

Appraisal of Ilio-popliteal Bypass Surgery for Limb Salvage (In Patients with Critical Lower Limb Ischemia and Infected Femoral pseudo-aneurysms)

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Introduction: Critical limb ischemia is usually involving a spectrum of clinical features to describe long term severe compromise limb perfusion that manifested by rest pain, with or without trophic skin changes or tissue loss, including ischemic ulceration and/or ischemic gangrene for more than two weeks. A patient who was diagnosed with infected femoral pseudo aneurysm might be misdiagnosed as a simple groin abscess, and drug abuse is the most common cause of infected femoral pseudo aneurysms. Long ilio-popliteal bypass in critical limb ischemia may be required depending on a good arterial segment as a donor and recipient.

Aim: The aim of this study was to assess the different aspects of ilio-popliteal bypass surgery as a long conduit in patients presented with critical limb ischemia and infected femoral pseudo aneurysms.

Setting and design: Forty patients were admitted in the vascular surgery units, and they were diagnosed with critical lower limb ischemia. An ilio-popliteal bypass was done to save their limbs. The patients were selected and divided into two groups; A and B. Group A: This group included twenty patients suffering from atherosclerotic critical ischemia, while group B included twenty patients suffering from infected femoral pseudo-aneurysm as a result of intra-arterial drug injection and drug abuse.

Patients and methods: All patients were assessed at the pre-operative stage as regards to the present conditions and symptoms related to critical lower limb ischemia; the lower limb was locally examined as well. Angiography was done for all patients. Ilio-popliteal bypass using a PTFE synthetic graft was done, with station on the deep femoral artery in certain patients, anatomically in group A, and placed laterally extra anatomic in group B after ligation of the pseudo aneurysm. One year follow up was conducted mainly clinically and by the ankle brachial pressure index (ABI).

Statistical analysis: Statistical Package for the Social Sciences, version 15.0 was used. Values were compared with a paired samples t test. P values less than 0.05 were considered significant.

Results: During the follow up period, the ABI values were recorded immediately after the procedure, 24 hours, one week, and then one, three, six and twelve months later. There were no significant changes in the ABI changes among patients indicating the continuation of the hemodynamic success. At the end of the study follow up period, limb salvage rate was 90%, and four major amputation following graft occlusion took place in the twenty studied patients. Primary patency was 80% as eight grafts were occluded.

Conclusions: Although the ilio-popliteal bypass is a long conduit, it is a reasonable solution for limb salvage in patients with critical limb ischemia, anatomical bypass with station on the deep femoral artery should be performed when possible, meanwhile in drug abuse cases with infected groin pseudo aneurysm, the healthy arterial axis is maintaining the patency of the long lateral extra anatomic graft.

Key words: Ilio-popliteal bypass, critical limb ischemia, infected femoral pseudo aneurysm.

Introduction

The results of lower limb vascular therapy depend on early accurate diagnosis, customized intervention, and long term follow-up to ensure the integrity of the treatment.¹

Critical limb ischemia (CLI) is a critical definition involving a spectrum of clinical features to describe long term severe compromise limb perfusion that results in failure to meet the basal metabolic needs.^{2,3}

It is usually manifested by rest pain, with or without trophic skin changes or tissue loss, including ischemic ulceration and/or ischemic gangrene for more than two weeks due to circulatory impairment.⁴⁻⁶

Pseudo aneurysms result from a variety of mechanisms including infection, a nastomotic graft disruption, arterial trauma caused by endovascular procedures, closure device infection, and intra-arterial Abdominal exposure was gained through

drug injection.^{7,8} A patient who is diagnosed with infected femoral pseudo aneurysm is typically presented with fever together with a painful pulsatile swelling. This condition might however be misdiagnosed as a simple groin abscess.⁹ Intra-arterial drug abuse is the most common cause of infected femoral pseudo aneurysms. This complication of intra-arterial drug abuse is not only limb-threatening, but also life-threatening which makes for a difficult problem for surgeon to manage.¹⁰⁻¹²

Controversy still exists about the management of such threatened limbs. Long ilio-popliteal bypass in critical limb ischemia may be required depending on the existence of a fair suitable arterial segment as a donor and recipient.¹³ Although ligation and excision of the infected femoral pseudo aneurysm along with debridement and drainage of a possible associated abscess comprise the standard primary treatment, the time of revascularization remains controversial.^{14,15} Some advocate for immediate vascular reconstruction via an extra-anatomic route, while others prefer delayed revascularization.¹⁶

Aim of the work

The aim of this study is to assess different aspects of ilio-popliteal bypass surgery as a long conduit for management of threatened limbs in patients diagnosed with critical limb ischemia and infected femoral pseudo aneurysms.

Patients and methods

Forty patients were admitted in the Vascular Surgery Units from October 2017 through July 2019. Those patients were suffering from critical lower limb ischemia. An ilio-popliteal bypass was done to save their limbs.

All patients were assessed in the pre-operative stage as regards to the present conditions and symptoms related to critical lower limb ischemia as well as associated co-morbid conditions. They were clinically examined to assess the general condition while the lower limb was locally examined as well. Angiography was done for all patients. Cardiac, renal and laboratory blood tests were also done before surgery.

The patients were selected and divided into two groups; A and B.

Group A: This group included twenty patients suffering from critical lower limb ischemia as a result of atherosclerosis affecting the whole arterial tree. A long segment of external iliac (EIA), common femoral artery (CFA) and superficial femoral artery (SFA) was occluded together with fair common iliac artery (CIA). The CIA was taken as the donor segment while the popliteal artery was the recipient one (either supra- or infra-genicular). an

iliac retroperitoneal approach to expose a suitable segment of the common iliac artery. However the popliteal artery was exposed via a small supra- or infra-genicular incision. An eight millimeter ringed polytetrafluoroethylene (PTFE) graft was used and placed via a tunneller passed in an anatomical sub-fascial pathway just anterior to the arterial tree (**Figure 1**). The proximal and distal anastomoses were constructed by the end-to-side technique. An additional femoral incision was done in some patients for graft station and side to side anastomosis in those patients where the profunda femoris artery was patent in the angiography.



Fig 1: A tunneller for a retroperitoneal left common iliac-left supra-genicular popliteal bypass.

Group B: This group included ten patients suffering from critical lower limb ischemia triggered by the urge of management of infected femoral pseudo-aneurysm. Infected femoral pseudo-aneurysm was a result of intra-arterial drug injection and drug abuse in all patients. Arteriography showed a healthy arterial tree apart from the pseudo-aneurysm located in the CFA. Exposure of a fair healthy iliac artery segment was obtained through an abdominal iliac incision exposing the retro-peritoneum, this arterial segment was used for proximal arterial control if the pseudo-aneurysm ruptured and further as the donor side for the proximal graft anastomosis. Urgent ligation just proximal and distal to the aneurysm to avoid secondary hemorrhage was done to all patients together with debridement, draining and mass closure through a separate groin femoral wound. A small supra-genicular incision was performed to expose a fair recipient popliteal artery segment. At the same session, ilio-popliteal bypass was performed using an eight millimeter PTFE ringed graft placed using a tunneller passed sub-fascial from the distal supra-genicular incision running up lateral and far to the infected femoral wound to reach the iliac artery in the retro-peritoneum in a manner described as extra-anatomic pathway. The proximal and distal anastomoses were constructed by the end-to-side technique. In a single patient, and due to the difficulty in exposing the iliac artery segment because of the adhesions and amalgamated tissues, three months later to the ligation, a cross over extra-anatomic ilio-popliteal bypass was performed using the contra-lateral external iliac artery (EIA) as a donor (**Figure 2**).

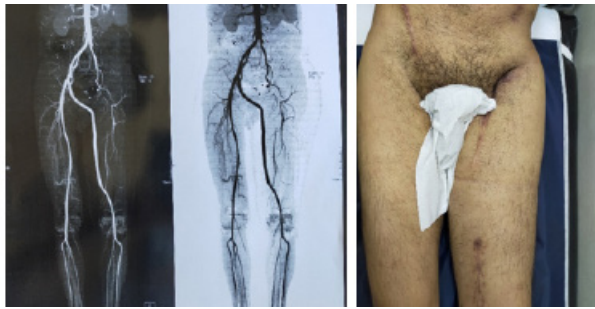


Fig 2: Post-operative case of the cross over ilio-popliteal bypass (Right external iliac to left supra-genicular popliteal).

All patients had registered for follow up visits at ten days, one month, three, six and twelve months. Follow up was done as regard to patients' complaints, clinical evaluation, wound condition and by measuring the ankle brachial pressure index (ABI) if distal pulse could not be palpated. Duplex and angiography were done for some patients. Evaluation of the procedure was done according to Rutherford guidelines as following:-

- **Technical success:** The presence of ante-grade flow through the treated lesion at the termination of the procedure.
- **Clinical success:** An improvement by at least one or two categories according to the Rutherford classification.
- **Hemodynamic success:** An increase of ABI by 0.1 or greater.

Results

The study was carried out on forty patients divided into two groups A and B, each including twenty patients. The mean age of the atherosclerotic group A was 61 years, eighteen were male. The mean age of the drug abuse group B was 34 years, all the twenty patients were males. **(Table 1).**

Tabagism was the most common co-morbidity in both groups. However in group B, chronic debilitating diseases were nearby null in comparison of their presence in group A. Although group B are obviously more carrying positive hepatitis B and HIV markers **(Table 2).**

All patients were presented with either rest pain and/or foot lesion. The foot lesion was in the form of an ischemic ulcer and/or toe gangrene. In group B, it was noticed that all patients were presented with a groin mass diagnosed as femoral pseudo-aneurysm, strangely enough it was localized in the left groin. 80% of group B patients were affected by deep vein thrombosis (DVT) with chronic sonographic changes **(Table 3).**

The plan of surgical procedures was based on

the angiographic features. A tunneller was used to perform the bypass pathway between the two distant anastomoses. The pathway was either anatomical in group A or extra-anatomical in group B to avoid the infected femoral pseudo-aneurysm. Femoral station on the deep femoral was performed in fourteen patients in group A. Debridement in group A was done for twelve patients in the form of ulcer debridement (6 patients) and toe amputation for the other six patients. Four major above knee amputation were done few weeks later, and encountered as complication of graft occlusion. In group B, a single patient was presented with deep and large groin infected pseudo aneurysm, and preferred to postpone the bypass few weeks till controlling of the infection **(Table 4).**

Follow up was conducted mainly clinically and by the ankle brachial pressure index (ABI). ABI was measured for all group A patients and not done for group B patients as all of them a distal tibial pulse was regained. During the follow up period, the ABI values were recorded immediately after the procedure, 24 hours, one week, then at one, three, six and twelve months later. There were no significant changes in the ABI changes among patients indicating the continuation of the hemodynamic success **(Table 5).**

No intra-operative mortality. Intra-operative bleeding occurred once, the two anastomoses were secured and the bleeding was controlled with a given heparin reversal dose of protamine sulfate. The bleeding was interpreted as an acute heparin-induced thrombocytopenia (HIT), and this was confirmed by low post-operative platelet count **(Table 6).**

Twelve patients in group A were relieved from rest pain, while the other eight were complaining pain from polyneuropathy and it was nicely controlled with medications. The six presented patients with ischemic ulcer achieved complete healing within the average of four months. Four patients had a major above knee amputation few weeks later to the bypass following occlusion of the graft which was long starting up from the CIA to the infra-genicular popliteal, and was with a very poor run off. In group B, fourteen patients were relieved from rest pain, however ischemic neuropathy proved by nerve conduction was the cause of pain in the rest of patients. No major amputation. Although four patients were operated for toe amputation and a two patients had a forefoot amputation, these amputations were done approximately one month later to ensure good demarcation **(Table 7).** Primary patency was 80% as eight grafts were occluded within the twelve months follow up.

At the end of the twelve month follow up period, limb salvage rate was 90%.

Table 1: Demographic data

	Group A (n=20)	Group B (n=20)
Age (year)		
Min – Max	48 -72	22 – 51
Mean +/- SD	57 +/- 4.3	31 +/- 4.91
Sex		
Male	18 (90%)	20 (100%)
Female	2 (10%)	

Table 2: Co-morbidities

	Group A	Group B
Smoking	14(70%)	20 (100%)
Diabetes mellitus	12(60%)	0 (0%)
Hypertension	8(40%)	6 (30%)
Obesity (BMI>30)	8(40%)	2 (10%)
Coronary artery disease	10(50%)	0 (0%)
Chronic obstructive pulmonary disease (COPD)	4(20%)	2 (10%)
Hostile abdomen	2(10%)	0 (0%)
Viral markers		
HBV	0 (0%)	10 (50%)
HCV	2(10%)	18 (90%)
HIV	0 (0%)	6 (30%)

Table 3: Clinical presentation

	Group A	Group B
Rest pain	20 (100%)	20 (100%)
Ischemic ulcer / gangrene	12 (60%)	4 (20%)
Pulsatile infected groin swelling	0 (0%)	20 (100%)
Deep vein thrombosis (DVT)	0 (0%)	16 (80%)

Table 4: Procedures

	Group A (n=20)	Group B (n=20)
Side		
Right	4	0
Left	16	20
Donor		
EIA	0	8
CIA	20	12
Recipient		
Supra-genicular	16	20
Infra-genicular	4	0
Ringed PTFE		
8mm	18	20
6mm	2	0
Bypass tunnel		
Anatomical	20	0
Extra-anatomical	0	20
Additional Intervention		
Femoral station (anastomosis)	14	0
Debridement +/- Pseudo-aneurysm ligation	12	20

Table 5: ABI values

ABI	Pre-operative	Post-operative					
		Immediate and 24 hours	One week	One month	Three months	Six months	Twelve months
Group A							
Min – Max	0.30 – 0.57	0.55 – 0.90	0.55 – 0.90	0.60 – 0.90	0.55 – 0.85	0.55 – 0.80	0.55 – 0.75
Mean +/- SD	0.42 +/- 0.07	0.76 +/- 0.09	0.76 +/- 0.09	0.73 +/- 0.06	0.68 +/- 0.07	0.68 +/- 0.07	0.66 +/- 0.07
P value	< 0.001*	< 0.001*	< 0.001*	< 0.001*	< 0.001*	< 0.001*	< 0.001*
Group B							
Min – Max							
Mean +/- SD	Not done as distal pulse was present						
P value							

p: Stands for adjusted Bon ferroni p-value for comparison between pre and each other period.

*: Statistically significant at $p \leq 0.05$.

Table 6: Complications

	Group A	Group B
Deaths	-	-
Intra-operative bleeding	1 (5%)	-
Cardiac arrhythmias	2 (10%)	-
Transient raise of creatinine	-	-
Venous thrombo-embolism	-	-
Incisional		
• Infection	-	-
• Hematoma	-	-
• Sero-sanguinous discharge	-	-
• Wound edge necrosis	-	-
• Incisional hernia	-	-

Table 7: Fate of the studied cases

	Group A	Group B
Relief of the rest pain	12 (60%)	14 (70%)
Healed ulcer	6 (30%)	-
Amputation		
• Toe amputation	-	4 (20%)
• Forefoot amputation	-	2 (10%)
• Above knee amputation	4 (20%)	-

Discussion

Critical limb ischemia is involving a spectrum of clinical features to describe long term severe compromise limb perfusion. We are aiming in this study to discuss the different aspects of the iliopopliteal bypass as a long conduit via the retroperitoneal approach and by the use of the tunneller. Patency of such a long conduit is ranging in many studies between 68 – 83% with up to five years of follow up.^{2,4,12} In this study, the high patency rate (80%) is most probably due to the healthy arterial tree in those with pseudo aneurysm (Group b), also might be due to the relatively short term follow up period (One year).

When the atherosclerotic process is involving the arterial axis and not sensitive to percutaneous angioplasty, iliopopliteal bypass is decided when a fair donor and recipient are available. Again when the deep femoral artery is seen clear in the arteriogram, a side to side anastomosis with the graft is performed in favor to maintain long term patency of the graft. This scenario is matching with Latour B et al and other studies.¹⁶

In infected femoral pseudo aneurysms, critical ischemia is developed after the debridement and ligation of the axial artery. Usually the extra anatomical bypass using a tunneller makes for a long conduit, but as the healthy axial arterial tree at the donor iliac artery and the recipient popliteal artery is keeping the conduit patency (Salehian MT et al.¹⁷). Rabbani A et al,¹⁸ stated that obturator foramen bypass is associated with technical difficulties and many complications such as injuries to the genitourinary tract, to the obturator vessels and nerve, and also the motor dysfunction resulting in wide-based gate due to adductor muscle weakness.

The plan of the surgical procedure was based on the angiographic features, and the one year follow up was performed clinically and by the ankle brachial pressure with no life threatening complications (De Luccia et al.¹⁹). Spahos T et al.²⁰ stated that the retroperitoneal iliac clamping is regarded with a smooth postoperative course and a speedy recovery. In spite of the equal patency rate using the diameter of 6 or 8mm graft, although the larger caliber is more preferable with most patients as to overcome the possible long term intimal hyperplasia.

Conclusions

Although the iliopopliteal bypass is a long conduit, it is a reasonable solution for limb salvage in patients with critical limb ischemia as well as those with infected groin pseudo aneurysm.

For critical limb ischemia, anatomical iliopopliteal bypass with station on the deep femoral artery should be performed -when possible- to maintain

its patency.

In drug abuse with infected groin pseudo aneurysm, the healthy arterial axis is maintaining the patency of the long extra anatomic graft.

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Conflicts of interest

There are no conflicts of interest.

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