Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/478

Original Article

Efficacy of Diagnosing Vascular Occlusion in Diabetic Foot Patients to Improve the Outcome

K Karunakaran[1], B Sathyapriya[1], T Rajkiran[2], Heber Anandan[3]

[1]Associate Professor, Department of General Surgery, Government Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India, [2]Resident, Department of General Surgery, Madurai Medical College, Madurai, Tamil Nadu, India, [3]Senior Clinical Scientist, Department of Clinical Research, Dr. Agarwal's Healthcare Limited, Tirunelveli, Tamil Nadu, India

Abstract

Introduction: Peripheral artery occlusive disease (PAOD) is a manifestation of atherosclerosis characterized by atherosclerotic occlusive disease of the lower extremities and is a marker for atherothrombotic disease in other vascular beds. PAOD is also a major risk factor for lower-extremity amputation, especially in patients with diabetes.

Aim: To study the efficacy of diagnosing vascular occlusion and to improve the treatment outcome in diabetic ulcer foot patients.

Methods: Prospective study was conducted to predict the outcome of diabetic foot patients using ankle-brachial index (ABI) and toe-brachial index (TBI).

Results: A total of 19 patients underwent amputation in both minor/major. 4 patients had duplex ultrasonography proven arterial occlusion/stenosis and rest of 15 patients had diffuse arteriosclerosis. Among the 15 patients with diffuse arterial disease, 5 patients had normal ABI. All these 5 patients had very low TBI suggesting TBI is a better indicator of amputation in diabetic foot patient according to the study.

Conclusion: Toe-brachial pressure index is a better index to diagnosis PAOD in diabetic ulcer foot patient, compared to ABI.

Key words: Amputation, Diabetic ulcer foot, Peripheral artery occlusive disease

INTRODUCTION

Peripheral artery occlusive disease (PAOD), referred to as peripheral arterial disease (PAD) or peripheral vascular disease (PVD), refers to the obstruction or deterioration of arteries other than those supplying the heart and within the brain.[1] The risk of PAD is markedly increased among individuals with diabetes, and ischemic event rates are higher in diabetic individuals with PAD than in comparable non-diabetic populations. PVD is common among patients with diabetes. An increase in hemoglobin A1c by 1% can result in more than a 25% risk of PAD.[2] Major amputation rates are 5-10 times higher in diabetics than non-diabetics.[3] Because of these causal relations, the American Diabetes Association recommends ankle-brachial index (ABI) screening every 5 years in patients with diabetes. The care of diabetic patients should start with preventive measures, and it is important to avoid infections in patients with insensate feet because of neuropathy.[4] These patients need to wear properly fitted shoes at all times for protection. Orthotic inserts should be used to distribute weight evenly to avoid pressure on the metatarsal heads of the foot. Diabetic patients may be unaware of the presence of infections or ulcerative lesions because of peripheral neuropathy and a decreased ability to sense pain. In this population, infections can progress rapidly, with significant tissue damage from a combination of delayed presentation and compromised immune function. On presentation, a careful physical examination is important to plan for appropriate treatment. The overlying cellulitis is assessed, and any possible underlying abscess is examined by palpation for crepitus or detection of drainage of purulent fluid. Cellulitis should not be confused with dependent rubor caused by severe ischemia in patients with PAD.[5] The presence of an abscess requires immediate drainage before revascularization. The status of arterial

Access this article online

www.ijss-sn.com

Month of Submission : 07-2016
Month of Peer Review : 08-2016
Month of Acceptance : 09-2016
Month of Publishing : 09-2016

Corresponding Author: Dr. K Karunakaran, A126, Shanthinikethan Apartments, Anna Nagar, Madurai - 625 020, Tamil Nadu, India. Phone: +91-9443009197.E-mail: kkaruna66@gmail.com

circulation is documented. The presence or absence of lower-extremity pulses in the common femoral, popliteal, and pedal arteries is examined. The pulses may be difficult to palpate because of swelling from foot infection; non-invasive arterial ultrasound can be useful in assessing the extent of arterial disease. Insulin-dependent diabetic patients may have calcified walls of the medium and small arteries that can falsely elevate the segmental pressures of the leg. In this situation, digital pressures of the toes can be accurately measured and a pressure higher than 30 mm Hg is predictive of healing after local amputation and debridement.[6] Plain X-rays with multiple views of the foot can assist in assessing the extent of foot infection. Gas in soft tissue signifies deep tissue infection and the need for surgical débridement. Advanced osteomyelitis can be seen; however, plain films may not show early bone infection. Magnetic resonance imaging of the foot is a sensitive imaging modality for detecting soft tissue infection and early bone infection. Routine laboratory work is sent and evaluated for subtle signs of sepsis. Sudden worsening of glycemic control or a rise in creatinine level is seen frequently, often without an increase in leukocytes.[7] In infections with only cellulitis and no underlying soft tissue involvement, patients are treated with intravenous antibiotic therapy. If the cellulitis does not resolve in several days, there may not be adequate antibiotic coverage and the presence of deep tissue infection is considered. The choice of the antibiotics used and the foot need to be reevaluated; reimaging the foot may be necessary. The cause of persistent cellulitis and non-healing sepsis is usually underlying deep infection or osteomyelitis. Other patients may present with gangrene, open joint or exposed bone, or abscess. In these patients, surgical débridement and drainage are required in addition to antibiotic therapy. Small open wounds can be treated with simple débridement and drainage, but often there is deep tissue involvement that is not visible on the surface. To remove all non-viable tissue and wide drainage, amputation may be required. If there is extensive infection of the foot with gas, calf pain, or systemic sepsis, the patient may require amputation as initial therapy. After surgical débridement and drainage, patients are treated with aggressive wound care using dressing changes and continued broad-spectrum antibiotic therapy until intraoperative culture sensitivities are finalized and allow for the use of targeted antimicrobials. Wounds are evaluated closely for persistent infection that may require additional surgical intervention. In patients with adequate arterial circulation, the wound can be closed secondarily after resolution of the infection. All patients with evidence of concomitant arterial occlusive disease are considered for lower-extremity revascularization with open bypass surgery or endovascular stenting or angioplasty to optimize wound healing and limb salvage.[8-13]

Aim

To study the efficacy of diagnosing vascular occlusion and to improve the treatment outcome in diabetic ulcer foot patients.

MATERIALS AND METHODS

A prospective study was conducted in the Department of General Surgery and Vascular Surgery at Government Rajaji Hospital, Madurai. The Ethics Committee approval and informed consent was obtained. The patient from both gender and age more than 18 years were screened. Patients with diabetic ulcer foot more than Grade 2 as per the University of Texas Grading System were included in the study. Known cases of PVDs are excluded from the study. The study patients demographic details with history of diabetes were collected. All patients were subjected to clinical examination, ABI measurement, toe pressure measurement, and arterial ultrasound Doppler study of both lower limbs. Patients were assessed after 1 month of the first visit.

RESULTS

In this study of 100 patients, 19 females and 81 males were included. 41-50 years of age group had the highest number of patients 48% (Table 1).

In Grade 2 ulcer patients, 29 patients had infection and 5 patients had ischemia. In Grade 3 ulcer patients, 71 patients had infection and 5 patients had ischemia (Table 2). Out of the 100 patients, 75 patients did not have pain. 25 patients had pain in lesion and on walking showing that patients with diabetic foot in addition have peripheral neuropathy. So, pain perception is less.

Table 1: Distribution study patients in age group

Age distribution	Number of patients (%)
31-40	7 (7)
41-50	48 (48)
51-60	22 (22)
61-70	11 (11)
71-80	12 (12)

Table 2: Distribution of study patients in ulcer grading

Ulcer grading	Number of patients with infection	Number of patients with ischemia
Grade 2	29	5
Grade 3	71	5

Duplex Doppler of both lower limb showed diffuse atherosclerosis in 95 patients and occlusion/stenosis in 5 patients; all had pathology in the popliteal artery (Table 3).

After 1 month follow-up, 19 patients were subjected for minor and major amputation, 31 patients were on regular wound debridement and dressing, 49 patients underwent grafting, and 1 patient expired. 84% of patients are palpable, 14% had absent dorsalis pedis artery followed by posterior tibial artery 2% (Table 4).

The prediction of outcome comparing ankle-brachial index and toe brachial index has shown a reasonably significant difference i.e., toe-brachial index predicted the disease outcome better than ankle-brachial index. TBI predicted the disease outcome better than ABI (Table 5).

19 patients underwent amputation in both minor/major. 4 patients had duplex ultrasonography proven arterial occlusion/stenosis and rest of 15 patients had diffuse arteriosclerosis. Among the 15 patients with diffuse arterial disease, 5 patients had normal ABI. All these 5 patients had very low TBI suggesting TBI is a better indicator of amputation in diabetic foot patient according to the study (Figure 1).

Table 3: Doppler study results

Doppler study	Number of patients (%)
Diffuse atherosclerosis	95 (95)
Occlusion/stenosis	5 (5)

Table 4: Pulse status of the lower limbs

Pulse status	Number of patients (%)
Absent dorsalis pedis artery	14 (14)
Absent posterior tibial artery	2 (2)
All palpable	84 (84)

Table 5: Comparison of ABI and TBI

Doppler finding	Mean value	
	ABI	TBI
Diffuse	1.07	0.75
Popliteal occlusion	0.51	0.19
Popliteal stenosis	0.71	0.44

ABI: Ankle-brachial index, TBI: Toe-brachial index

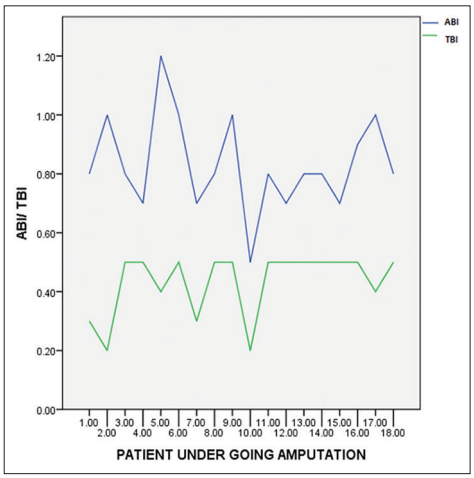

Figure 1: Variations in ABI and TBI among individual patient who had undergone amputation (ABI- Ankle-brachial Index, TBI- Toe -brachial index)

DISCUSSION

Pilot study of the prevalence of asymptomatic peripheral arterial occlusive disease in patients with diabetes by Elhadd *et al.*[14] suggested the prevalence of asymptomatic PAOD in diabetic foot patients in their study cohort was 33%. In this study, around 20% had PAOD, diagnostic criteria were ABI <0.9, TBI <0.6, duplex ultrasound proven arterial occlusive disease. In our study, 20 patients had low TBI, and 5 patients had Duplex ultrasound proven PAOD. All these patients were started on antiplatelet agents, lipid lowering agents and referred to vascular surgery department for further management and revascularization procedure after amputation of gangrenous segments of the foot. Steven and William suggested[15] cigarette smoking is the most important risk factor for the development and progression of PAD. The amount and duration of tobacco use correlate directly with the development and progression of PAD in diabetic foot patients smoking cessation increases long-term survival in patients with PAD. In one study, the 10-year survival rate was 82% in former smokers compared with 46% in continuing smokers. In this study, 80% patients were smokers. Steven and William[15] suggested hypertension increases the high risk of cardiovascular disease associated with diabetes. However, the role of intensive blood pressure control in patients with diabetes and PAD has not been established.

In a recent study, blood-pressure lowering in normotensive patients with diabetes and PAD was particularly effective in preventing cardiovascular events. In this study, 36% patient had hypertension and treated to the same. In diabetic foot with PAD, the ankle-systolic blood pressure is less than the brachial systolic blood pressure, and the ABI is reduced to <1.00; PAD is defined as an ABI <0.90. Lower ABI values indicate more severe PAD and a higher risk of cardiovascular events. In the primary care setting, Mohler *et al.*[16] assessed perceptions of the ABI among 886 clinicians; most believed the ABI was useful in the diagnosis of both symptomatic (96%) and asymptomatic (89%) PAD. The ADA consensus statement recommends that a screening ABI is performed in all diabetic individuals more than

50 years of age. If normal (0.91-1.40), the test should be repeated every 5 years. Ankle-brachial pressure index is less useful in diagnosing PAOD as ABI may be normal or even more than normal in vessels which are calcified. As many patients in diabetic foot have calcified vessels. Palumbo and Melton[17] suggested X-ray of the extremities will identify calcified arteries that may be associated with high ABI levels, indicating non-compressible arteries. Toe-systolic blood pressure index may be helpful in identifying occlusive lower-extremity arterial disease in this circumstance. In this study, among the 14 patients, who underwent amputation with diffuse arteriosclerosis, 5 patients had normal ABI. All these 5 patients had very low TBI suggesting TBI is a better indicator of amputation in diabetic foot patient according to the study. In experienced hands, duplex scanning is as accurate as angiography and has the advantages of cost-effectiveness and safety. However, the aortoiliac segment can be difficult to visualize particularly in obese patients. For those patients in whom revascularization is considered and anatomical localization of stenoses or occlusions is important, an evaluation with a computed tomography angiogram or a magnetic resonance angiogram (MRA) may be valuable. Duplex ultrasound can directly visualize vessels and is also useful in the surveillance of post procedure patients for graft or stent patency. MRA is non-invasive with less risk of renal insult. It may give images that are comparable with conventional angiography, especially in occult pedal vessels, and may be used for anatomical diagnosis. In this study, four patients had arterial occlusion/stenosis at the level of the popliteal artery.

CONCLUSION

Optimal ulcer healing requires adequate tissue perfusion. Thus, arterial insufficiency should be suspected if an ulcer fails to heal. Toe-brachial pressure index is a better index to diagnosis PAOD in diabetic ulcer foot patient, compared to ABI.

REFERENCES

1. Minar E. Peripheral arterial occlusive disease. Vasa 2007;36:155-64.
2. Muir RL. Peripheral arterial disease: Pathophysiology, risk factors, diagnosis, treatment, and prevention. J Vasc Nurs 2009;27:26-30.
3. Moss SE, Klein R, Klein BE. The prevalence and incidence of lower extremity amputation in a diabetic population. Arch Intern Med 1992;152:610-6.
4. Siano D. Diagnosis and Treatment of Peripheral Arterial Disease - American Family Physician [Internet]. Aafp.org. 2016. Available from: http://www.aafp.org/afp/2013/0901/p306.html. [Last cited on 2016 Aug 16].
5. Hannan CM, Attinger CE. Special considerations in the management of osteomyelitis defects (diabetes, the ischemic or dysvascular bed, and irradiation). Semin Plast Surg 2009;23:132-40.
6. Holstein PE. Skin perfusion pressure measured by radioisotope washout for predicting wound healing in lower limb amputation for arterial occlusive disease. Acta Orthop Scand Suppl 1985;213:1-47.
7. Gentry LO. Osteomyelitis: Options for diagnosis and management. J Antimicrob Chemother 1988;21 Suppl C:115-31.
8. Pollak AN, Jones AL, Castillo RC, Bosse MJ, MacKenzie EJ; LEAP Study Group. The relationship between time to surgical debridement and incidence of infection after open high-energy lower extremity trauma. J Bone Joint Surg Am 2010;92:7-15.
9. Kurtz SM, Lau E, Schmier J, Ong KL, Zhao K, Parvizi J. Infection burden for hip and knee arthroplasty in the United States. J Arthroplasty 2008;23:984-91.
10. Zimmerli W. Clinical practice. Vertebral osteomyelitis. N Engl J Med 2010;362:1022-9.
11. Barrett AM, Lucero MA, Le T, Robinson RL, Dworkin RH, Chappell AS. Epidemiology, public health burden, and treatment of diabetic peripheral neuropathic pain: A review. Pain Med 2007;8 Suppl 2:S50-62.
12. Abdulrazak A, Bitar ZI, Al-Shamali AA, Mobasher LA. Bacteriological study of diabetic foot infections. J Diabetes Complications 2005;19:138-41.
13. Chen WL, Chang WN, Chen YS, Hsieh KS, Chen CK, Peng NJ, *et al.* Acute community-acquired osteoarticular infections in children: High incidence of concomitant bone and joint involvement. J Microbiol Immunol Infect 2010;43:332-8.
14. Elhadd T, Robb R, Jung R, Stonebridge P, Belch J. Pilot study of prevalence of asymptomatic peripheral arterial occlusive disease in patients with diabetes attending a hospital clinic. Pract Diabetes Int 1999;16:163-6.
15. Steven PM, William RH. Peripheral arterial disease in patients with diabetes. J Am Coll Cardiol 2006;47:921-9.
16. Mohler ER 3rd, Treat-Jacobson D, Reilly MP, Cunningham KE, Miani M, Criqui MH, *et al.* Utility and barriers to performance of the ankle-brachial index in primary care practice. Vasc Med 2004;9:253-60.
17. Palumbo PJ, Melton LJ. Peripheral vascular disease and diabetes. In: Diabetes in America, Data Compiled 1984. Washington DC: US Govt. Printing Office, NIH publ. No. 85-1468; 1985. p. 1.

How to cite this article: Karunakaran K, Sathyapriya B, Rajkiran T, Anandan H. Efficacy of Diagnosing Vascular Occlusion in Diabetic Foot Patients to Improve the Outcome. Int J Sci Stud 2016;4(6):19-22.

Source of Support: Nil, **Conflict of Interest:** None declared.