Original Article

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Prevalence and Risk Factors of Peripheral Vascular Disease in Diabetic Foot Lesions

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Abstract

Introduction: Diabetic foot problems are common throughout the world, resulting in major medical, social, and economic consequences for the patients, their families, and society. Ischemia (peripheral vascular disease [PVD]) and peripheral neuropathy contribute to its etiopathogenesis. Of the two primary etiopathogenic factors, PVD represents only potentially preventable and correctable variable.

Aim: The aim of the study is to check prevalence and risk factors of PVD among the patients with diabetic foot lesions.

Materials and Methods: It was a cross-sectional study done in the Department of Surgery, PESIMSR Kuppam, a tertiary care centre from 2011 to 2013. The diagnosis of PVD and the risk factors will be studied at the same time.

Results: A total of 140 Type 2 diabetes patients with foot lesions were studied. 14 patients were diagnosed to have PVD among which 13 (92.9%) are males and 1 (7.1%) patient was a female. Mean age of the patients with concomitant diabetes and PVD is 56.4 years (standard deviation ± 8.1). The mean hemoglobin A1c in the study population was 9.2 ± 2.4 with claudication (71.4%), rest pain (14.3%) or absent/feeble lower limb distal arterial pulses are a more likely presentation.

Conclusion: The prevalence of PVD is multi-fold higher in patients with diabetes with smoking, hyperglycemia, hypertension, dyslipidemia, as major risk factors. Ankle, brachial pressure index, is useful in identifying PVD and it needs further evaluation by an arterial color Doppler and digital subtraction angiography.

Key words: Ankle brachial pressure index, Claudication, Diabetic foot lesions, Peripheral vascular disease

INTRODUCTION

In India, the prevalence of foot ulcers in diabetic patients in the general population is 3%, which is much lower than reported in the western world.[1] With increasing prevalence of unhealthy lifestyles and aging of the Indian population, it is no surprise that diabetes mellitus is reaching epidemic proportions, and this comes along with its colossal socioeconomic and medical burden. Diabetic foot lesions represent a common morbid end point of this metabolic derangement associated with significantly poor functional outcomes and limb loss. Ischemia (peripheral vascular disease [PVD]) and peripheral neuropathy contribute to the etiopathogenesis of the diabetic foot lesions when superimposed by injury or infection. Of the two primary etiopathogenic factors, PVD represents only potentially preventable and correctable variable. A low ankle/arm index is a good marker of vascular events and may be diminished without presenting symptomology (silent PVD).[2] The epidemiology of PVD has rarely been studied in non-European population. PVD is a major cause of morbidity and mortality especially affecting the elderly population. The prevalence of PVD is multi-fold higher in patients with diabetes compared with the age of sex-matched non-diabetic patients, and this may be because of hyperglycemia, hypertension, hyperlipidemia, platelet factors, and other factors that are increased in diabetic foot patients. The impact of PVD on the natural history of diabetic foot lesions has been extensively studied in Caucasian populations where it is prevalent in significant numbers. Recent estimates by the World Health Organization (WHO) show that India already has the largest number of diabetic patients in any given country, and this trend will continue in the future. Unfortunately,

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there is very little epidemiological data on PVD in migrant Indians or individuals from the Indian subcontinent.

Epidemiology

In India, the prevalence of foot ulcers in diabetic patients in the general population is 3%, which is much lower than reported in the western world.

Up to 25% of patients with diabetes will suffer from a foot ulcer during their lifetime.[3]

Approximately 50% of diabetic foot ulcers become infected, and 20% of these require amputation.[4]

About 60% of all non-traumatic amputations occur in those with diabetes. After a major limb loss, 50% of contralateral limbs develop a serious lesion. After the index amputation, 9-17% of patients experience a second amputation within the same year. 25-68% of amputees have their contralateral extremity amputated within 5 years.[5]

In the world, at least one amputation for every 30 s is done for patients with Type II diabetes mellitus.[6]

MATERIALS AND METHODS

It was a cross-sectional study done in the Department of Surgery, PESIMSR, Kuppam, a tertiary care centre from 2011 to 2013. The diagnosis of PVD and the risk factors were studied at the same time. All patients with diabetic foot lesions were included in the study and other non-diabetic foot lesions including traumatic, neuropathic, and infective ulcers were excluded from the study.

Detailed history and clinical examination were done in all patients with diabetic foot lesions and history of PVD mainly on the presence of claudication pain and absent foot pulses, etc.

The ankle brachial pressure index (ABPI) was calculated in every patient, the criterion for diagnosing PVD is ABPI <0.9. All patients examined evaluated, and data of risk factors were collected.

RESULTS

Table 1 shows that 2.14% of the study population was between 31 and 40 years, 20% was between 41 and 50 years, 54% was between 51 and 60 years, 45% was between 61 and 70 years, 8% was between 71 and 80 years, and 2% was between 81 and 90 years. The maximum number of patients are in the age group of 51-60 years.

Table 2 shows 10% of the study population had PVD.

Table 3 shows 10 (71.4%) out of 14 PVD and 10 (7.9%) out of 126 non-PVD patients had a history of claudication pain ($P < 0.0001$) which means that the patients presenting with complaints of claudication pain have more chances of having PVD.

Table 4 shows 2 (14.3%) out of 14 PVD and 3 (2.4%) out of 126 non-PVD patients had rest pain.

Table 5 shows the mean ABPI in the PVD group of patients is 0.81 ± 0.20 in the right leg, and it is 0.94 ± 0.15 in the

Table 1: Age and sex distribution among the study population

Age (years)	Female	Male	Total patients (%)
31-40	2	1	3 (2.14)
41-50	10	18	28 (20)
51-60	19	35	54 (38.5)
61-70	16	29	45 (32.14)
71-80	2	6	8 (5.7)
81-90	0	2	2 (1.4)
Total (%)	49 (35)	91 (65)	140

Table 2: Distribution of pvd among the study population

Patients with	Number of patients	Percentage
PVD	14	10
Non-PVD	126	90
Total	140	100

PVD: Peripheral vascular disease

Table 3: Claudication pain among study population

Claudication pain	PVD (%)	Non-PVD (%)	Total
Yes	10 (71.4)	10 (7.9)	20
No	4 (28.6)	116 (92.1)	120
Total	14	126	140

PVD: Peripheral vascular disease

Table 4: Rest pain among study population

Rest pain	PVD (%)	Non-PVD (%)	Total
Yes	2 (14.3)	3 (2.4)	5
No	12 (85.7)	123 (97.6)	135
Total	14	126	140

PVD: Peripheral vascular disease

Table 5: Distribution of ankle brachial pressure index among the study population

ABPI	Right	Left
0.3-0.59	1	0
0.6-0.89	9	4
0.9-1.2	125	126
>1.2	5	9

ABPI: Ankle brachial pressure index

left leg. Whereas in the non-PVD group, it is 1.07 ± 0.08 in the right leg and 1.07 ± 0.08 in the left leg.

Table 6 shows 7 (50%) out of 14 PVD and 37 (29.4%) out of 126 non-PVD patients have the habit of smoking ($P = 0.11$).

Table 7 shows 5 (35.7%) out of 14 PVD and 29 (23%) out of 126 non-PVD patients were hypertensive. With a $P = 0.29$.

Table 8 shows 10 (71.4%) out of 14 PVD and 42 (33.3%) out of 126 non-PVD patients had dyslipidemia.

DISCUSSION

Diabetes is a chronic complex metabolic disease which results in the inability of the body to maintain and use carbohydrates, fats, and proteins. Most people (95% of all cases) have a form of diabetes known as non-insulin dependent diabetes or Type 2 diabetes. Diabetic foot is defined, based on the WHO criteria as infection, ulceration and/or destruction of deeper tissues associated with neurological abnormalities and various degrees of PVDs of the lower limb.[7] It is one of the most serious complications of diabetes. Approximately 50% of all non-traumatic amputation are performed on diabetics for complications of diabetic foot like non-healing ulcers and gangrene PVD is a common associated condition in patients with Type 2 diabetes. In west around 14%[8] of the patients with Type 2 diabetes suffer from PVD, but in India, these figures vary between 4% and 15%.[9,10] It is one of the major causes of morbidity, mortality, and severe disability in diabetes. Peripheral atherosclerosis observed in patients with the diabetic is typically more distal in distribution and often more extensive.[11] The vessels involve being distal popliteal, the tibial, and metatarsal vessels of lower limbs are most commonly and severely affected.[12]

Table 6: Smoking among study population

Smoking	PVD (%)	Non-PVD (%)	Total
Yes	7 (50)	37 (29.4)	44
No	7 (50)	89 (70.6)	96
Total	14	126	140

PVD: Peripheral vascular disease

Table 7: Hypertension among study population

Hypertension	PVD (%)	Non-PVD (%)	Total
Yes	5 (35.7)	29 (23)	34
No	9 (64.3)	97 (77)	106
Total	14	126	140

PVD: Peripheral vascular disease

Table 8: Dyslipidemia among study population

Dyslipidemia	PVD (%)	Non-PVD (%)	Total
Yes	10 (71.4)	42 (33.3)	52
No	4 (28.6)	84 (66.7)	88
Total	14	126	140

PVD: Peripheral vascular disease

Diabetic atherosclerosis has also been described as extraordinary diffuse, multi-segmental, and often involving collateral vessels.[13]

Early diagnosis and treatment allow up to 80% of patients with diabetic foot problems to have some form of surgical or endovascular revascularization.[14]

Histologically, atherosclerosis in the diabetics is indistinguishable from that in the non-diabetic.[15] Intimal atherosclerosis and medial calcific stenosis (MCS) are both commonly found in the diabetic. The latter condition, MCS is also called Monckeberg's arteriosclerosis, has been found in some studies to occur with increased frequency in the diabetic population.[16] It involves progressive degeneration and calcification of the tunica media of muscular arteries.

The three main factors leading to diabetic foot ulceration - Neuropathy[17] microangiopathy and large vessel disease - gives rise to a similar array of abnormalities of microvascular function - limited vasodilatory reserve, impaired postural vasoconstriction, impaired pressure regulation, and maldistribution of blood flow.

In the majority of cases, the diabetic foot is classified as neuro-ischemic. It is the combination of the two fundamental factors of neuropathy and PVD rather than either factor alone which contributes to the clinical problem of the diabetic foot.

Other factors also contribute to foot ulceration. These include loss of joint position sense, limitation of joint mobility, foot deformity, high plantar foot pressures, and the presence of callus underweight bearing areas. These alone do not cause foot ulceration.

The symptoms of PVD in diabetic patients are similar to those of any other patient group:[18]

1. Intermittent claudication
2. Rest pain
3. Ischemic loss of tissue - ulceration.

Diabetes with PVD has a poorer lower limb function than those with PVD alone, attributed to diabetic neuropathy differences in exertional leg symptoms and greater risk of cardiovascular diseases in a patient with diabetes. Diabetics are at four times greater risk in developing PVD than the

general population, the disease is more aggressive and has 5 times more chances of developing critical limb ischemia.

Assessment should be made to establish the degree of infection, ulceration gangrene, and ischemia, whether it requires treatment and if so the most appropriate treatment. Ischemia is a contributing factor in diabetic foot ulcer that must be recognized and treated to avoid prolonged hospital stay, spreading infection, and unnecessary amputation.

A key principle in treatment of PVD is a hemodynamic assessment of circulatory impairment which helps in deciding further course of treatment. In lower limbs, measurement of pressure plays a central role in assessing disease severity. Segmental pressure measurements in limbs can be used for localized and grade hemodynamically significant lesions, as well as overall degree of circulatory impairment. The single most useful index is ankle pressure which can be measured by handheld Doppler probe and a pressure cuff which is tied just above malleolus, the probe is positioned over dorsalis pedis or posterior tibial arteries to obtain a flow signal.

Normally, ankle brachial index is 1-1.2 but values of 0.6-0.9 are typical of claudication. 0.3-0.6 of rest pain and below 0.3 of incipient or actual gangrene.[19] In some individuals at rest, occult disease may be uncovered if ABPI falls after exercise.

Toe pressure may be obtained by an appropriately sized cuff and use of photoplethysmograph probe on the pulp of distal digit. It is useful in patients with disease confined to the distal vessel are more commonly to help predict the likelihood of healing forefoot procedures ulceration or toe amputations toe pressure 30 mm Hg is predictive of healing in 90% of cases, a pressure 10 mm Hg is predictive of poor outcome. Toe pressure also gives an objective measurement of the extent of occlusive disease between ankle and toe. Normal toe-brachial index is 0.75 and index 0.25 represents severe occlusive disease.

Duplex scanning evaluation of aorta and iliac arteries empods the same 2-3 mHz transducers employed for evaluation of mesenteric and renal arteries. Patients are best studied after an overnight, initial posting is supine but right and left lateral decubitus positions may be helpful to accomplish a complete study. The evaluation proceeds along bifurcation and each iliac artery through the pelvis to groin. A 5 or 75 mHz transducer is typically used to study the femoral, popliteal, and tibial vessels. Evaluation of popliteal and tibial and popliteal arteries is best performed with a combination of prone and supine patient positioning. The tibial arteries are scanned from infrageniculate popliteal artery distally.

Color flow image is useful to identify all vessels initially and to search for regions of color flow disturbance indicative of stenosis.[20,21] Subsequently, the technologist sweeps the pulse Doppler probe through all the segments. Representative images and Doppler velocity spectra are recorded in all regions. The technical adequacy of this examination for identification of all vessels exceeds 90% in most reports although evaluation of peroneal artery may be somewhat less successful.

Patients with atypical symptoms that might be due to ischemia can be examined to exclude the presence of significant arterial disease. The duplex scan also has a potential to find suitable distal revascularization targets when none is visualized by angiography.

Angiography

It must be stressed that angiography should only be performed if intervention is intended. It allows assessment of whether intervention is technically possible and enables a most appropriate form of treatment to be chosen.

Early diagnosis and treatment by specialized podiatric teams have reduced the rate of diabetes-related amputations by 50%. A podiatric team has following responsibilities to identify patients at high risk and monitor them and to treat patients with ulcers.

Treatment modalities include:

A. Medical management
B. Intervention
    1. Endovascular[22]
    2. Surgical
    3. Amputation.

CONCLUSION

Peripheral arterial disease (PAD) is a common cardiovascular complication in patients with diabetes. The risk of developing PAD is much higher in patients with diabetes, and the disease is more severe and progresses more rapidly than in non-diabetic individuals. Moreover, the presence of PAD is a potent marker of increased cardiovascular risk. If PAD is identified on the basis of an ABI of −0.90, its prevalence in patients with diabetes may be as high as 10%.

Because the major threat to patients with diabetes and PAD is from cardiovascular events, the primary therapeutic goal is to modify atherosclerotic risk factors. Risk factor management includes lifestyle modifications, treating associated conditions (diabetes, dyslipidemia, and hypertension), and preventing ischemic events with aggressive antiplatelet therapy such as clopidogrel. Pharmacologic therapies to improve symptomatic PAD

include cilostazol. A supervised exercise program or cilostazol are the preferred first treatment steps for the management of symptomatic PAD. Revascularization has an important role to play in the management of patients for whom risk factor modification and pharmacological treatment prove inadequate.

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