

RETROSPECTIVE STUDY OF DISTAL SHORT VEIN BYPASS VERSUS TIBIAL ANGIOPLASTY IN THE MANAGEMENT OF CRITICAL ISCHAEMIA

By

Mahmoud A. Abouzeid *M.D.; Hussein M. Khairy *M.D,FRCS; Wafik Z. Massoud *M.D, FRCSI.
Abdel Hameed O. Ascar *M.D., and Mohamed M. Hamed **M.D.

Departments of General Surgery* and Radiology** , Cairo University.

Short vein bypasses and percutaneous transluminal angioplasty have evolved as possible treatment options for patients with crural arterial lesions. In this retrospective study a comparison was made between the results of management of 24 patients who were subjected to short vein bypasses (group I) and those of 19 patients (22 limbs) who were subjected to percutaneous transluminal angioplasty (group II). In group (I) patients (short bypasses) the one month limb salvage rate was 87.5%, the six months limb salvage rate was 78.2% and the one year limb salvage rate was 68.2%. In group (II) patients (balloon angioplasty without stenting), the one month limb salvage rate was 72.7% and the 6 months limb salvage rate was 50%. These results denote that the long-term patency rates of short vein bypasses are superior to those of balloon angioplasty, consequently short vein bypass can be considered the procedure of choice for good risk patients. High risk patients and patients without usable veins can benefit from balloon angioplasty.

Keywords: Crural ,tibial angioplasty,critical ischaemia,short vien bypass.

INTRODUCTION

Atherosclerotic occlusive disease of the lower limb remains a significant cause of chronic limb ischaemia which is responsible for limb loss in many cases. Common locations for these atherosclerotic lesions are the aortoiliac segment, the superficial femoral artery and the tibial arteries. Isolated tibial artery affection which is especially prevalent in diabetics is not a rare presentation of the disease. In these cases the popliteal pulse is well felt and the patient's symptoms are exclusively caused by the infrapopliteal affection. The management of these patients has for some time been long vein grafts to the tibial arteries. Traditionally, the common femoral artery has served as the inflow origin to these grafts even if the femoropopliteal segment was patent and in continuity with the common femoral artery. This was due to the concern that the superficial femoral artery is often affected by atherosclerosis and that using its distal part or the popliteal artery as an inflow site is doomed to failure due to progression of the atherosclerotic process.

However this traditional concept has been challenged by the data reported in many series ⁽¹⁻⁵⁾. These studies have

shown that short vein grafts originating from healthy superficial femoral or popliteal arteries could have success rates equivalent to or even better than conventional long grafts originating from the common femoral artery.

On the other hand, current advances with catheter and guide-wire technology and improved visualization capabilities made it possible to reevaluate traditional views on the role of balloon angioplasty in the treatment of infrapopliteal arterial lesions. Tibial arteries remained for a long period of time an almost forbidden territory for catheter recanalization. But nowadays, many series have proved the feasibility of limb salvage using percutaneous transluminal angioplasty (PTA) of diseased tibial arteries ^(6,7,8).

In this way, two techniques (short bypasses and PTA) have evolved as possible substitutes to conventional long grafts in the management of isolated lesions of the tibial arteries. The aim of this retrospective study was to compare these two techniques in terms of technical feasibility and short-term as well as long-term outcome.

MATERIALS AND METHODS

A retrospective review of the data of the patients presenting with isolated tibial arterial disease at Kasr El-Aini Hospital was done. According to their management strategy, these patients were divided into 2 groups. Group I included those patients who received short vein bypasses i.e. bypasses originating from the superficial femoral, popliteal or tibial arteries. This group consisted of 24 patients. Group II included those patients who received percutaneous transluminal angioplasty. This group consisted of 19 patients.

The indication for vascular reconstruction in both groups was limb threatening ischaemia (rest pain and/or tissue loss). None of the patients was subjected to either procedure for claudication. The following are the details of each group :

Group I:

This group included 24 patients who underwent 24 bypasses to the tibial or peroneal vessels (fig. 1). Nineteen patients were males and 5 were females. Age ranged from 30 to 72 years with a mean age of 43 years.

Diabetes mellitus was prevalent in 14 patients, hypertension in 8 patients and ischaemic heart disease in 11 patients. Two thirds of the patients were smokers.

Arteritis was the suspected cause of tibial arterial disease in one third of the patients, whereas atherosclerosis was the suspected cause in the remaining two thirds.

Pre-operative arteriograms were obtained in all patients. Duplex scan was done to evaluate the haemodynamic significance of any lesion proximal to the selected inflow site of the graft. Actually, none of the 4 lesions demonstrated angiographically in the superficial femoral or the popliteal arteries were of haemodynamic significance.

Reversed autogenous saphenous vein grafts were used in all patients. The vein was usually harvested through the same incision done for exploration of the proximal and distal arteries. The inflow site was from the superficial femoral artery in 13 patients, from the proximal popliteal artery in 7 patients, from the distal popliteal artery in 3 patients and from the proximal posterior tibial artery in one patient. The outflow site was to the anterior

tibial artery in 5 patients, to the posterior tibial artery in 13 patients and to the peroneal artery in 6 patients.

Group II:

In this group, PTA (without stenting) of the crural vessels was attempted in 22 limbs of 19 patients presenting with critical lower limb ischaemia. In 3 patients crural artery PTA was performed in both legs. There were 9 males and 10 females. Age ranged from 42 to 75 years with a mean age of 58 years. Diabetes mellitus was prevalent in 12 patients, hypertension in 10 patients and ischaemic heart disease in 9 patients. Eleven patients were heavy smokers.

Aspirin in a dose of 300-500 mg was given the night before the procedure. Heparin (5000 I.U) was injected at the beginning of procedure. Intra-arterial injection of papaverine 60 mg and sublingual capsule of nifedipine were given routinely before angioplasty. Patients in whom PTA was successful continued to receive aspirin in a dose of 75 mg per day for at least 6 months. None of the patients received systemic anticoagulant therapy after angioplasty.

In both groups the patients were followed up clinically with special attention to the distal pulses and the state of the ulcers or the amputation sites. The mean follow-up period was 1 year for the surgical group and 6 months for the angioplasty group. In the angioplasty group the ankle brachial pressure index (ABI) as well as the treadmill studies were performed. All were compared with the basic pre PTA duplex and treadmill results. Similarly, in group I, duplex studies were done at 30 days and 1 year to assess graft patency.

RESULTS

Group I:

There was no postoperative (30 day) mortality. Three patients had early graft occlusion and required above knee amputation (3/24, 12.5%). The early graft occlusion in all 3 cases was due to compromised outflow tract. Graft thrombectomy was attempted in the 3 cases but failed. The one month patency rate was 21/24 (87.5%). The one year patency rate was 14/22 (63.6%) (two patients died within the first year from unrelated causes). The one year limb salvage rate was 15/22 (68.2%). One graft closed after 6 months but the limb did not suffer from any critical ischaemia. The incidence of graft infection was 0%. However, one patient suffered severe popliteal wound sepsis that was not complicated by graft sepsis.

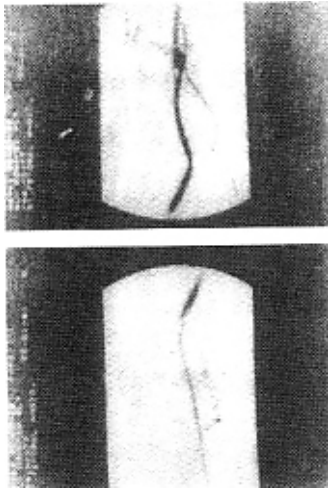


Fig. (1): angiogram depicting a patent short vein bypass.

Group II :

A) Technical Success.

Technical success was defined as crossing and dilating the target artery, a post PTA angiogram (figures 2 and 3) demonstrating a patent lumen significantly improved in appearance as compared to that of the pre PTA angiogram and no distal embolization. Technical success was achieved in 86.3% of the arteries dilated.

B) Clinical Success.

As for the surgical group, successful clinical outcome was defined as relief of rest pain, healing of ulcers or of



Fig.(2): angiogram showing occlusion of the lower inch of the popliteal artery as well as the tibioperoneal trunk. Refilling of the anterior tibial and peroneal arteries through collaterals.

previous amputation stumps and resolution of infection.

The primary clinical success rate at one month was 72.7% (16/22). Among the 6 failures 2 patients underwent in-situ grafts with successful outcome, one patient had a below knee amputation during the same hospital stay, and 3 patients - who showed no clinical deterioration post PTA- were discharged but returned thereafter with further deterioration warranting below knee amputation.

The limb salvage rate at 2 and 3 months was 68.2% and 63.6% respectively, and at 6 months it was 50% in patients in whom PTA was performed for the crural arteries alone and 59% in cases in whom PTA of the superficial femoral or the popliteal arteries was performed in addition.

C) Complications:

Minor complications included 2 local small haematomas at the puncture site that were managed conservatively. Major complications occurred in 5 cases :

One patient had rupture of his posterior tibial artery. The artery was not embolized, also the limb condition did not allow bandage application. The bleeding stopped by itself but the limb condition deteriorated and a below knee amputation was necessary.

Thrombotic complications occurred in two cases. Those were treated successfully by transcatheter aspiration.

Two patients developed myocardial infarction one week after the procedure. Comparison of the results of both groups is shown in (Table 1).



Fig.(3): post angioplasty angiogram showing recanalisation of the popliteal and tibioperoneal trunk.

Table (1):

	Group I		Group II	
	No.	%	No.	%
Technical success of the procedure	21 / 24	87.5	19 / 22	86.3
One month limb salvage rate	21 / 24	87.5	16 / 22	72.7
Six months limb salvage rate	18 / 23	78.2	11 / 22	50
One year limb salvage rate	15 / 22	68.2	Not available	-

DISCUSSION

Reconstructive procedures for diseased tibial arteries have always lagged behind those for other more proximal vessels. This has been the case for surgical bypasses where femoropopliteal grafts have established themselves as acceptable techniques long before the development of the short vein bypasses and the in-situ technique which both rendered bypasses to the distal portions of the tibial vessels possible. Similarly, transluminal angioplasty in the distal arteries had to await the development of coronary balloon and guide-wire technology in the early 1980s, and further catheter refinements introduced a few years later, which made small-vessel endovascular intervention safer and more attractive ^(9,10). This is despite the astonishing fact that at the dawn of the endovascular era, in the year 1964, two cases of below-knee angioplasty were reported in Dotter's classic paper ⁽¹¹⁾.

Actually, this undue delay in conquering the field of reconstruction of this distal segment of the arterial tree was both harmful and to some extent not rationalistic. It was harmful because it offered below-knee amputation as the only option for patients suffering from critical ischaemia caused by infrapopliteal disease. And it was not rationalistic as it was based on misconceptions related to the efficacy of short vein bypasses and tibial PTAs.

Short vein bypasses were regarded as procedures doomed to failure due to progression of disease in the superficial femoral or popliteal arteries proximal to the site of intake of the graft. Actually, several studies have later proved that this concept was erroneous and that short grafts did as well as and even better than long grafts ⁽¹⁻⁵⁾. An explanation given for this good outcome of short grafts is that the involvement of the superficial femoral artery by the atherosclerotic process is usually focal and tends to start at the adductor canal. Once occlusion occurs at this site, proximal progression is largely by thrombus which extends to the next major branch. If a bypass origin is placed in a relatively disease-free portion of the superficial femoral artery, the bypass may act like a large branch and prevent proximal extension of thrombosis beyond the origin of the bypass if a distal occlusion occurs at the adductor canal. Furthermore, the increased superficial femoral or popliteal

artery flow which results from the bypass may itself prevent disease progression in the arteries proximal to the bypass origin in the same way that the donor iliac artery is protected when it provides inflow for a femorofemoral bypass ^(1,12,13). Further explanations for the superiority of short grafts over long grafts include that long segments of vein when placed in restricted outflow tracts may be more susceptible to graft thrombosis because of the longer contact of blood with the graft with its possible damaged inner surface. Also, short grafts may avoid crossing the knee joint, have less chance of being twisted or kinked and allow the use of optimum vein by discarding imperfect vein segments.

As for tibial balloon angioplasty, its efficacy was put in doubt by the beliefs that tibial PTA was technically complex, that it carried a high risk of serious complications likely to result in amputation or compromise of a subsequent surgical bypass, that success rates were low or dismal, that occlusive disease in the tibial arteries was often extensive and not treatable by PTA and that surgical procedures were possible and likely to be successful in the majority of patients. These beliefs kept the tibial arteries away from the territory of catheter recanalization so that they were together with the carotid arteries - the last major arterial segments to be managed by interventional techniques.

However, recent innovations in PTA technology have given an answer to the problem of technical complexity of the procedure : currently available tools include catheters with 3-5 F shafts carrying balloons that are wedged to the catheters resulting in very low smooth profiles and that can be inflated to 8 atm. and steerable 0.014 - 0.018 inch guide - wires with fluoroscopically bright platinum tips capable of crossing tight and complex lesions and easily entering angled branch orifices ⁽¹⁴⁾. The 86.3% technical success rate achieved in the present study - using this modern technology -proves the role of these recent innovations in improving the technical success of the procedure.

The present study proved also that failed tibial - peroneal PTAs do not preclude subsequent crural - vessel bypass grafting. The two failed PTAs that were managed by in-situ grafts had good outcome. Actually, most PTA procedures involve the upper and mid-calf arteries leaving the more distal segments nearly intact for bypass

anastomosis when necessary. This is because PTAs are performed only in the presence of nearly intact distal vessels in the lower leg and with direct pedal flow, in other words, PTAs are not performed for isolated tibial segments.

On the other hand, the rather big number of lesions managed in this study by short bypasses or PTAs put in doubt the statement that very few patients may be amenable to PTAs due to the extensive multilevel occlusions affecting patients with critical limb ischaemia. Actually, in the present study, even many of the patients subjected to short vein bypasses had lesions manageable by PTA. In fact, it is not unusual to find on angiography one patent vessel with its continuity interrupted by a short (<3cm) stenotic or occlusive lesion where transluminal recanalization and angioplasty are likely to be successful. Even more, PTA could be successful in patients who have two focal lesions in tandem in a single crural vessel, or a second lesion in the superficial femoral / popliteal artery, as shown in 6 cases in the present study. It is even expected that in the future more extensive lesions could be dilated by the use of the subintimal technique which in the opinion of some authors - could give excellent results comparable to those of the iliac and superficial femoral artery PTAs ⁽¹⁵⁾.

It is therefore apparent that some of the concerns related to the efficacy of crural PTAs have been grossly exaggerated. However, the present study shows that some of these concerns are of real validity; on the top of these concerns is that clinical success sometimes does not parallel technical success. In the present study, although technical success in dilating the lesions was achieved in 86.3% of the patients, yet at the end of one month only 72.7% of the patients had benefited from the procedure. By the end of 6 months only one half of the patients had their limbs saved. These results are inferior to those of short bypasses in which - at the end of one year - two thirds of the limbs remained saved. The results of crural PTAs in this study are also inferior to the results of crural PTAs reported in the literature. Most studies have presented their results as primary patency, secondary patency following a repeat PTA and limb salvage which in some patients was obtained by a bypass procedure ^(16,17). Most give results at 2 or 3 years with primary patency varying from 36 to 68%, secondary patency from 44 to 79% and limb salvage from 72 to 80%. Is the superiority of the results reported in the literature related to better technique, better selection of patients or different pattern of distal disease? A qualified answer cannot be given to this question; however, two points are worth noting in this respect. First, the primary patency in the literature is relatively low and the good results achieved in terms of limb salvage are obtained at the expense of redo PTAs during the follow up period.

Unfortunately strict follow-up programs that permit timely reintervention whether by surgery or PTA - are not

obtainable in a certain number of our patients.

Second, the infrainguinal disease in the Egyptian patients seems to be more aggressive than that in the Western population. This is well shown when comparing the long term patency rates of femoropopliteal grafts in the Egyptian and the Western literature, especially if these grafts are synthetic. Such difference in the patency rates in these bypasses is unlikely to be attributed to the technique. It may be due to the relative non compliance of the Egyptian patients to the measures aiming at control of the atherosclerotic process - especially smoking, or it may be related to the nature and aggressiveness of the atherosclerotic process itself.

On the whole, the superiority of the results of short bypasses is well apparent in this study, especially in relation to the long term patency, which is the Achilles' heel of crural PTAs and which is at the same time the main objective of the patient management. Consequently, it can be stated that, uptill now, distal bypass grafting should remain the gold standard. When a good-quality saphenous vein segment is available, surgical short vein bypass is the best possible therapy offering the patient incomparable long-term patency and limb salvage rates. In high risk patients, in whom surgery is performed at the expense of significant morbidity and even possible mortality, crural PTA gives an acceptable solution for a difficult situation. Still, complications of PTA may mandate emergency operative intervention in a high risk patient. The use of PTA applies also to patients who do not have adequate saphenous veins. In other words, both procedures should be looked at as complementary rather than competitive, with the short bypasses being offered as the primary option in good risk patients.

CONCLUSIONS

1. Short vein bypasses and percutaneous balloon angioplasty are both dependable treatment options in the management of critical ischaemia caused by infrapopliteal arterial disease.
2. With proper case selection a high technical success rate can be achieved with balloon angioplasty.
3. The long-term patency rates of short vein bypasses are superior to those of balloon angioplasty, a fact that renders short vein bypass the procedure of choice for good risk patients.
4. High risk patients and patients without usable veins can benefit from balloon angioplasty. In such cases good follow-up programs should be planned for timely

reangioplasty if needed.

5. More informative comparison of the results of the two procedures still needs a prospective randomized trial that assures that both groups subjected to comparison are alike especially as far as the lesion patterns are concerned.

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