11] Similarly, **Umetsu et al.** reported that ischaemic duration varied by aetiology, shortest in embolism (median 8 h) and longest in thrombosis (60 h), with delayed presentation linked to higher Rutherford III rates and poorer surgical outcomes, including 3.2% amputation.^[13] **Hemingway et al.** showed that shorter time to intervention improved limb salvage in Rutherford I–IIb, while delayed treatment increased fasciotomy rates and reduced salvage.^[15] Early presentation and prompt intervention are critical in ALI, directly improving limb salvage and reducing the need for amputation.

Limitations

This study was limited by its retrospective, single-centre design, which may affect the generalisability of the findings. Reliance on medical records and short-term outcome assessments restricted insights into long-term limb function and patient recovery.

CONCLUSION

Patients with ALI were most commonly middle-aged men, with smoking, hypertension, and diabetes as frequent comorbidities. The lower limbs and femoropopliteal segments were predominantly involved, with trauma being the leading cause. Surgical revascularisation and endovascular

thrombolysis achieved high limb salvage rates, particularly in patients presenting early, whereas delayed presentation increased the amputation risk. Early recognition and prompt intervention are crucial for improving limb salvage. Future studies should focus on long-term functional outcomes, multicentre data, and strategies to reduce delayed presentation and optimise management protocols.

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