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ORIGINAL ARTICLE

Comparative Study Between Surgical Arterial Bypass and Endovascular Interventions in the Treatment of Popliteal Artery Occlusion

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Abstract

Background: **Peripheral Arterial Occlusive Disease is characterized by decreased arterial blood flow to lower extremities as result of atherosclerotic arterial lesions and is identified by ankle-brachial index less than 0.9.**

Aim: **The goal of this work was to compare between bypass surgery and endovascular interventions in treatment of popliteal artery occlusive disease as regard to success rate, patency, limb salvage as well as postprocedure complications.**

Patients and methods: **This prospective randomized controlled clinical trial has been conducted in the vascular surgery departments of Al-Azhar University Hospitals (from December 2019 to December 2021).**

Results: **There is a variance found among groups concerning pre or postoperative ABI. Moreover, there is increase in ABI postoperatively in both groups. Limb salvage was higher in group A compared with group B but without variation.**

Conclusion: **Surgical arterial bypass and endovascular interventions in therapy of popliteal artery occlusion were easy and effective way in therapy of popliteal artery occlusion. Our results showed that, Operative time was greater in group A compared with group B. There is a variation found among groups concerning pre or postoperative ABI. Limb salvage was greater in group B compared with group A.**

Keywords: Endovascular interventions, Popliteal artery occlusion, Surgical arterial bypass

1. Introduction

Peripheral Arterial Occlusive Disease is characterized by decreased arterial blood flow to lower extremities as result of atherosclerotic arterial lesions and is identified by ankle-brachial index less than 0.9. It can cause intermittent claudication or, as disease progresses, critical limb ischemia.[1]

Intermittent claudication is common clinical manifestation of PAOD. It is described as ischemic pain that occurs throughout exercise and is quickly relieved by rest.

CLI is more severe form of PAOD that is described as ischemic rest pain or ischemic skin lesions: ulcers or gangrene. Years old, tobacco use, and diabetes mellitus are important risk factors for progression to advanced form of PAOD.

Prevalence of PAOD in general population is around 13.4% in those over 65, rising to 21.6% in those over 75. German get ABI research found prevalence of 19.8% in males over the age of 65 and 16.8% in females over the age of 65.[2]

Atherosclerotic disease of popliteal artery can cause intermittent claudication and critical limb ischemia. It can result in severe problems, like amputation. Revascularization alleviates symptoms while also preventing these problems.

Unlike superficial femoral artery, popliteal artery exhibits distinct features, such as extreme mobility among proximal and distal fixation points and biomechanical forces caused by repetitive motion. PA is traditionally regarded as no-stent zone, with stent placement reserved only for suboptimal confirmed percutaneous transluminal angioplasty, like significant recoil, flow limiting dissection, or residual stenosis.[3]

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Aim of this work was to compare between bypass surgery and endovascular interventions in therapy of popliteal artery occlusive disease as regard to success rate, patency, limb salvage as well as post-procedure complications.

2. Patients and methods

This prospective randomized controlled clinical trial has been conducted in the vascular surgery departments of Al-Azhar University Hospitals (from December 2019 to December 2021).

The research contained forty studied cases suffering from manifestations of popliteal artery occlusive disease, and divided randomly into two equal groups (Group: A = 20 studied cases) and (Group: B = 20 studied cases). Group A: included 20 studied cases for whom surgical arterial bypass has been performed. Group B: included also 20 patients for whom an endovascular treatment has been performed.

2.1. Inclusion criteria

Patients with Critical limb ischemia (CLI) with Computerized Topographic Angiography (CTA) evidence of significant isolated popliteal artery occlusive disease with involvement of popliteal trifurcation. Written consent will be taken from patient before including them in the study and patients with generally adequate state of cardiac, respiratory and renal conditions that allow the procedure.

2.2. Exclusion criteria

Patients with multi-level arterial lesions i.e. aorto-iliac, femoro-popliteal combined with tibial arterial lesion, inevitable amputation, acute limb ischemia or Acute on top of chronic ischemia, Buerger's disease, patients with creatinine greater than1.7 mg/dL, poor general condition (decompensated heart failure, stroke, bedridden, appearance of metastatic malignancy, and other disease that limits life expectancy, previous endovascular or surgical treatment for popliteal artery occlusion and incapability or unwillingness to complete with follow-up schedule.

3. Methods

3.1. The studied cases were subjected to following

3.1.1. Clinical data for every patient was recorded in a printed vascular sheet

History: Personal history: Name, years old, sex, Occupation, and Residence, and Special habits, complaint: Rest pain or Tissue loss, all patients gave a complete full history taking including demographic features (age and sex), clinical variables (site of lesions, severity, duration, family history) disease and smoking habits, angioplasties were performed by vascular surgeons. Clinical indications will include symptomatic peripheral arterial disease with rest pain, ischemic ulcers, or ischemic tissue loss/gangrene (Rutherford stages 3–6), present history: Analysis of complaint: Onset, Course. Duration, Risk factors: Diabetes mellites, Smoking Hypercholesterolemia, Ischemic heart disease, Hypertension, Renal impairment and past history: Neurological, Cardiac Operations, Drug intake, Hepatic disease, Lung disease, Similar conditions, Vascular procedure or Allergies.

Examination: General examination: Temperature, Respiration, Pulse, Weight, Head and neck, Heart and Abdomen. Local examination: Exposure (from umbilicus downwards), colour changes: pallor, cyanosis, mottling, trophic changes: hair loss, dry skin, tissue loss: ulcer or gangrene if present and arterial pulsations in both sides.

Investigations: labs and imaging: Lab: CBC, blood sugar level, kidney functions, liver functions, coagulation profile, and lipid profile and hepatitis markers). Imaging: duplex US, CTA, MRA.

Statistical analysis: was carried out by social sciences statistical package. Quantitative variables such as mean, standard deviation, and range are described. Qualitative variables are described as numbers and percentages. To compare qualitative variables, the χ^2test was used. In parametric data, the 2-sample *t*-test was used to compare quantitative variables among independent groups. *P* values less than 0.05 were considered significant.

Study outcome measures: Primary patency of the re-vascularized vessel. Freedom from major adverse limb events including amputation or any re-intervention.

Ethical considerations: Aims of the study and any possible risk has been discussed with the patient, Privacy of the collected data has been assured and Investigation has been delivered to the patient.

Statistical analysis: Data from the history, basic clinical test, and result measures were coded, entered, and analyzed using Microsoft Excel software. After that, data was imported into Statistical Package for Social Sciences version 21 software for analysis. Following examinations were used to determine significance of variations; Chi square test for variation and association of qualitative variables (χ^2). The *t*-test is used to compare quantitative independent groups. The *P* value for significant results was set at less than 0.05 and less than 0.001 for highly outcomes.

4. Results

This table founds that two groups were comparable in terms of age, sex, and BMI, with no differences.

There is no variation showed among groups regarding comorbidities.

There is no significant variation found among groups.

This table shows Element of revascularization in both groups.

Two groups were comparable in length of occlusion and laterality without statistically variation among groups.

This table founds that operative time and hospital stay was higher in group A compared with group B.

There is a variation found among groups regarding pre or postoperative ABI. Moreover, there is increase in ABI postoperatively in both groups.

There is no variation showed among groups regarding complications.

This table founds that limb salvage was higher in group A compared with group B however without variation.

This table founds that success rate was higher in group A compared with group B nonetheless without variation.

Patency rate was higher in group A compared with group B but without variation.

5. Discussion

Popliteal artery is constantly moving vessel, and involvement of trifurcation outcomes in angioplasty with arteries of varying diameters. Moreover, there is no specific bifurcation device for infrapopliteal arteries, and there are some technical problems with tibial artery re-entry that may worsen Biagioni and colleagues.[2]

The aim was to compare between bypass surgery and endovascular interventions in therapy of popliteal artery occlusive disease as regard to: success rate, patency, limb salvage as well as post-procedure complications.

The study included 40 patients suffering from manifestations of popliteal artery occlusive disease and separated into two equal groups (Group A: contained twenty studied cases for whom surgical arterial bypasses has been performed) and (Group B: included also 20 patients for whom an endovascular treatment has been performed).

This prospective randomized controlled clinical trial has been conducted in the vascular Surgery Departments of Al-Azhar University Hospitals from December 2019 to December 2021.

Our study showed that two groups were comparable in years old, sex, and BMI without statistical variation among groups with P value 0.664 for age and P value 0.749 for sex and along with our study Biagioni and colleagues,[2] found that there is no difference in age and sex with P value 0.071 for age and P value 0.306 for sex.

Regarding the co-morbidities distribution as smoking, diabetes mellitus, hypertension, dyslipidemia, and heart diseases among studied groups, our study showed that there is no variation.

Along with our study Hernando and colleagues,[4] reported there was no variation concerning hypertension with P value $= 0.48$ and smoking with P value $= 0.10$ and diabetes mellitus with P value $= 0.09$ and coronary artery disease with P value $= 0.32$.

Our study showed no significant difference regarding clinical presentation as rest pain, claudication pain, ischemic ulcers and tissue loss between the two studied groups.

And along with our study Leake and colleagues,[5] showed that there were no variations in clinical presentation, tibial runoff score and comorbidities.

Regarding operative time & hospital stay, research reported that operative time and hospital stay was higher in group A compared with group B.

Against study Aly and colleagues,[6] described that hospital stay ranged from 5 to 21 days in Bypass group and from 4 to 7 days in PTA group.

Our research found that there is a variation found among groups concerning pre or postoperative Ankle brachial index (ABI). Moreover, there is a significant increase and development in ABI postoperatively in both groups so both groups are effective.

Along with our study Aly and colleagues,[6] reported that the apparent increase in ABI in both groups postoperatively at 1, 3, and 6 months as shown in the results reflects the high success rates of revascularization in both groups as raised from (0.3) preoperative to reach (0.75) at 6 months postoperative.

Our study showed that the incidence of complications (minor and major complications) was higher in group A compared with group B.

Along with study Aly and colleagues,[6] described that incidence of complications was higher in bypass group as infection, bleeding, lymphorrhea and that was closely related to the nature of the surgery compared with the PTA.

Regarding clinical outcome, our study showed that limb salvage was greater in group B compared with group A but without variation.

Along with our study Aly and colleagues,[6] reported that the late limb salvage rate in the group with Bypass was 73.33% while in the group with PTA was 66.66%.

Our study showed that success rate was higher in group A compared with group B but without variation with P value 0.313.

Along with our study Biagioni and colleagues,[2] reported that technical success was accomplished in

one hundred percent of studied cases in open and 96.9% of studied cases in endo group.

Boyle and colleagues,[7] reported that numerous providers recommend endovascular revascularization as first-line therapy for CLI, citing great technical and clinical success rates as well as low morbidity/mortality for process that can be conducted as outpatient under local anesthesia.

Our study revealed that patency rate was higher in group A compared with group B nevertheless without variation.

Along with our study Von Stumm and colleagues,[8] reported that there were no variations in studied case survival, limb loss, and primary patency among open and endovascular therapy.

Fig. 1. 67-year-old men with type II diabetes mellites and hypertension presented with ischemic dry gangrene in the right big toe, impalpable pulses of the popliteal and tibial arteries, arterial duplex revealed monophasic waves on pedal vessels, and ABI of 0.4 at the posterior tibial artery. Post-operatively, the studied case was in good general condition, with warm foot and good signals on the anterior tibial artery, and ABI of 0.8.

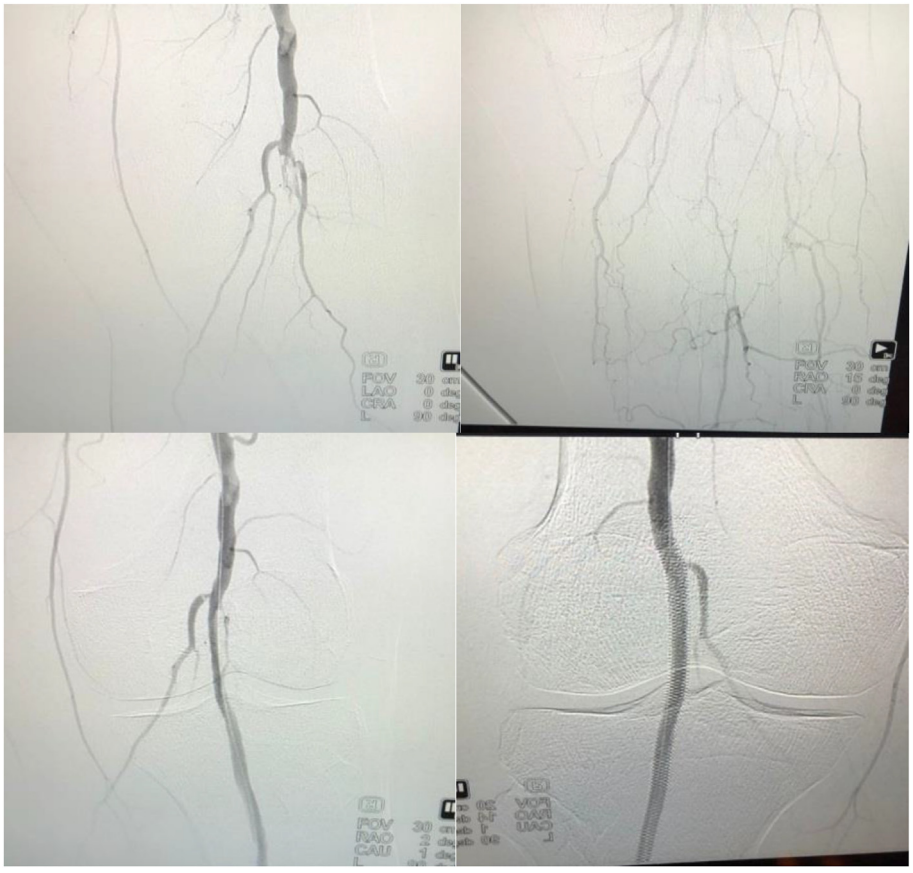

Fig. 2. Case (63 of age) men, known case of diabetes mellites type II, hypertensive, presented with wet gangrene in big and second toes, impalpable pulse of popliteal and tibial arteries, arterial duplex exposed monophasic waves on pedal vessels and ABI was 0.3 at posterior tibial artery. The studied case underwent popliteal angioplasty with stenting. Postoperative: patient had good signals on posterior tibial artery, ABI postoperative is 0.9.

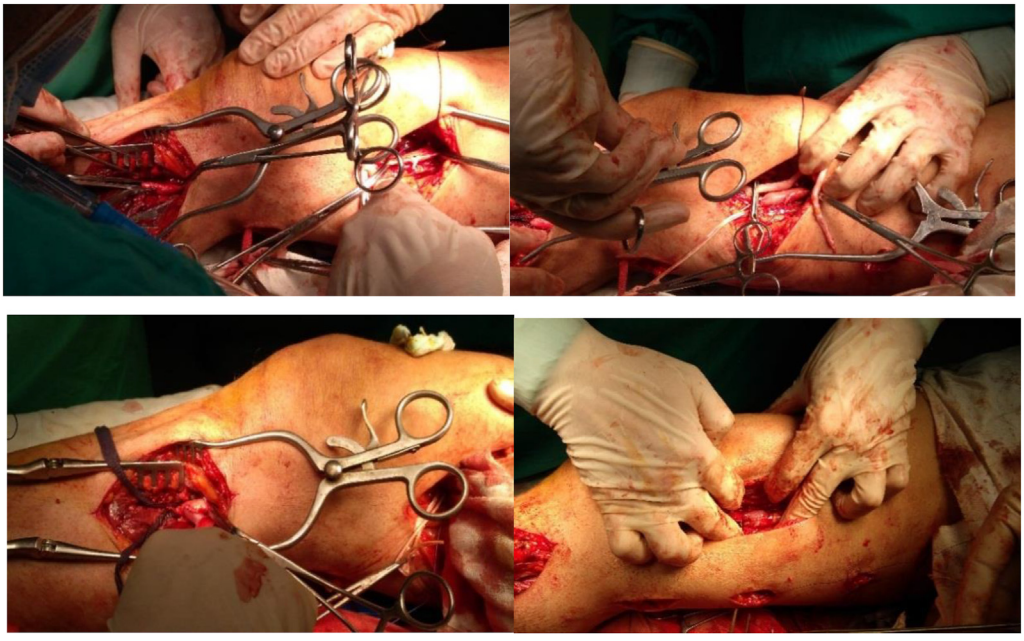

Fig. 3. Case of 60 of age men, known case Hypertensive, Diabetes mellites presented with rest pain in right lower limb, impalpable pulse at popliteal and pedal arteries, by Doppler US monophasic waves on posterior and anterior tibial artery and ABI was 0.4. The patient underwent short bypass from supra-genicular popliteal artery to tibio-peroneal trunk using reversed GSV. Postoperative: studied case had clean wounds, foot warm by test with good signals on posterior and anterior tibial artery, ABI postoperative was 0.9.

Fig. 4. A case of 53 of age men, known case Hypertensive, Diabetic, and smoker, presented with rest pain in right foot, impalpable distal pulse at ankle level and popliteal artery. ABI was 0.38 at posterior tibial artery. Postoperative: studied case had foot warm by test with good signals on posterior and anterior tibial artery, ABI postoperative was 0.8.

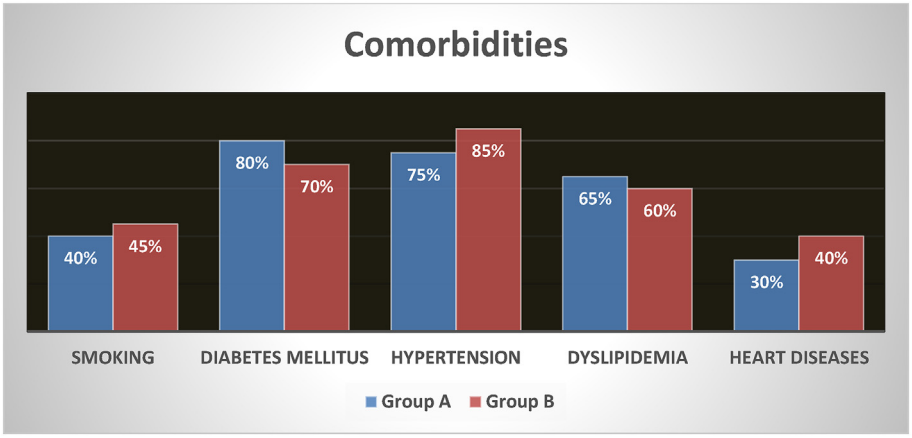

Fig. 5. Comorbidities distribution between the studied groups.

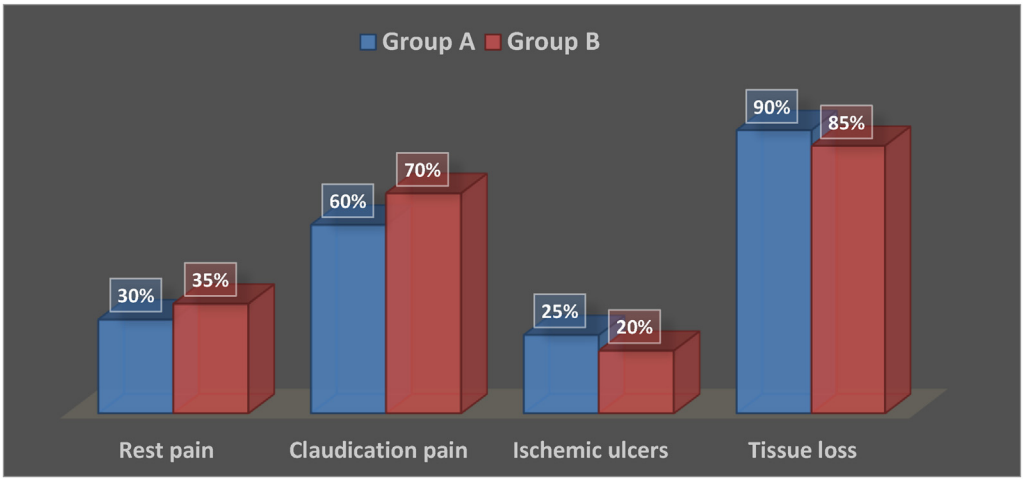

Fig. 6. Clinical presentation among two studied groups.

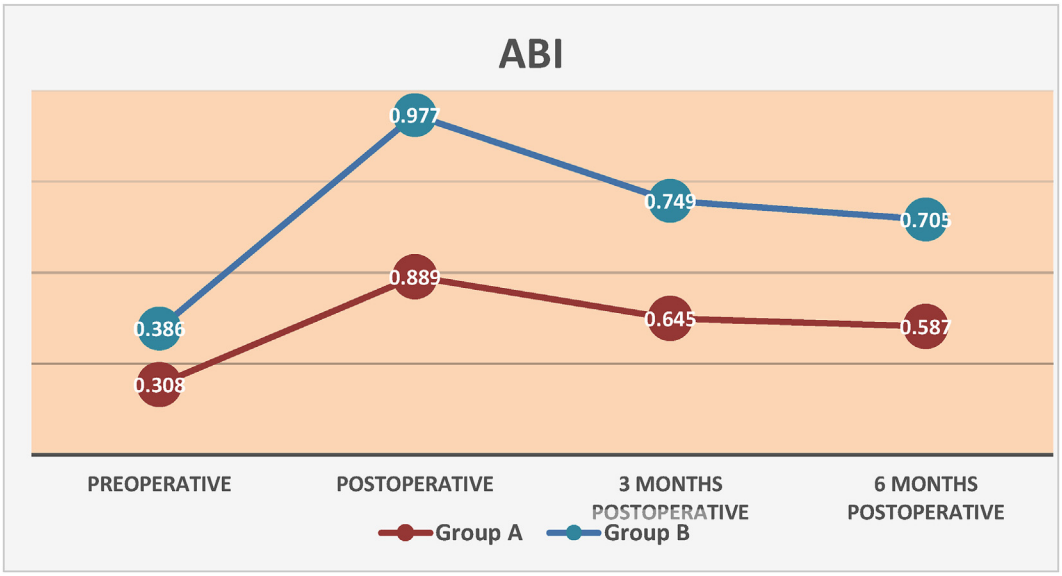

Fig. 7. Preoperative and postoperative Ankle brachial index (ABI) among two studied groups.

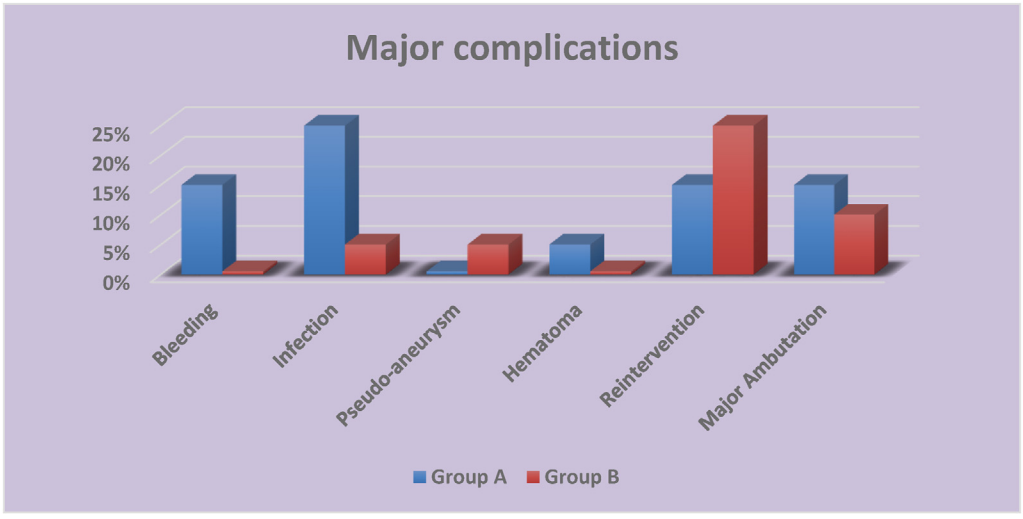

Fig. 8. Postoperative major complications between the two studied groups.

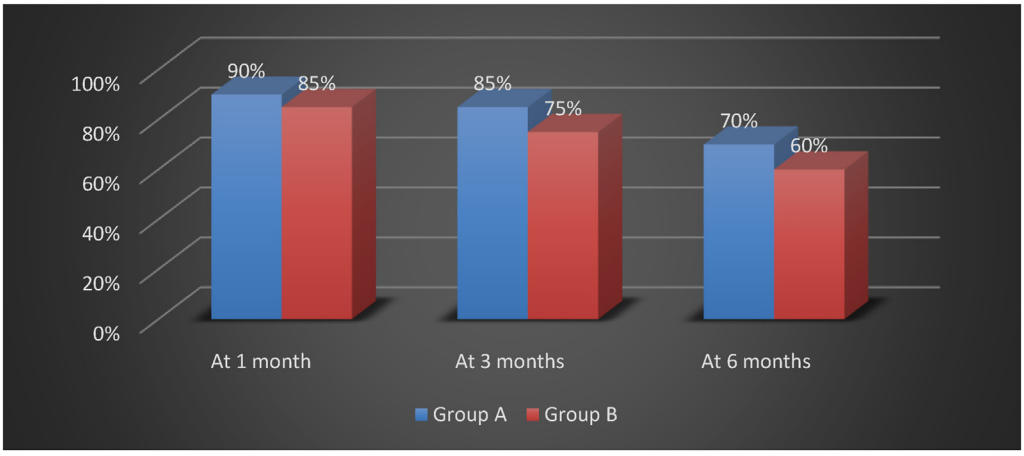

Fig. 9. Patency rate between the studied groups.

6. Conclusion

Surgical arterial bypass and endovascular interventions in therapy of popliteal artery occlusion were easy and effective way in therapy of popliteal artery occlusion. Our results showed that, Operative time was greater in group A compared with group B. There is a variation found among groups concerning pre or postoperative ABI. Limb salvage was greater in group B compared with group A Figs. 1–9, Tables 1–6.

Table 1. Demographic features among studied groups.

	Group A (n = twenty)	Group B (n = twenty)	t/χ^2	P
Years old				
Mean ± SD	62.37 ± 9.54	60.81 ± 12.74	0.438	0.664
Sex				
Female	8 (40%)	9 (45%)	0.102	0.749
Male	12 (60%)	11 (55%)		
BMI (kg/m^2)				
Mean ± SD	28.33 ± 4.25	28.64 ± 3.97	0.238	0.813

Table 2. Element of revascularization in both groups.

	Element of the	Revascularization
Group A	**GSV 16 Cases (80%)**	**PTFE Graft 4 Cases (20%)**
Group B	**Angioplasty without stenting 15 cases (75%)**	**Angioplasty with stenting 5 cases (25%) Supera Stent**

Table 3. Clinical features among studied groups.

	Group A (n = twenty)	Group B (n = twenty)	t/χ^2	P
Length of occlusion (cm)				
Mean ± SD	28.24 ± 4.35	25.64 ± 7.14	1.39	0.172
Laterality				
Unilateral	20 (100%)	19 (95%)	0.229	0.633
Bilateral	0	1 (5%)		

Table 4. Operative time and hospital stay between the studied groups.

	Group A (n = twenty)	Group B (n = twenty)	t/χ^2	P
Operative time (min)				
Mean ± SD	90.43 ± 12.61	60.25 ± 15.22	3.88	0.001
Hospital stay (day)				
Mean ± SD	5.92 ± 3.85	1 ± 5.78	421	0.153

Table 5. Clinical outcome between the studied groups.

	Group A (n = 20)	Group B (n = 20)	χ^2	P
Limb salvage	17 (85%)	18 (90%)	0.229	0.633

Table 6. Success rate (postoperative and before discharge) between the studied groups.

	Group A (n = 20)	Group B (n = 20)	χ^2	P
Success	18 (90%)	17 (85%)	1.03	0.313
Failed	2 (10%)	3 (15%)		

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declared that there were NO conflicts of Interest.

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