



HYBRID PROCEDURES IN ACUTE ON CHRONIC LIMB ISCHEMIA - A INNOVATIVE WAY OF MANAGEMENT

Surgery

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ABSTRACT

Background : To evaluate the need for hybrid procedure in acute on chronic ischemia **Methods:** All patient who underwent interventions for acute limb ischemia from January 2018 to march 2019 were included . Study was prospective type and was done at SJICR. 44 patients were included in the study. **Results:** Out of 44 patients included in the study , 36 patient who underwent lower limb thromboembolectomy and 8 patient underwent hybrid procedures . Hybrid procedures included thromboembolectomy and endovascular procedures with on table angiogram in hybrid OT setting. Post procedural technical and clinical success noted with respect to decreased limb pain , increased limb warmth , improved toe and ankle movements and improved doppler ankle signals **Conclusion:** Hybrid procedures is the treatment of choice in acute on chronic limb ischemia . There is a need to subclassify acute limb ischemia as acute on chronic limb ischemia. **SUMMARY :** Acute limb ischemia is vascular surgical emergency which varied outcomes, even with prompt intervention .This original research describes a innovative way of managing of acute limb ischemia especially acute on chronic limb ischemia variant .

KEYWORDS

Acute On Chronic Limb Ischemia , Hybrid Procedure , Acute Limb Ischemia

INTRODUCTION :

A sudden decrease in limb perfusion that threatens limb viability defines acute limb ischemia (ALI). In ALI symptoms occurs within 14 days, however in CLI it is more than 14 days. ALI threatens limb viability in a very short interval due to sudden ischemia resulting in loss of limb perfusion affecting metabolically active tissues. Hence, urgent recognition of ALI with prompt revascularization is required to salvage limb.

ALI occur due to arterial embolism (46%), in-situ thrombosis (24%), stent / graft related thrombosis 10% and also trauma, complex factors, iatrogenic complications and dissection (20%). [1,2] Most of ALI patients has normal artery especially in case of embolism. Some case of insitu thrombosis has preexisting peripheral vascular disease.[1] This subset of can be conveniently called as acute on chronic limb ischemia.

The classical clinical feature of ALI are "6 Ps": pain, pallor, paralysis, pulselessness, paresthesia and poikilothermia. History taking and physical examination are critical aspects and helps in distinguish between an embolic etiology from in situ thrombosis.

Acute embolic disease can be treated embolectomy. However, ALI with preexisting PVD requires a combination of endovascular techniques and open vascular surgery to be performed in a hybrid OT setting.[3]

This study is an attempt to evaluate ALI and to compared it with subset of case i.e., acute on chronic limb ischemia who has underlying PVD and also helps in modifying treatment strategies accordingly.

METHODOLOGY:

Our study was prospective study done from January 2018 to march 2019 in Sri Jayadeva Institute of Cardiovascular Sciences, Department of vascular surgery. Among 44 patients those intervened for acute limb ischemia during the study period, 36 patients underwent only lower limb thromboembolectomy and 8 patients required hybrid procedure. Inclusion criterias were acute limb ischemia (ALI), age more than 25 years and age less than 75 years. Exclusion criterias were ALI (class 3), aneurysm, trauma, asymptomatic disease and mild ALI (class1) on medical management.

After detailed history taking and thorough clinical examination, acute limb ischemia diagnosis was made. ALI patients were classified as per table1[4]. Later, categorized as acute limb ischemia and acute on chronic limb ischemia. Along with routine investigation specific

investigation includes CT/ MR angiogram of abdominal aorta and bilateral lower limb vessels.

Table 1: Rutherford classification for acute limb ischemia

Class	Description/p rognois	Findings		Doppler signals	
		Sensory loss	Muscle weakness	Arterial	Venous
I. Viable	Not immediately threatened	None	None	Audible	Audible
II.Threatened					
a. Marginally	Salvageable if promptly treated	Minimal (toes) or none	None	Inaudible	Audible
b.Immediate	Salvageable with immediate revascularizat ion	More than toes, associated with rest pain	Mild, moderate	Inaudible	Audible
III.Irreversibl e	Major tissue loss or permanent nerve damage inevitable	Profound anesthesia	Profound, paralysis	Inaudible	Inaudib le

Acute limb ischemia management involved emergency

thromboembolectomy with fogarthy balloon catheter. However, in acute on chronic limb ischemia cases, hybrid procedures was done .It includes open surgical procedure with on-table angiogram and endovascular procedures.

Postoperatively, patients were started on heparin infusion 1000 unit / hour and was titrated to therapeutic APTT. Reperfusion sequelae were managed by alkaline diuresis, IV fluids, maintaining adequate urine output & antioxidants. All patients were on appropriate antibiotics and adequate analgesics. Patients were monitored for compartment syndrome. Source of embolus were identified and treated accordingly. During follow-up patient's history, clinical examination and doppler signals assessment was noted. It was done at the interval of 1 week, 1 month, 2months, 6months @ yearly there after.

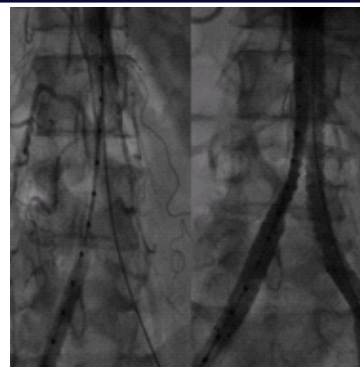
Case 1. A 62-year male presented with sudden onset of pain in left lower limb, 3 hour post femoral arterial line removal. Left lower limb was cold on examination. Past history of claudication of 800 m since 3 years was present. He was known case of IHD, CAD-TVD and underwent CABG 3 days back. Table 2

Table 2: CASE 1 Hybrid Intervention

INTERVENTION	Left SFA thromboemblectomy Left Popliteal & ATA angioplasty
APPROACH	Left Femoral Cut down
LOCATION / TYPE OF LESION FINDINGS	Left SFA, ATA – occlusion Left Popliteal – high grade stenosis
TARGET VESSEL	Left SFA, popliteal & ATA
GUIDE CATHETER	Cordis 6F
GUIDE WIRE	0.035” Terumo 0.014” PTCA
BALLOON	4x20mm Ultraverse balloon
FOGARTHY CATHETER	Red, 4
END RESULT	Good flow noted in SFA, Popliteal & ATA. No flow limiting lesions in angioplasty segment
POST OP FINDING	ATA & DPA signals heard

**Fig 1.1 Angiographic guided SFA thromboemblectomy****Fig 1.2 Post embolectomy ATA angioplasty**

Case 2. A middle-aged female had a delayed presentation of bilateral lower limb ischemia, bladder dysfunction and minimal toe movements. She also complained of bilateral lower limb claudication since 1 year. She also complained of MR angiogram revealed saddle thrombus. She underwent bilateral femoral thromboemblectomy under general anesthesia. Post embolectomy angiogram revealed residual chronic lesion in aortoiliac segment, for which she underwent bilateral iliac angioplasty and stenting.

**Fig 2.1. Thrombus removed during thromboemblectomy****Fig 2.2 : Post embolectomy bilateral iliac angioplasty and stenting****RESULTS:**

Among 44 patients, 37 patients were male and 7 were female. Thrombosis were more frequently seen in male. Patients in embolism group were older. Most of thrombosis group were smokers. Comorbidities were also more frequent among patients with thrombosis, with the exception of atrial fibrillation, which was more common among patients with embolism. Embolism group patients presented early within 12 hour of onset of symptoms. (Table 3). Femoral artery was most commonly involved in both the groups. (Table 4)

Table 3: Demographics of the patients.

Characteristics	Embolism	Thrombosis
Age (median)	59	40
Male gender	30 (28%)	7(87.5%)
Previous vascular procedure	0 (0)	1(12.5%)
Smoking	29(80.5%)	7(87.5%)
Diabetes mellitus	12(33.3%)	3(37.5%)
Hypertension	20 (55.6%)	4(50%)
PVD	1(2.7%)	8(100%)
Atrial fibrillation	5 (13.9%)	0(0)
Surgery within 12 hours	34(83.3%)	0(0)

Table 4. Level of occlusion

Site	Embolism	Thrombosis
Infrarenal aorta	5(13.9%)	1 (12.5%)
Iliac	10 (27.8%)	0 (0)
Femoral	12 (33.3%)	4(50%)
Popliteal	6(16.6%)	2 (25%)
Tibial	3 (8.3%)	1(12.5%)

Importance of differentiating patients with acute limb ischemia from those with acute on chronic vascular ischemia as there is increased recurrence and mortality rates as well as the need for further vascular intervention in the later groups. The limb salvage rate for embolic ALI was better when operations were performed within 12 hours. However, with delayed presentation, the limb salvage rates are decreased (Table 5)

Table 5. Postoperative complication

	Embolism	Thrombosis
Rethrombosis	3(8.33%)	2(25%)
Amputation	2 (5.55%)	0(0)
Mortality	1 (2.7%)	0 (0)

We consider primary success as complete recanalization of occluded segment with satisfactory outflow and good capillary filling of the distal parts of the limb without any major or obstructing residual thrombi either in the treated segment or in the outflow tract. Initial technical success was defined as restoration of continuous inline flow. Clinical success was defined as the absence of symptoms related to arterial occlusion.

All patients were followed up for 6 months for occurrence of major clinical events. During the study period, the combined incidence of perioperative mortality (POM) and major adverse limb events (MALE) was defined as the primary endpoint. The secondary efficacy endpoint was defined as the occurrence of a major adverse cardiovascular event (MACE), which consisted of myocardial infarction, stroke or mortality from any cause.

DISCUSSION:

ALI patients are a heterogeneous population with various ischemic etiologies, with significant baseline comorbidities, and a low physiologic reserve. The main cause of acute limb ischemia are thrombosis and emboli. In Fagundes et al cohort thrombosis (56.6%) more than emboli (43.4%). Also, higher proportion of embolism (Aune and Trippstad 1998), thrombosis (Ouriel and Veith 1998), and a similar frequency of both conditions (Gutowski et al 1999) have been described.[5,6,7,8] Thrombotic occlusions commonly involves superficial femoral artery though it can occur in any segment of extremity. Thrombosis less commonly in cystic adventitial disease, popliteal entrapment and aneurysm, trauma and dissection, vasculitis, repetitive trauma (occupational) in the upper extremities. Procoagulative states such as hyperhomocysteinemia can lead to thrombosis even in the absence of underlying occlusive disease.[1,2,11] Patients with thrombotic complication of an atherosclerotic plaque has unclear onset and ambivalent symptoms. Hence, initially in a preconditioned limb produce overt ischemia is usually not produced due to collaterals. However, the propagation of the thrombus may induce extensive ischemia. Embolic occlusions should be suspected in patients with sudden and severe onset pain (due to the absence of collateral vessels)[1]

It is evident that patients with thrombosis were more frequently male and smokers.[9,10] Comorbidities were also more frequent among patients with thrombosis, with the exception of atrial fibrillation, which was more common among patients with embolism. In general, atherosclerotic vascular disease is a risk factor for thrombosis.[5]

The advantages of preoperative CT angiography are identification of level and extent of lesions, visualization of calcifications, stents, bypasses and planning treatment strategies.[1] Usually ALI patient are treated with immediate systemic anticoagulation and emergency thromboembolectomy especially in ALI class 2b cases.[1,11] Hybrid revascularization in immediately threatened limbs provides an effective and durable option with acceptable morbidity and mortality and amputation rate in these high-risk patients. Endovascular therapy with on table intraoperative angiogram which is part of hybrid approach has many advantages. First, it can be done under local anesthesia (LA), which is convenient because as many ALI patients are elderly and fragile with multiple co-morbidities. Secondly, it includes accurate angiographic imaging. It helps to plan more directed and definitive therapeutic approach. It also ensures a completion control at the end of the procedure, which is not always the case after open surgery.[12] It helps to identify a residual thrombus in (30.4%) patients, and need for additional solutions (repeated thromboembolectomy and/or endovascular interventions) in (35.3%) patients.[13]

Successful treatment in acute limb ischemia depends upon recanalization of the outflow and the amount of residual thrombosis.[14] It is also influenced by several prognostic factors: e.g., antecedent cardiovascular risk factors, duration and presentation of the acute episode, surgical technique, and location of occlusion etc. (Perry 1995; Rutherford et al 1997.[15,16]

In spite of procedures being done under LA, anesthesiologist presence ensures an additional physiological review of the patient which is beneficial especially in presence of multiple co-morbidities. They can monitor high risk patients especially during the reperfusion phase which is associated with hyperkalaemia, myocardial depression, arrhythmias, myoglobinaemia, and acute renal failure.[17]

ALI patients carries high rate of morbidity, high rate of amputation and considerable risk of mortality in case of bilateral lower ischemia. The limb salvage rate for embolic ALI varied from 93% when operations were performed within 12 hours and the mortality rate was 19%; however, with delayed presentation, the limb salvage rate fell to 78% and the mortality increased to 31%. Abott et al, Elliott et al. demonstrated a linear relationship between treatment delay and outcome in embolic ALI.[5,17] In the Basle study, it was reported that major amputations were 11 times more frequent in diabetic patients. with peripheral arterial disease (PAD) than in nondiabetic PAD patients.[5,10,18,19] Although there have been numerous advances in peri-operative care, the population with ALI tend to present late and still have a significant mortality and limb loss rate.[5] Female sex, history of coronary artery disease, and thrombolysis were factors independently associated with worse in-hospital outcomes.[11]

Even with continuous high levels of medical care, ALI patients show poor clinical outcomes with high amputation and mortality rates, despite improvements having been made in surgical techniques and perioperative patient care.[13].

There is a need for subclassification of acute limb ischemia into acute on chronic limb ischemia in a subset of cases which has underlying atherosclerotic disease. Our study demonstrates individual's potential to develop a post-operative adverse event (particularly morbidity and amputation), risk of rethrombosis and need for additional procedure. It is an innovative way in management of acute on chronic limb ischemia

CONCLUSION:

Hybrid procedures can be the treatment of choice in acute on chronic limb ischemia. It may improve the clinical outcomes of patients, by permitting the identification of inflow, outflow, conduit and anastomotic defects intraoperatively and treatment of the underlying lesions. This procedures in hybrid OT suite increases clinical and technical success and achieve higher limb salvage rate. These findings can be further validated by larger scale clinical studies.

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