Evaluation of Peripheral Lower Limb Insufficiency among Patients with Diabetes Mellitus using Doppler Ultrasound - An Prospective Study

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ABSTRACT

INTRODUCTION

Diabetes mellitus is a common pathological condition of the present times, with a higher prevalence rate in developing countries. It has a marked impact on the quality of life due to the acute and long-term complications secondary to the involvement of micro and macro vasculature with the progression of the natural history of disease. The Doppler ultrasound is non-invasive and can be used as a means of evaluating vascular complications in diabetics. Hence, the aim of the present study was to determine the frequency, level and flow patterns in lower limb arterial insufficiency among diabetic patients with the help of Doppler ultrasound study.

Materials and Methods: The present prospective study was done in December 2011 to December 2012 on 100 patients admitted in the Krishna institute of medical sciences, Karad. Adult diabetic patients (aged 18 years or above) irrespective of type of diabetes and gender with suspected peripheral vascular insufficiency or complaints of numbness, discoloration of periphery or ulceration were taken in this study.

Results: The most common artery involvement was found to be dorsaepaedis artery in 26% of the cases followed by proximal femoral and distal femoral in 18% of the cases whereas there were 12% cases with popliteal artery and distal artery branches involvement. The most common site of lesion involved was proximal femoral artery and dorsaepaedis artery seen in 26% of the cases (both) whereas distal femoral artery (DFA) was found in 10% of the cases, popliteal artery (PA) in 18% of the cases followed by posterior tibial artery (PTA) and anterior tibial artery (ATA) in 8% and 12% of the cases respectively.

Conclusion: Peripheral vascular insufficiency was a significant finding in patients having diabetes for 1-10 years. The dorsaepaedis artery was the commonest site of involvement. The normal Doppler study virtually rules out a haemodynamically significant lesion and helps to prevent unnecessary intervention.

Keywords: Doppler Ultrasound, Diabetes Mellitus, Peripheral Arterial Disease, Lower Limb
Peripheral Lower Limb Insufficiency among Patients with Diabetes Mellitus

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1. Introduction

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia arising from defects in insulin secretion, insulin action, or both. The prevalence of diabetes is increasing worldwide, and it is estimated that by 2040, diabetes will be the seventh leading cause of death globally. Diabetes is associated with a high risk of lower limb complications, including peripheral arterial disease (PAD), foot ulceration, and amputation. The aim of this study was to assess the prevalence of peripheral arterial disease and its relationship with diabetes mellitus.

2. Materials and Methods

The present study was a prospective study which was conducted in December 2011 to December 2012, among the patients admitted in Krishna Institute of Medical Sciences, Karad. Total 100 patients were included in this study by purposive non-randomized sampling. Adult diabetic patients (aged 18 years or above) irrespective of type of diabetes and gender with suspected peripheral vascular insufficiency or complaints of numbness, discoloration of periphery or ulceration were included in this study. Patients with a previous history of trauma to the arterial vasculature, those suffering from other causes of peripheral arterial insufficiency like hypertension, vitamin deficiency, and known athrosclerotic disease, and those who underwent arterial graft procedures were excluded.

Demographic data was collected to analyse details such as identification, gender, age, address, presenting complaints, treatment history and level of HbA1c (when available). Doppler ultrasound (U/S) was done by a convex linear array probe of 11.5 MHz on Toshiba Nemio-17. Colour and spectral Doppler technique were used to find out the affected vessel. Mapping of the lower limb arterial tree was performed, from common iliac up to the dorsalis pedis artery.

Presence of significant ischemia was confirmed with the measurement of ankle to brachial index ratio (ABI), involving the measurement of peak systolic flow velocities in the ankles (dorsalis pedis and posterior tibial arteries), and arms (brachial artery) by using a handheld Doppler and then calculating a ratio, with an ABI of 0.9–1.3 indicating normal flow, 0.6–0.9 indicating mild ischemia, 0.4–0.6 indicating moderate ischemia and < 0.4 severe ischemia. Ultrasonic Doppler equipment is for detecting and evaluating blood flow. In ultrasonography, transducers convert electrical energy into mechanical energy to produce ultrasound and vice versa. Five types of diagnostic Doppler instruments are usually distinguished such as (1) Continuous Wave (CW) Doppler (2) Pulsed Wave (Pw) Doppler (3) Colour Doppler Imaging (Cdi, Colour Velocity Imaging) (4) Duplex Doppler (5) Power Doppler Imaging.

3. Statistical Analysis

The data was entered into the Microsoft excel sheet and was analysed with the help of SPSS software version 21. Descriptive statistics was performed and was presented in the form of tables and graphs.

4. Results

In the present study, out of 100 cases, 68% were males and 32% were females (Graph 1). The majority of cases belonged to 51–60 years followed by 61–70 years (Graph 2). The patients with Type I diabetes mellitus was found to be 40% followed by Type II diabetes in 60% of the cases (Graph 3). The newly detected diabetes cases were found to be 35% whereas the majority of cases with diabetes since 1-10 years were found to be 38% (Graph 4). The vascular abnormality...
Artery involve in stenosis | Number of cases | Percentage
--- | --- | ---
Dorsapaealis alone | 26 | 26%
Proximal femoral and Distal femoral | 18 | 18%
Popliteal artery and distal arterial branches | 12 | 12%
Posterior tibial with dorsapaealis artery | 12 | 12%
Posterior tibial artery alone | 10 | 10%
Popliteal artery alone | 12 | 12%
Common ilieac and distal arterial branches | 10 | 10%

Table-3: Shows the distribution of data according to arterial involvement in stenosis among the study subjects

Level | Number of cases | Percentage
--- | --- | ---
PFA | 26 | 26%
DFA | 10 | 10%
PA | 18 | 18%
PTA | 8 | 8%
ATA | 12 | 12%
DPA | 26 | 26%

Table-4: shows the distribution of data based on site of lesion by Doppler ultrasound among the study subjects

Graph-1: Shows the distribution of data according to gender among the study subjects

Graph-2: Shows the distribution of data based on age group among the study subjects

Graph-3: Shows the distribution of data according to type of diabetes mellitus among the study subjects

Graph-4: Shows the distribution of data based on duration of diabetic status among the study subjects

Graph-5: Shows the distribution of data based on Doppler evidence in limbs among the study subjects

was found to be 72% and normal cases were found to be 28% in this study (Graph 5). The involvement of right limb was 48.8% and left limb was found to be 32.5% followed by bilateral involvement in 18.6% cases (Graph 6). Majority of the cases showed generalized atherosclerosis narrowing in 55% of the cases whereas generalized atherosclerosis narrowing only plus arterial block was found in 31% of the cases (Table 1). It was observed that about 80.1% were present with amputation and about 19.2% did not
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Graph-6: Shows the distribution of data based on side of limb involvement among the study subjects

Showed any amputation (Table 2). The most common artery involvement was found to be dorsaepalaisis artery in 26% of the cases followed by proximal femoral and distal femoral in 18% of the cases whereas there were 14% cases with popliteal artery and distal artery branches involvement (Table 3). The most common site of lesion involved were proximal femoral artery (PFA) and dorsaepalaisis artery seen in 26% of the cases (both) whereas distal femoral artery (DFA) was found in 10% of the cases, popliteal artery (PA) in 18% of the cases followed by posterior tibial artery (PTA) and anterior tibial artery (ATA) in 8% and 12% of the cases respectively (Table 4).

DISCUSSION

The concept of diabetic foot syndrome incorporates various clinical pictures characterized by different etiologies and pathological mechanisms. Common to all is the fact that injuries to the foot of diabetic patient can results in complication that may lead to amputation of the limb if treatment is delayed or ineffective. Diabetic foot lesions are common in middle aged person i.e. in 4th and 5th decade of life and this may be attributed to many factors like duration of diabetes, history of addiction to smoking or alcohol and hyperlipidaemia along with hyperglycaemia which together accelerates the process of plaque formation in arteries of lower extremities. Male predominance was also encountered in a previous similar study by Das et al which reported that out of 60 patients examined for diabetic lower limbs arterial disease, 60% were male and 40% were female.2,10 Higher incidence of diabetic foot lesion is found in males is attributed to smoking, trauma, and unhygienic habits. As males are the breadwinners of the family and are mostly working out door, which makes them more vulnerable for trauma and sequelae. Most of the patients were having diabetes of long duration, have higher chances of developing foot lesions. Most of the patients presented with history of some kind of injury to the foot before the onset of the lesion, because in long standing diabetes there is neuropathy which results in loss of sensation and the patient will be unaware of the injury and neglects it.2,10

This is in agreement with previous studies by Guo et al., who found higher results than the present study as regards bilateral and multi-segmental diabetic lower limbs arterial affection. About 53% of patients examined were affected by bilateral lower limb arterial disease and 70% had multi-segmental distribution.13

In a study conducted by Zeinab Ali et al reported that diabetic lower limb arterial disease had more affection of the distal i.e. below knee arteries in about 66% of patients. The DPA was the most commonly involved artery with significant stenosis in our study (26%); the femoral artery was the second most commonly affected at 18%. There were similar results of arterial stenotic characteristics and segmental distribution of diabetic lower limb arterial disease in previous studies. In a study made by Das et al, the ATA (in 31%) and PTA (in 30%) were the most commonly involved arteries with luminal narrowing and these results are not in concordance with the findings of the present study.14,11

The development of atherosclerosis in the course of diabetes consists in the process of vessel wall remodeling. At the early stage of atherosclerosis, remodeling allows to maintain the flow lumen as it consists in centrifugal thickening of vessel wall with increase in overall vessel diameter (outward remodeling). In a more advanced stage of atherosclerosis, the wall undergoes centripetal hypertrophy, leading to stenosis of the flow lumen (inward remodeling). Pathophysiology of vessel remodeling was first described by Galgov. The type and size of remodeling depends on the production of vascular epithelial growth factor, proteases and cellular adhesion molecules as a response to the changes in blood flow.15,16

The amputation rate is much lower as compared to other studies, due to better education of the patient, better glycaemic control, and proper care of foot followed by proper usage of antibiotics and extensive debridement and regular dressing. Hyperlipidaemia in diabetic foot patients accelerate the process of formation of atheromatous plaque in intima media of the arteries. Thus, along with good glycaemic control hyperlipidaemia should also be under control to minimise diabetic foot complication and hazards of amputations.17,18

CONCLUSION

Middle aged person are at increased risk of peripheral arterial atherosclerotic disease associated with diabetes. Duplex sonography can accurately locate the site and extent of stenosis/occlusion with advantages of low cost, non-invasive in nature, outpatient procedure within less time. Doppler ultrasound being a non-invasive is an easily repeatable procedure.

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