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A Critical Analysis to Evaluate Outcomes in Acute Limb Ischemia

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ABSTRACT: Background: Acute limb ischemia (ALI) is a rapid decrease in lower limb blood flow due to acute occlusion of peripheral artery, the steps for emergency diagnosis are proper history, clinical examination and imaging; mainly duplex ultrasound, CT angiography and digital subtraction angiography. The different therapeutic techniques are presented, ranging from pharmacological (thrombolysis) to interventional techniquesor established surgical revascularization and minor or major amputation of necessity. The objective of this study was to classify the modes of presentation in cases of acute limb ischemia viz. acute, acute on chronic and delayed acute limb ischemia and to study the various investigation and treatment modalities in the management of ALI with the outcomes of management.

Material and methods: This study included 40 patients, presenting with Acute limb ischemia in all forms, in General Surgery department at New Medical College Hospital, Kota.

Results: The maximum of patients was in the age group of 40-60 years.Out of the 40 patients, male patients constituted 34 (85%) and female 6 (15%).21 (52.5%) of these patients consumed tobacco in some form, 8 patients had cardiac disease.32 patients (80%) presented with lower limb ischemia compared to 8 patients (20%) of upper limb ischemia, in 15 (36.58%) patients' pre-gangrene or gangrene was present. 2D echocardiographic changes were present in 11 (27.5%).The most common site of occlusion was femoral artery, which was involved in 18 (45%), Upfront amputation was done in 11 (27.5%) patients.

Conclusion: Acute limb ischemia threatens the viability of the extremity and the patient's survival, so the accurate early diagnosis and treatment is important.

Key-words: Acute limb ischemia, thrombus, Doppler, gangrene, thrombo-embolectomy.

I. INTRODUCTION

Acute limb ischemia occurs when an extremity is deprived of adequate blood flow. Although there is little information on the incidenceof acute limb ischemia (ALI) in the general population, it is estimated to be 14 per 100,000 and compose 10% to 16% of the vascular workload [1].

The mortality associated with acute peripheral arterial occlusion remains high, averaging 10% to 25% [2]. In the past, patients presenting with acute peripheral arterial occlusion were most often in the 5th decade of life [3]. This represents an era when rheumatic heart disease, with associated mitral valve disorder (MR, MS) resulting in peripheral embolization, were the most common causes of ischemia. More recent data demonstrate that the mean age of patients with acute peripheral arterial occlusion is 70 years, reflecting a shift in etiology from rheumatic to atherosclerotic heart disease and the increased frequency of peripheral atherosclerosis as an inciting cause for occlusion [2].

Acute limb ischemia may occur as the result of embolization or in-situ thrombosis. Emboli originate from the heart in more than 90% of cases [2] and normally lodge at the site of an arterial bifurcation such as the distal common femoral or popliteal arteries. When embolization occurs, it usually does so in the setting of atrial fibrillation or acute myocardial infarction when portions of atrial or ventricular mural thrombus detach and embolize to the arterial tree.

Embolic problems result in a greater degree of ischemia than thrombosis, as the embolus characteristically lodges in a virgin vascular bed with no prior collaterals development. On the contrary, as in situ thrombosis occurs in vessels with prior, gradual atherosclerotic narrowing that has stimulated the formation of collateral channels [4]. The presence of these collaterals lessens the severity and rapidity of symptom development when the atherosclerotic narrowing progresses to occlusion.

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Vascular trauma and iatrogenic injury are other well recognized common causes of acute limb ischemia [5]. Irrespective of the etiology of ischemia, the end result is the build-up of toxic byproducts within the ischemic tissue bed. These toxins include the free radicals, which are oxygen-derived, chemically reactive molecules that are responsible for the injury that occurs after ischemia and reperfusion. Ischemia induces leakage of protein and fluid from the capillary bed, resulting in tissue edema which may progress to the development of compartment syndrome [6].

The management of acute limb ischemia remains a major surgical challenge. Most patients with acute limb ischemia require urgent revascularization, but some selected cases can be managed successfully by an endovascular approach. Surgical techniques that are commonly employed for revascularization of the limb include thrombo-embolectomy, primary arterial repair with or without patch angioplasty and autologous or venous bypass grafting.

The purpose of this study was to review a single center's experience of managing acute limb ischemia. The varied presentations, co-morbidities, investigations and treatment options were studied. The outcome of conservative and surgical intervention was studied and compared with published series of acute limb ischemia.

II. AIMS AND OBJECTIVES

1. To study the modes of presentation in cases of acute limb ischemia viz. acute, acute on chronic and delayed acute limb ischemia.
2. To study the various investigation and treatment modalities in the management of acute limb ischemia.
3. To evaluate the outcomes of management.

III. MATERIALS AND METHODS

This study included 40 patients, presenting with Acute limb ischemia in all forms,in General Surgery department at New Medical College Hospital, Kota.

Inclusion Criteria

- All patients of acute limb ischemiapresenting to a tertiary care hospitalfor thefirst time.

Exclusion Criteria

- Patients with concomitant venousdisease
- Diagnosed cases of diabetic foot
- Known cases of vasculitis
- Previously operated cases of acute limbischemia

A detailed history was obtained from all patients with particular attention to the presence of:

- Onset & duration of symptoms
- Presence of risk factors with special attention to smoking and cardiac disease
- History of claudication

All patients were examined with particular attention to temperature changes, tone, motor power, diminished sensation, pulse deficits and presence of any gangrene or pre-gangrene. The presence or absence of arterial flow in the limb was confirmed by hand held Doppler.

Investigations performed routinely were complete blood cell count, renal and liver function tests, PT, PTTK, INR and blood glucose levels. All patients underwent electrocardiography and chest radiography. 2 D echocardiography was also done either preoperatively or postoperatively to detect intracardiac thrombi, dilated cardiomyopathy and valvular heart disease.

All patients underwent Color Doppler Flow Imaging to see site and extent of obstruction. Most of the patients underwent angiography for further evaluation of diseased limb.

These patients were managed depending on the cause, presentation and stage of ischemia; the treatment options being either surgical, endovascular or conservative.

Patient outcomes were recorded in terms of limb salvage, restoration of function, return of distal pulses and mortality.

Patients recovered fully were considered as good outcome. Absence of distal pulses or persistence of gangrene/pre-gangrene was considered as fair outcome. Amputations or death were considered as poor outcome.

Outcomes were compared with various factors like age, gender, risk factors, presentation and stage of disease to see for any correlation between these.

Statistical analysis

Data was entered in computerized database and was analyzed using pertinent statistical tests. The study variable was presented as percentage.

IV. OBSERVATIONS AND RESULTS

A total of 40 patients presented with features of acute limb ischemia in the period of study. The age distribution is as shown in table 1. Almost half of the patients in the study group presented in their 5^{th} and 6^{th} decade of life. The mean age was 48 years. 34 males and 6 females comprised the study group.

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Age group	Number of patients	Percentage (%)
≤ 30	4	10
31 – 40	9	22.5
41 – 50	11	27.5
51 – 60	12	30
61 – 70	4	10
Total	40	100

Table- 1: Distribution of patients with respect to age (years)

Out of these, 21 (52%) patients consumed tobacco in some form. In addition, most of the older patients had associated co-morbidities, mostly Hypertension and Diabetes (Table 2). Out of 8 patients who had cardiac disease, 3 patients had Rheumatic heart disease while 5 patients had Atherosclerotic heart disease.

Risk Factor	Number of patients	Percentage (%)
Cardiac disease	8	20
Diabetes	7	17.5
Hypertension	11	27.5
Hyperlipidemia	10	25
Smoking	21	52.5
Obesity	2	5
No risk factor	3	7.5

Table- 2: Distribution of risk factors among patients

In our study 32 patients presented with lower limb ischemia compared to 8 patients of upper limb ischemia. 26 patients had involvement of left side while 14 patients had right side involvement.

The patients were asked about time of onset of symptoms and time of presentation to hospital was noted. Patients who reported after 72 hours of onset of symptoms were grouped as Delayed presentation. The patients who had previous history of arterial occlusive disease were grouped as Acute on chronic presentation.So, in our study number of patients with acute, acute on chronic and delayed acute presentation were 15, 6 and 19 respectively.

The presenting complaints were mostly acute onset pain, swelling and paresthesia. Some patients presented with pre-gangrene/gangrene or paralysis of affected limb. On clinical examination, pallor, poikilothermia, tone, power, sensations and peripheral pulses were noted. Hand held Doppler was used routinely in all patients to confirm clinical findings.

All patients were evaluated by hematological and biochemical parameters. Twelve (30%) patients were found to have hyperglycemia. Of these, 7 were known diabetics while 5 patients were newly detected diabetics. Ten (25%) patients were found to have hyperlipidemia.

Cardiac workup was done routinely in all the patients either preoperatively or postoperatively. This included ECG and 2D Echocardiography. Eleven patients had 2D Echocardiography abnormality while 9 patients had ECG changes.Out of 11 patients who had 2D Echo abnormality, 2 patients had findings suggestive of IHD, 2 patients

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had findings suggestive of valvular heart disease, 4 patients had nonspecific diastolic dysfunction, and 3 had nonspecific LVH.

All patients underwent X-Ray chest to look for and rule out cervical rib causing Thoracic Outlet Obstruction (TOS). 1 patient in this study group had bilateral cervical rib however these had lower limb ischemia.

All patients underwent Color Doppler Flow Imaging (CDFI) to determine the level of arterial obstruction (Table 3). 45% (n=18) patients had involvement of femoral artery followed by 18% (n=7) patients having popliteal artery occlusion. Among cases of upper limb ischemia, most patients had radial artery obstruction (n=3).

S No	Site of Obstruction	No. of Case	%
1	Subclavian A.	1	2.5%
2	Axillary A.	1	2.5%
3	Brachial A.	2	5%
4	Radial A.	3	7.5%
5	Ulnar A.	1	2.5%
6	External iliac A.	6	15%
7	Femoral A.	18	45%
8	Popliteal A.	7	17.5%
9	Anterior tibial A.	1	2.5%

Table no 3: - patients with respect to site of arterial obstruction

Management was planned as per clinical and imaging findings (Table 4) 58% (n=23) patients underwent thrombo-embolectomy. Out of these 23, fasciotomy was also done in 5 patients

Management	Number of patients	Percentage (%)
Thrombo-embolectomy	23	57.5
Omentoplasty	1	2.5
Medical management	5	12.5
Amputation	11	27.5
Total	40	100.0

Table- 4: Distribution of patients with respect to management

Thrombo-embolectomy with fasciotomy was done later due to development of compartment syndrome. 5 patients of digital ischemia were managed medically by antithrombotic therapy. Omentoplasty was done in 1 patient. All these patients had acute on chronic ischemia. Upfront amputation of the gangrenous limb was done in 11 patients.

Final outcome was assessed during follow-up visit in OPD after 1 month (Chart 1). The affected limb was salvaged in 68% (n=28). Outcome was assessed by clinical examination of limb including palpation of pulses and was confirmed by hand held Doppler. Full recovery was considered as good outcome. Persistence of gangrene/pre-gangrene or absence of distal pulses was considered as fair outcome. Amputation and death were considered as poor outcome.

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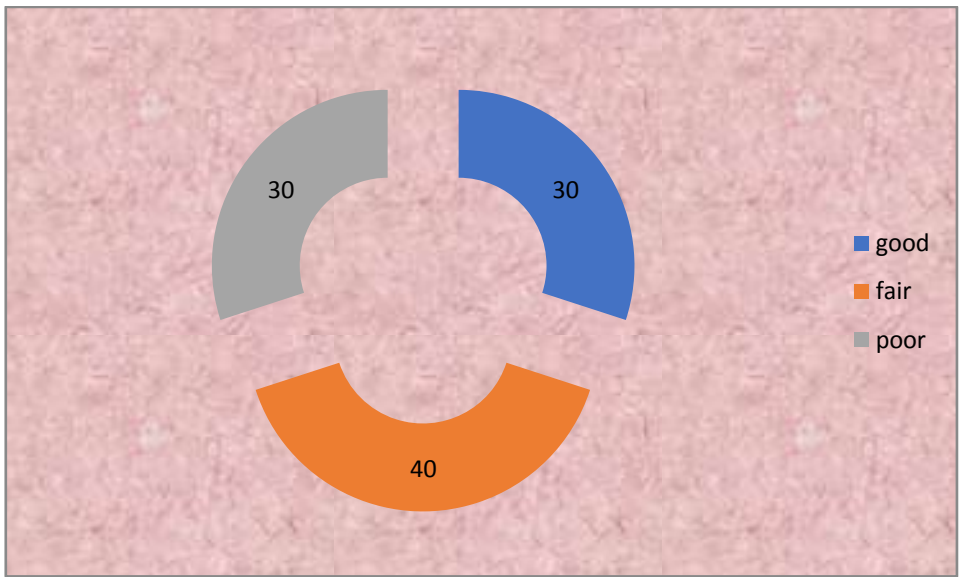

Chart- 1: Graphical representation of patients with respect to outcome.

We compared mode of presentation with outcome to see any correlation between these. The relation between these two variables are highly significant (‘p’=<0.001).

Presentation	Outcome			Total	p-value
	Good	Fair	Poor		
Acute	9	2	4	15	< 0.001
Acute on chronic	1	4	1	6	
Delayed Acute	2	10	7	19	

Table- 5: Distribution of patients with respect to presentation and outcome.

Conclusion: - By using Fisher’s exact test p-value < 0.05, therefore there is association between presentation and outcome

We also compared the outcome in relation to age distribution(‘p’=0.841), gender(‘p’=0.741), site(‘p’=0.886) and side(‘p’=0.844). However, none of these correlations were found to be statically significant.

We also compared the outcomes in relation to various risk factors however none of these were found to be statically significant.

Finally, outcome was compared with management done to see any correlation between these. Results were statically highly significant (‘p’=<0.001).

Management	Outcome			Total	p-value
	Good	Fair	Poor		
Thrombo-embolectomy	10	13	0	23	< 0.001
Omentoplasty	0	1	0	1	
Medical Management	2	2	1	5	
Amputation	0	0	11	11	

Table- 6: Distribution of patients with respect to management and outcome

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Conclusion: - By using Fisher's exact test p-value < 0.05, therefore there is association between management and outcome.

V. DISCUSSION

This study was undertaken to study acute limb ischemia in reference to patient profile, clinical presentation, diagnostic modalities and management. We also studied outcome following management in these patients and any relation of outcome with various patient factors.

This study was conducted in a tertiary care hospital, over a period of 3 years. data were collected of 3 years duration which included prospective study. A total of 40 patients presented with features of acute limb ischemia in the period of study.

The youngest patient was of 12 years of age and the oldest was 70 years. The maximum of patients was in the age group of 40-60 years. The mean age of the patients was 48 years with a standard deviation of 10.31 years which compares with the mean age of 58.7 ± 7.5 years in a study of 822 patients [13].

Out of the 40 patients, male patients constituted 34 (85%) and female 6 (15%). Incidentally mean age for male and female patients was same.

21 (52.5%) of these patients consumed tobacco in some form, most of them had habit of smoking. These patients had thrombotic events compared to non-smokers who had embolic events in majority. 7 (17.5%) patients had diabetes and were on treatment for the same. 11 (27.5%) patients had hypertension and were on treatment. 2 patients had obesity as a co-morbidity.

Out of 40 patients, 8 patients had cardiac disease. Among these patients 3 patients had Rheumatic heart disease and 5 patients had Atherosclerotic (ischemic) heart disease. There has been a shift in the underlying heart disease from rheumatic valvular disease to atherosclerotic coronary vascular disease. Presently, atherosclerotic heart disease has been implicated as a causative factor in 60% to 70% of all cases of embolus, with rheumatic mitral valve disease and associated atrial fibrillation in the remaining 30% to 40% [2,7].

The patients of cardiac disease were on antithrombotic prophylaxis (aspirin) following the cardiac event. One of these patients had stopped aspirin 13 days prior to onset of ischemic limb event. In a study in France relation was shown between aspirin withdrawal and acute limb ischemia [17].

Although most hypercoagulable states are associated with venous thrombotic events, arterial thrombosis occurs most notably with malignancy. In our study 3 patients had no known risk factor at the time of presentation.

Distribution of patients according to involved site shows that 32 patients (80%) presented with lower limb ischemia compared to 8 patients (20%) of upper limb ischemia which compares with a study of 547 thrombo-embolectomies over a period of 26 years in which the portion of upper limb ischemia was 17.7 % [16]. In our study 26 (65%) patients had involvement of left side and 14 (35%) patients had right side involvement.

Acute pain, pallor, coldness and pulselessness were present in all of our patients. In addition to that, variable degree of paresthesia was present in 61% (n=25) patients. Variable degree of paralysis was present in 31.7% (n=13) patients. In 15 (36.58%) patients' pre-gangrene or gangrene was present. 6 patients gave history of claudication pain in past.

Hand held Doppler was used in all cases to confirm the clinical examination and to measure ABPI.

The patients were asked about time of onset of symptoms and time of presentation to hospital was noted. Patients who reported after 72 hours of onset of symptoms were grouped as Delayed presentation. 19 (47.5%) patients in our study reported after 72 hours of onset of symptoms. Many of these patients reported late as they considered the condition as simple myalgia and took over the counter analgesics. Some of these patients were diagnosed wrong by primary clinicians. It is known that a delay of more than 8 hours increases ischemic complications in patients with arterial emboli in an extremity.

The patients who had previous history of arterial occlusive disease were grouped as Acute on chronic presentation. Peripheral arterial thrombotic events develop in the setting of an underlying native arterial stenosis or a hypercoagulable state or as the result of occlusion of a bypass conduit. All these patients in our study had, diagnosed atherosclerotic vessels disease in past. None of these patients had bypass graft in past.

Cardiac workup was done routinely in all the patients either preoperatively or postoperatively. This included ECG and 2D Echocardiography. Out of 40 patients, 2D echocardiographic changes were present in 11 (27.5%). Clot formation is particularly common in the left atrial appendage. In this location, transthoracic echocardiographic techniques have

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had only intermediate success in thrombus detection [8]. The absence of detected thrombus does not rule out the heart as a potential source [9].

Electrocardiographic changes were present in 9 (22.5%) of our patients. In a study electrocardiographic changes were noted in 64% of all patients presenting with acute extremity ischemia requiring surgical intervention [11]. The presence of electrocardiographic changes predicted a higher morbidity and mortality. The low incidence of ECG changes in our study may be due to a smaller number of cases.

Contrast angiography remains the gold standard investigation for limb ischemia. Angiography can be helpful in differentiating emboli from thrombosis. It should be performed in patients planned for surgery or percutaneous intervention. However, in patients undergoing emergency thrombo-embolectomy it can be avoided. The most common site of occlusion was femoral artery, which was involved in 18 (45%) which compares with previous literature [7,10].

Management of patients was decided on the basis of stage of ischemia and duration of ischemia. Upfront amputation was done in 11 (27.5%) patients. All these patients had stage III ischemia. Consideration of primary amputation for irreversible limb ischemia (class III patients) is recommended. Blaisdell et al recommended amputation for such patients in view of reperfusion injury [15].

5 patients had digital ischemia which was managed medically by Heparin and anticoagulants. two of these patients had complete recovery while other patient had partial recovery.

These patients had thrombotic occlusion and presented as acute on chronic ischemia.

The advent of the Fogarty catheter simplified the surgical management and improved the results of operative intervention. These developments have been responsible for a limb salvage rate of between 75% and 90%. In our study 23(57.5%) patients underwent thrombo-embolectomy. Most of these patients had stage IIa or IIb ischemia.

Out of total, 5 patients also received fasciotomy with thrombo-embolectomy due to compartment syndrome. Compartment syndrome caused by reperfusion after embolectomy must be carefully assessed. Early fasciotomy is required to prevent ischemia and complications that may occur.

Our classical knowledge states that the earlier the embolectomy (especially when it is within the first 8 hours), the better the result. However, cases of successful embolectomies performed a few days after an acute occlusion have also been reported. Eliot et al showed that for patients with arterial emboli, a delay of more than 8 hours increases ischemic complications, but when the delay exceeds 7 days, the occurrence of complications decreases [14]. On the other hand, Blaisdell et al findings contradict those of Eliot. According to his view, embolectomy should be performed only on patients with less than 8 hours of ischemia, who are low risk [12]. Another study at Turkey showed that late embolectomies of acute late leg ischemia increases blood flow in the extremity and reduces the number of amputations required. In our study total 19 (47.5%) patients had delayed presentation. Among these upfront amputations was done in only 7 patients. Limb was salvaged in 63% (n=12) patients.

In 2 patients intra-arterial thrombolysis was started however embolectomy was done later due to development of compartment syndrome.

For all patients diagnosed with limb ischemia heparin was started in preoperative period and continued for 5 days postoperatively. Following this, all patients were administered anticoagulants.

Final outcome was assessed during follow-up visit in OPD after 1 month. Most important factors to affect outcomes in acute limb ischemia are severity of ischemia and the time spent between the onset of symptoms and the treatment performed. Re-embolectomies also contributed to increased morbidity. Avoidance of risk factors like smoking also affect outcomes in these patients.

Presence of co-morbidities, ECG and echocardiographic changes are related to poor prognosis. Absence of these relations in our study may be due to less sample size.

VI. CONCLUSION

Acute limb ischemia threatens the viability of the extremity and the patient's survival because of systemic acid-base, electrolytes, and other abnormalities. The diagnosis and initial assessment are largely clinical, and diagnostic errors can result in a high price to the patient. Acute ischemia often presents in a patient with multiple medical co-morbidities. Therefore, careful clinical assessment of the individual is as important as assessment of the limb.

Due to inaccuracy of pulse palpation and physical examination, all patients with suspected ALI should have Doppler assessment of peripheral pulses immediately at presentation to determine if a flow signal is present.

Immediate parenteral anticoagulant therapy is indicated in all patients with Acute Limb Ischemia.
A variety of modalities of treatment are available. Selection of the most appropriate intervention can be critical to the eventual outcome.
In case of clinical suspicion of compartment syndrome, the treatment of choice is a four-compartment fasciotomy
Presence of co-morbidities, severity of ischemia, and interval for medical care and attention are important prognostic factors.

Conflict of interest- Nil

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