ORIGINAL ARTICLE

Revascularization for Foot Salvage in Diabetic Critical Foot Ischaemia

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Summary

A consecutive series of 32 diabetic patients, 16 male and 16 female, who presented to the authors with critical limb ischaemia was reviewed over a two-year period. Atherosclerotic risk factors and co-morbidities were present in 56% of these patients. Diagnostic angiography was performed in all patients. Revascularization was achieved in 91% of the cases with three perioperative deaths. Ten bypasses were anastomosed distally to one of the crural or ankle arteries at the foot. Major amputations were required in five patients who had had revascularization and in 4 of these gross sepsis was the main factor responsible for limb loss despite patent grafts. The primary graft patency rates at one month and one year were 96% and 90% respectively. Surgical reconstruction was possible in the majority of diabetic patients with critical ischaemia and should be offered to patients preferably before the establishment of gross sepsis to improve limb salvage.

Key Words: Diabetes mellitus, Foot complications, Critical foot ischaemia, Vascular grafting

Introduction

Diabetes increases the risk of arterial occlusive disease of the lower limbs by 7 to 20 times[1]. In some patients the disease progresses rapidly to critical ischaemia and the major amputation risk is 15 to 70 times higher than in a non-diabetic[2,3]. In Malaysia the prevalence of diabetes is rising with increasing urbanisation and lifestyle changes[4,5]. It is to be expected that more patients will present with critical limb ischaemia in the future. The Society of Vascular Surgery/International Society for Cardiovascular Surgery (SVS/ISCVS) reporting standards define chronic critical limb ischaemia (CLI) as either the presence of rest pain that requires moderate to strong analgesia for at least 3 weeks with objective evidence of diffuse pedal ischaemia (resting ankle pressure <40mmHg or toe pressure <30mmHg) or tissue loss (gangrene or non-healing ulcer) with objective evidence of diffuse pedal ischaemia (resting ankle pressure <60mmHg or toe pressure <50mmHg)[6]. In the diabetic patient, pressure measurement was modified to absence of pedal pulses due to unreliable reading with the presence of incompressible calcified arteries. Despite many reports of successful revascularization in diabetic foot ischaemia, it is still a commonly held misconception among many medical practitioners that such a procedure is rarely possible. In Malaysia, vascular surgery is still a developing specialty and it is our intention to review our series of patients to increase the awareness of the possibility of vascular reconstructive surgery in this high-risk group of patients.

Materials and Methods

All data on patients referred to both authors at their respective hospitals (MKY at Sarawak General Hospital, Kuching and NCL at Armed Terendek Hospital, Malacca) with diabetes mellitus and critical lower limb ischaemia as defined by the SVS/ISCVS document was collected prospectively on proformas and subsequently transferred to a computerised database for analysis.

These referrals came mainly from the respective states though occasionally referrals from neighbouring states were also accepted. Acute limb ischaemia with symptoms less than 3 weeks and diabetic neuropathic ulceration/lesions were excluded from this study. The period of the study covered 2 years (August 1996 to July 1998). Clinical historical details included age, sex, ethnic origin, presence of medical co-morbidities and smoking habit. All patients with the diagnosis of critical foot ischaemia underwent diagnostic angiography for the possibility of revascularization to save the limbs. Digital subtraction angiography (DSA) was available to the first author (MKY) while routine angiography (RA) was the only option available to the other. The preoperative arterial outflows were noted. Patients were offered exploratory surgery if no outflow artery was visualized. Patients with associated infection of the necrotic area (gangrene or ulcer) were treated with broad spectrum antibiotic until specific organisms were cultured. Indications for operative interventions were recorded. Postoperative outcomes and follow-up especially with respect to the complications, mortality, graft patency rate and limb salvage were recorded. All revascularizations were for limb/foot salvage. Partial amputation of the foot (such as toe or transmetatarsal amputation) with retention of a sufficiently functional foot remnant to allow standing and walking without a prosthesis was regarded as successful limb/foot salvage[6].

Results

A total of 32 patients were reviewed in the 24 months study period. There were 16 male and 16 female patients. The median age was 64 years (range 34 to 80 years) with co-morbidities present in 56% of them. Atherosclerotic risk factors included smoking in 10 patients, hypertension in 8 patients with 14 patients having ischaemic heart disease and 4 patients having chronic renal impairment. The indications for revascularization were ischaemic rest pain in 3 patients (9%), gangrene in 20 patients (63%) and non-healing ulcer in 9 patients (28%). Associated infection of the necrotic area (gangrene or ulceration) occurred in 13 cases (41%).

Angiography was performed in all patients. In 23 of them, an outflow artery judged reconstructable preoperatively was visualised. Successful bypasses were possible in 22 of these cases (96%). In the remaining 9 cases, no reconstructable outflow artery was visualised and all were performed by the routine angiographic technique without computerised digital subtraction. Exploration intraoperatively found 7 of these cases to be ameanable to bypass (78%).

The level of bypasses performed and the conduits used in these procedures are shown in Table I. Two patients had double sequential bypasses for severe multi-level diseases. Ten of the bypasses ended at a single crural artery of the leg or ankle artery (dorsalis pedis or posterior tibial) at the foot. Autologous veins only were used in these very distal bypasses. The more proximal bypasses to the popliteal artery and above were performed with either prosthetic grafts or autologous veins. Associated amputations with successful foot salvage included toe amputations in 9 patients and transmetatarsal amputations in 6 patients. All these patients ambulated successfully without the assistance of limb prostheses except for minor foot ware modifications.

Table I
Level of Bypasses and the Conduits Used

Bypass Procedures	Number	Synthetic Grafts / Autologous Veins
Ileo-femoral bypasses	7	7/0
Femoro-popliteal (Above knee)	7	5/2
Femoro-popliteal (Below knee)	7	2/5
Femoro-tibial	2	0/2
Popliteal-pedal	8	0/8

Early results

Three patients died perioperatively. Two had acute myocardial infarctions and one died of acute on chronic renal failure. This was despite optimal management with pre-angiographic hydration, minimal contrast with digital subtraction angiography and intraoperative diuresis. Eight patients underwent major amputations. In three of these, no bypass was possible and the major amputations were offered as primary treatment for the critical ischaemia. In the other 5 cases, one had failed bypass graft and could not be salvaged. In the remaining 4 cases, the bypass grafts were patent but persistent gross sepsis led to major amputations at knee level.

Late results

The primary patency rate of the bypasses at one year was 90.5%. No further major amputation was required even though two bypasses ceased to function and the limbs have no further recurrent lesions.

Discussion

Foot complications in the diabetic patients remain one of the most expensive morbidities to treat as shown in the United States and Britain[7,8]. The risk of major amputation is 15 to 70 times higher than the general population[2,3]. It is important to institute appropriate management right from the initial contact to reduce further morbidity, especially major amputation and mortality[9]. The prevalent rates of diabetes in Malaysia have risen from an estimate of 2% in 1980's to over 8% in certain groups as the standard of living continues to improve and with increasing urbanisation[4,5]. As such the incidence of diabetic foot complications is expected to rise.

Peripheral arterial occlusive disease is common in the diabetic patients[1] and remains one of the most important aetiological factors in the diabetic foot complications apart from peripheral neuropathy and sepsis. It is still the commonly held misconception among many medical practitioners that diabetic patients suffer from 'small-vessel' disease or microangiopathy and hence vascular reconstructive surgery is rarely possible. Recent review has shown that although there is no doubt that there is microvascular circulatory disturbance, there exists no firm evidence from the literature of surgically significant occlusive 'small-vessel' disease in diabetic patients to account for the diabetic foot complications[10]. Rather most ischaemia is due to macrovascular disease. Macrovascular occlusive disease in the diabetic patients has certain characteristic differences when compared to non-diabetic occlusive atherosclerotic disease. Although larger proximal vessels are affected as shown in this study (iliac and femoral artery bypasses), in a large proportion of diabetic patients medium-sized arteries (tibial vessels) are the predominantly diseased segments with relative sparing of the proximal larger and distal/pedal vessels making vascular reconstructions possible[11]. It is therefore not uncommon to have diabetic critical foot ischaemia presenting with palpable popliteal pulses and absent ankle pulses. Angiographic imaging will often confirm patency in the foot artery and hence the possibility of reconstructive surgery[11,12,13]. This study confirms that revascularization of the foot is feasible in many diabetic patients.

The result from our small series is comparable to larger series from the literature review. The perioperative mortality of 9% was within the reported range of 0 to 9%. Taylor and Porter reviewed the results of lower extremity bypass in diabetic patients and showed that the surgical mortality was 2.2% with 9.7% perioperative complications. One, 3 and 5 year various graft patency rates were in the range of 72 to 92%, 57 to 85% and 51 to 85% respectively. These results were not significantly different from results in non-diabetic patients[12]. The comparable patency rates at one month and one year were 96% and 90% respectively in our series. Policy of aggressive surgical revascularization as in the experience of the New England Deaconess Hospital in Boston yielded very encouraging results in reducing all amputation rates[13,14,15]. Of 402 explorations for dorsalis pedis arterial bypass, successful revascularization in 95.5% was achieved. The perioperative death was 1.8% and cardiac morbidity was 5.4%. Primary and secondary graft patency rates and limb salvage were 92.5%, 97.4%, and 97.9% at one month and 68%, 82% and 87% at 5 years respectively[13].

Preoperative angiography especially digital subcraction angiography (DSA) remains the investigation of choice in planning reconstructive surgery. Our series showed that visualisation of the outflow arteries increased the likelihood of successful bypass (96%). This was again demonstrated in the series by Pomposelli et al where successful bypasses were carried out in 98.6 % when a

patent dorsalis pedis artery was demonstrated preoperatively in contrast to only 57% success rate when surgical explorations were performed on the basis of a Doppler signal alone[13].

Primary amputation is often offered as the primary modality of treatment in diabetic critical foot ischaemic complication in the past. We believe such a policy is now inappropriate as progresses made in the field of radiology, anaesthesia and surgery in this country allow reconstructive vascular procedures for limb salvage to be performed with safety. The loss of 4 limbs in the presence of patent bypass grafts as a result of persistent sepsis in this small series further stressed the urgency in instituting appropriate management early. Patient education and team work remain the key to successfully manage the complicated diabetic foot with early recognition of potential problems[16].

Conclusion

Vascular reconstructive surgery is feasible in the majority of diabetic critical foot ischaemia in this series. This may require very distal bypass into the foot and results are encouraging as in many centres. Successful foot salvage requires early intervention before the establishment of gross sepsis. When appropriate it should be offered to all patients rather than primary major amputation.

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