

## Research Article

# Revascularization in Diabetic Foot Ulcer and Outcome

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## Keywords

Peripheral arterial disease; Diabetes; Population

## Introduction

Diabetes is a major public health problem regionally and globally. In 2019, the International Diabetes Federation estimated that 465 million (9.3%) people worldwide had diabetes, and by 2045, the number may rise to 700 million (10.9%) [1]. The pooled prevalence of diabetes in the general population of Bangladesh is 7.8% and prevalence of pre-diabetes is 10.1% [2].

Diabetes is a complex disease with many serious potential sequelae, including large vessel arterial disease and microvascular dysfunction. The lifetime risk for foot ulcers in people with diabetes is estimated to be 15% [3]. Development of diabetic foot ulcer is attributed to many interacting factors, the most common ones being peripheral neuropathy and Peripheral Arterial Disease (PAD) [4]. PAD is an important precipitating factor in the outcome of diabetic foot ulcer [4]. Peripheral arterial disease is a common large vessel complication of diabetes, implicated in the development of tissue loss in up to half of patients with diabetic foot ulceration [5]. Diabetic patients with PAD commonly show involvement of the arteries below the knee, especially at the tibial and peroneal arteries, and involvement of the profunda femoris [6]. Diabetic ulcers always require vascular evaluation, and when ischaemia is suspected the diagnostics should be organized rapidly to ensure revascularisation without delay. Foot ulcer in patients with diabetes is associated with an increased risk of lower limb amputation, and thus the primary aim of treatment for ischemic foot ulcer is limb preservation [4]. Invasive revascularization, including open reconstructive surgery and/or endovascular intervention, is the most effective treatment that may improve peripheral circulation and remedy symptoms [4]. The basic aim of any successful revascularization is to achieve pulsatile flow to the foot. The two methods currently available are peripheral bypass surgery and peripheral angioplasty [7]. Current literature shows that percutaneous transluminal angioplasty (PTA) is the first choice of procedures in revascularization of the lower limb [7].

## Materials and Methods

Prospective study in combined military hospital Dhaka between Jan 2017 to Jan 2020. Total 267 diabetic patient with foot ulcer reported to the cardiovascular surgery department. 192 patients were suspected to have ischaemic ulcer and included in the study.

Patients with foot ulcer, absent pedal pulses and diabetes mellitus, were included in the study. Neuropathic ulcer and venous ulcer with present pedal pulses were excluded from the study.

All patients were evaluated clinically, Ankle-Brachial pressure, toe pressure were measured, and subsequent duplex scan and/or CT angiogram performed. Revascularization was done either by peripheral angiogram and angioplasty/stenting or by open surgery. Adjunctive therapy with local wound care and antibiotics were applied for ulcer. All patients were followed up for at least 01 year.

## Results

A total of 192 diabetic patients with foot ulcer and absent pedal pulse were seen during the 3-year recruitment period. Of these, 07 were lost after the first observation. The other 185 were included in our study (mean follow-up 18 +/- 8 months [range 1-42 months])

The clinical characteristics of the patients considered as a whole and divided by revascularization and conservative groups are reported in Table 1. Most of the patients were aged >60 years 137 (74%), were male 152 (82%) and had type 2 diabetes 160 (86%) with a disease duration of >15 years. The majority of the patients had hypertension that was controlled pharmacologically 155 (84%); only a small percentage of patients had end stage renal disease and were undergoing haemodialysis 20 (10.8%). A history of coronary artery disease or cerebral ischemic attack was present in 65 (35%) and 26 (14%) of patients, respectively, and 80 (42%) were smokers. Mean HbA1C was 7.5 +/- .6% and LDL cholesterol was 101 +/- 5mg/100ml. Of the ulcers, 72 (39%) had an area >5cm<sup>2</sup>, infection was present in 115 (62%). Revascularization was done in 141 (76.2%) patients. Percutaneous angioplasty was performed in 120 (85.1%) of patients and 21 (14.9%) patients revascularized by open surgery. 44 (23.8%) patients were treated conservatively because of poor anatomy of vasculature for revascularization 19 (10.3%), physical condition not suitable for any interventions 17 (9.2%), extensive gangrene/ulcer of foot need primary amputation 4.3% [8].

In conservative group (n=44) ulcer healed in 13 (29.5%) patients,

**Table 1:** Outcome of treatment after Revascularization (n=141).

Outcome	no
Ulcer healed with or without reconstructive surgery/Minor amputation of toes	110 (78%)
Ulcer not healed in 1 year	7 (5%)
Major amputation	13 (9.2%)
Patients died due to other co morbid conditions	11 (7.8%)

**Table 2:** Outcome of treatment after conservative treatment (n=44).

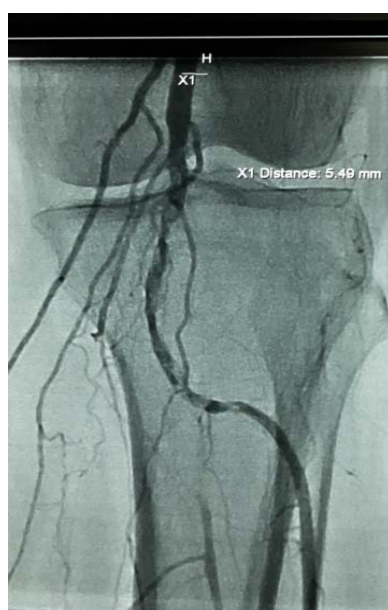
Outcome	no
Ulcer healed with or without reconstructive surgery/Minor amputation of toes	13 (29.5%)
Ulcer not healed in 1 year	12 (27.5%)
Major amputation	15 (34%)
Patients died due to other co morbid conditions	4 (9%)

**Table 3:** The reasons for no revascularisation for 44 limbs, and their outcome.

Reason	No
Por anatomy of vasculature for revascularization	19 (10.3%)
Physical condition not suitable for any interventions	17 (9.2%)
Extensive gangrene/ulcer of foot need primary amputation	8 (4.3%)

**Table 4:** Revascularisation Procedure.

Procedure	No
Percutaneous angioplasty +/- Stenting	120 (85.1%)
Open surgery	21 (14.9%)

**Figure 1a:** Gangrene of 2<sup>nd</sup> toe Left foot.**Figure 1b:** Critical stenosis of Popliteal, anterior tibial and posterior tibial artery.

ulcer not healed for >1 year in 12 (27.5%) patients and 15 (34%) patients need major amputation to control infections and save life. 4 (9%) patients died due to other co morbid conditions.

Patients after revascularization (n=141) ulcer healed in 110 (78%)

**Figure 1c:** Angioplasty of Popliteal, anterior tibial and posterior tibial artery.**Figure 1d:** Ulcer healed with amputation of 2<sup>nd</sup> toe.

patients, ulcer not healed for >1 year in 7 (5%) patients and 13 (9.2%) patients need major amputation to control infections and save life. 11 (7.8%) patients died due to other co morbid conditions.

Over all limb salvage rate at our center is 142 (76.8%).

## Discussion

Peripheral Arterial Disease (PAD) and Diabetic neuropathy lead to the development of foot ulceration in diabetic patient, which is frequently complicated by infection. PAD is present in up to 50% of patients with DFU, and its severity is strongly linked to wound healing potential [8]. Atheromatous disease in diabetic patients is diffuse and tends to affect more distal vessels with multiple lesions that are less straightforward for revascularization procedures [9].

Diabetic foot ulcer evaluated initially by integrating the clinical exam with non-invasive tests like ankle pressure measurement and Ankle Brachial Index, Colour-Doppler Ultrasound Scanning.

Planning of management depends on site and size of the wound, blood supply to the foot, infection and deformity of the foot.

The basic aim of any successful revascularization is to achieve pulsatile flow to the foot. The two methods currently available are peripheral angioplasty and bypass surgery.

We usually favour an “angioplasty first” revascularization strategy, as this offers several advantages including better tolerability by the patient and repeatability in case of re-occlusion

The objective of the angioplasty was to achieve straight-line flow from the aorta down to foot arteries either a patent dorsalis pedis or plantar arch. The aim of treatment is limb salvage and achieve ulcer healing. Percutaneous Transluminal Angioplasty (PTA) is today considered the first choice revascularization procedure. It is feasible, safe and cost effective for limb salvage in a high percentage of diabetic patients. Multi vessel disease can be treated with angioplasty and procedure can be repeated if require.

Arterial bypass surgery has traditionally been the main treatment with a well-documented long-term patency and limb salvage rate. Technical and anatomical limitations such as the availability of the long vein graft, the presence of infection near the site of planned distal anastomosis and co morbidity of patient often make surgery technically challenging and difficult. Outcome of surgical revascularisation is hampered due to multi vessel occlusion, narrow caliber artery/inflow and poor distal runoff.

In our study after revascularization ulcer healed in 78% patients but only 29.5% ulcer healed after conservative treatment.

Hinchliffe RJ et al. discovered at 1-year follow-up, 60% or more of ulcers had healed following revascularization with either open bypass surgery or endovascular techniques

Studies appeared to demonstrate improved rates of limb salvage associated with revascularization compared with the results of conservatively treated patients in the literature [10].

Over all limb salvage rate at our centre is 142 (76.8%) which is comparable to any good institute in the world.

Dayananda et al. reported a high limb salvage rate of 75.8% at the end of one year by using infrapopliteal angioplasties in diabetic patients [11].

Saab et al also reported a clinical success rate of 58.75% in a general population comprising of diabetic and non-diabetic patients [12].

In another study, Faglia et al. achieved a 5-year primary patency of 88% in diabetic patients undergoing peripheral angioplasty [13].

Zhu et al. showed that subintimal angioplasty for arterial lesions below the ankle in diabetic patients could achieve a limb salvage rate of 94.6% [14].

Ulcer healing rate and over all limb salvage rate is better after revascularization of ischaemic diabetic foot ulcer patients.

## Conclusion

Diabetic foot ulcer is a distressing complication for the patients and his family. Timely and proper intervention of diabetic foot ulcer can helps to salvage the limbs and improve quality of life and reduce social burden. Overall limb salvage rate and ulcer healing rate is much better after revascularization of diabetic foot ulcer. Percutaneous Transluminal Angioplasty (PTA) is the first choice of procedures in revascularization of the lower limb, which is more effective and easily tolerable by the patients with multiple co morbidities.

## References

1. Atlas Diabetes. International diabetes Federation. 10<sup>th</sup> edi. IDF diabetes Atlas. 2019. Prev.
2. Akhtar S, Nasir JA, Sarwar A, Nasr N, Javed A, et al. Prevalence of diabetes and pre-diabetes in Bangladesh: a systematic review and meta-analysis. *BMJ Open*. 2020; 10: e036086.
3. Singh N, Armstrong D, Lipsky B. Preventing foot ulcers in patients with diabetes. *JAMA*. 2005; 293: 217-228.
4. T Elgzyri, J Larsson, P Nyberg, J Thörne, K-F Eriksson. Early Revascularization after Admittance to a Diabetic Foot Center Affects the Healing Probability of Ischemic Foot Ulcer in Patients with Diabetes. *European Journal of Vascular and Endovascular Surgery*. 2014; 48: 440-446.
5. RO Forsythe, J Brownrigg, RJ Hinchliffe. Peripheral arterial disease and revascularization of the diabetic foot. *Diabetes, obesity and metabolism*. 2005; 17: 435-444.
6. Rastan A, et al. One-Year Outcomes Following Directional Atherectomy of Infrapopliteal Artery Lesions: Subgroup Results of the Prospective, Multicenter Definitive Le Trial. *J Endovasc Ther*. 2015; 22: 839-846.
7. Amit KC Jain, Ajit KV, Mangalanandan, Harish K. Revascularization in the diabetic lower limb. *The Journal of Diabetic Foot Complications*. 2013; 1: 18-23.
8. Forsythe RO, Brownrigg J, Hinchliffe RJ. Peripheral arterial disease and revascularization of the diabetic foot. *Diabetes Obes Metab*. 2015; 17: 435-444.
9. Jude E, Eleftheriadou I, Tentolouris N. Peripheral arterial disease in diabetes-a review. *Diabet Med*. 2010; 27: 4-14.
10. Hinchliffe RJ, et al. Effectiveness of revascularization of the ulcerated foot in patients with diabetes and peripheral artery disease: a systematic review. *Diabetes Metab Res Rev*. 2016; 32: 136-144.
11. Dayananda L, et al. Infrapopliteal Angioplasties for limb salvage in diabetic patients: Does clinical outcome justify its use. *Indian J Radio Imaging*. 2008; 18: 156-161.
12. Saab MH, Smith DC, Aka PK, Brownlee RW, Killeen JD. Percutaneous transluminal angioplasty of tibial arteries for limb salvage. *Cardiovasc Intervent Radiol*. 1992; 15: 211-216.
13. Faglia E, Mantero M, et al. Extensive use of peripheral angioplasty, particularly infrapopliteal, in the treatment of ischaemic diabetic foot ulcers: clinical results of a multicentric study of 221 consecutive diabetic subjects. *J Intern Med*. 2002; 252: 225-232.
14. Zhu et al. Subintimal Angioplasty for below the ankle arterial occlusions in diabetic patients with Chronic Critical Limb Ischaemia. *Journal of Endovascular Therapy*. 2010; 16: 604-612.