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Original Research Article

A STUDY ON DIABETIC FOOT ASSOCIATED WITH PERIPHERAL ARTERIAL DISEASE

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ABSTRACT

Background: Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, affects millions of people worldwide. The study aims to identify key risk factors contributing to the development and progression of diabetic foot in patients with PAD.

Material and Methods: Patients admitted and seen in the outpatient department for diabetic foot ulcers between October 2023 and January 2024 in the Department of General Surgery, at Sri Lakshmi Narayana Institute of Medical Sciences Puducherry India, were included in this study.

Results: The prevalence of peripheral arterial disease (PAD) among the study population is represented as 36%, indicating that over one-third of the patients with diabetic foot ulcers also have PAD. The mean age of patients with PAD was 42.17 years, slightly higher than the 41.35 years for those without PAD, though this difference was not statistically significant. The site of arterial narrowing or occlusion was categorized into several regions: aorto-iliac, iliac, femoral, femoro-popliteal, and popliteal. Among the 36 patients with PAD, 3 patients (8.3%) had aorto-iliac narrowing or occlusion, 4 patients (11.1%) had iliac involvement, 7 patients (19.4%) had femoral involvement, 12 patients (33.3%) had femoro-popliteal involvement, and 10 patients (27.9%) had popliteal involvement.

Conclusion: According to the findings of this study, the percentage of individuals who have diabetic foot who have peripheral artery disease is approximately 36%.

Keywords: Diabetic foot, Peripheral arterial disease.

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, affects millions of people worldwide. The prevalence of diabetes has been rising alarmingly, with projections indicating a continuous increase in the coming decades.[1] One of the most debilitating complications associated with diabetes is diabetic foot, which often leads to severe consequences such as infection, ulceration, and in extreme cases, amputation. Diabetic foot significantly impacts the quality of life of individuals and imposes a substantial burden on healthcare systems.[2]

Peripheral arterial disease (PAD) is a common and serious complication in diabetic patients. PAD is characterized by the narrowing or blockage of peripheral arteries, primarily in the lower extremities, due to atherosclerosis.[2] This condition exacerbates the risk of developing diabetic foot problems by compromising blood flow, leading to poor wound healing and increased susceptibility to infections. The interplay between diabetes and PAD creates a vicious cycle that complicates the management and treatment of diabetic foot.

Despite the critical impact of diabetic foot associated with PAD, there remains a gap in comprehensive understanding and effective management strategies. This study aims to explore the prevalence, risk factors, and clinical outcomes of diabetic foot in patients with PAD. By investigating these aspects, we hope to contribute valuable insights that can

inform better clinical practices and improve patient outcomes.[3]

The rationale for conducting this study is multifaceted. Diabetic foot associated with PAD represents a significant public health concern due to its high prevalence and severe complications. Diabetic foot is a leading cause of hospitalizations among diabetic patients, often resulting in prolonged hospital stays, recurrent infections, and major amputations. The presence of PAD further complicates the clinical scenario, making early diagnosis and effective management crucial.[4] The current literature lacks comprehensive data on the intersection of diabetic foot and PAD. While numerous studies have examined diabetic foot and PAD independently, there is a scarcity of research focusing on their coexistence and the compounded impact on patient health. Understanding the specific challenges and outcomes associated with this dual condition is essential for developing targeted interventions and improving clinical care.

The study aims to identify key risk factors contributing to the development and progression of diabetic foot in patients with PAD. Identifying these risk factors can aid in the early identification of high-risk individuals and the implementation of preventive measures.[5] This approach aligns with the broader goal of reducing the incidence and severity of diabetic foot complications, ultimately enhancing the quality of life for diabetic patients.[6,7] The study seeks to evaluate the clinical outcomes of diabetic foot in patients with PAD. By analyzing treatment responses, wound healing rates, and the incidence of amputations, the study aims to provide evidence-based recommendations for clinical management.[8,9] These findings can guide healthcare providers in optimizing treatment protocols and improving patient outcomes.

MATERIAL AND METHODS

Patients admitted and seen in the outpatient department for diabetic foot ulcers between October 2023 and January 2024 in the Department of General Surgery at Sri Lakshmi Narayana Institute of Medical Sciences Puducherry India, were included in this study.

The inclusion criteria for the study were as follows: diabetic patients with foot ulceration and gangrenous toes, those with a history of previous foot ulceration and amputations, and those with calluses on the foot. Additionally, diabetic patients with foot deformities, those experiencing a burning sensation, pins and needles, or loss of sensation in the foot, and those with intermittent claudication or rest pain in the feet were included. On the other hand, the exclusion criteria comprised patients with non-diabetic ulcers and diabetic patients whose ulcers coexisted with varicose veins or deep vein thrombosis (DVT). Patients with malignant ulcers, those on corticosteroids or immunosuppressants, and diabetic patients with previous amputations due to malignancy or acute trauma were also excluded. Furthermore, diabetic patients with lymphedema or osteomyelitis of the foot were not included in the study. With prevalence of 30% using formula n=4pq/l2, including 20% non-response rate, the total estimated sample size is about 100.[10]

Patient data were gathered using a structured proforma. Information collected included age, sex, and socioeconomic status. The medical history documented included details such as the duration of the foot ulcer, presence and duration of pain, numbness, discoloration, joint mobility, and trauma history. The duration and treatment of diabetes, family history of diabetes, and any previous surgeries (amputations or disarticulations) were also recorded.

A thorough physical examination was conducted, noting the site and size of the ulcer, presence or absence of discharge, peripheral pulsation, sensation to touch, pain and temperature, vibration perception, and joint mobility. Diagnostic tests included X-rays of the foot, Doppler studies, and ankle-brachial index (ABI) measurements.

RESULTS

The prevalence of peripheral arterial disease (PAD) among the study population is represented as 36%, indicating that over one-third of the patients with diabetic foot ulcers also have PAD. Conversely, the remaining 64% of the patients with diabetic foot ulcers do not have PAD. [Figure 1]

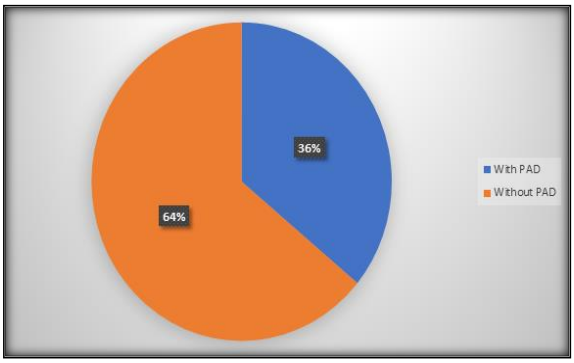

Figure 1: Distribution of Peripheral arterial disease among the study participants (N=100)

The study compares various demographic and clinical variables between patients with peripheral arterial disease (PAD) and those without PAD among individuals with diabetic foot ulcers. The mean age of patients with PAD was 42.17 years, slightly higher than the 41.35 years for those without PAD, though this difference was not statistically significant (p=0.18). Gender distribution revealed that 61.1% of PAD patients were male, compared to 51.6% of those without PAD, while 38.9% of PAD patients were female compared to 48.4% of those without PAD; however, this difference was also not statistically significant

(p=0.36). Regarding the duration of diabetes, 25% of PAD patients had diabetes for less than 5 years, 41.7% for 5-10 years, and 33.3% for over 10 years. In contrast, among those without PAD, 40.6% had diabetes for less than 5 years, 26.6% for 5-10 years, and 32.8% for over 10 years. The difference in diabetes duration between the two groups was not statistically significant (p=0.19). Smoking prevalence was similar between the two groups, with 55.6% of PAD patients being smokers compared to 53.1% of non-PAD patients, and 44.4% of PAD patients being non-smokers compared to 46.8% of non-PAD patients, showing no significant difference (p=0.82). Alcohol consumption was also comparable, with 47.2% of PAD patients and 46.8% of non-PAD patients consuming alcohol, and 52.8% of PAD patients and 53.1% of non-PAD patients abstaining from alcohol, yielding no significant difference (p=0.97). A significant difference was found in the presence of coronary artery disease (CAD) or cerebrovascular accident (CVA), with 19.4% of PAD patients having CAD/CVA compared to only 4.7% of non-PAD patients (p=0.02). This finding indicates a notable association between PAD and the presence of CAD/CVA among the studied diabetic foot ulcer patients. [Table 1]

The study examined various aspects of patients with peripheral arterial disease (PAD) and diabetic foot ulcers. The site of arterial narrowing or occlusion was categorized into several regions: aorto-iliac, iliac, femoral, femoro-popliteal, and popliteal. Among the 36 patients with PAD, 3 patients (8.3%) had aorto-iliac narrowing or occlusion, 4 patients (11.1%) had iliac involvement, 7 patients (19.4%) had femoral involvement, 12 patients (33.3%) had femoro-popliteal involvement, and 10 patients (27.9%) had popliteal involvement. Regarding the surgical procedures performed on these patients, 12 patients (33.3%) underwent debridement, 17 patients (47.2%) underwent amputation or disarticulation, and 7 patients (19.5%) underwent revascularization. These findings highlight the distribution of arterial involvement in PAD among diabetic foot patients and the range of surgical interventions employed to manage their conditions. The data indicate a significant prevalence of femoro-popliteal and popliteal artery involvement and a high rate of amputation or disarticulation procedures, reflecting the severity of the disease and the critical need for effective management strategies. [Table 2]

Table 1: Distribution of demographic variables among the study participants (N=100)

Sl no	Variable	With PAD (n=36)	Without PAD (n=64)	p
1	**Age in years (Mean)**	42.17±3.14	41.35±2.78	0.18
2	**Gender** Male Female	 22 (61.1) 14 (38.9)	 33 (51.6) 31 (48.4)	0.36
3	**Duration of diabetes** <5 years 5-10 years >10 years	 9 (25) 15 (41.7) 12 (33.3)	 26 (40.6) 17 (26.6) 21 (32.8)	0.19
4	**Smoking** Present Absent	 20 (55.6) 16 (44.4)	 34 (53.1) 30 (46.8)	0.82
5	**Alcohol** Present Absent	 17 (47.2) 19 (52.8)	 30 (46.8) 34 (53.1)	0.97
6	**Presence of CAD/CVA** Present Absent	 7 (19.4) 29 (80.6)	 3 (4.7) 61 (95.3)	0.02

Table 2: Distribution of study variables among the study participants (N=100)

Sl no	Study Variable	With PAD (n=36)
1	**Site of arterial narrowing or Occlusion** Aorto-iliac Iliac Femoral Femoro-popliteal Popliteal	 3 (8.3) 4 (11.1) 7 (19.4) 12 (33.3) 10 (27.9)
2	**Surgical Procedure** Debridement Amputation/disarticulation Revascularisation	 12 (33.3) 17 (47.2) 7 (19.5)

DISCUSSION

The study reveals a significant prevalence of peripheral arterial disease (PAD) among patients with diabetic foot ulcers, with 36% of the participants diagnosed with PAD. This finding indicates that more than one-third of individuals with diabetic foot ulcers also suffer from PAD, underscoring the critical interplay between these two conditions. Conversely, the remaining 64% of

patients with diabetic foot ulcers do not have PAD, highlighting that while PAD is a common complication, it is not universal among diabetic foot ulcer patients. Individuals under the age of 50 have a prevalence of PAD that is 3.2%, while those over the age of 80 have a prevalence that is 55%. The prevalence of PAD improves with increasing age.[9] The prevalence that was reported by Muthiah et al,[11] was 38%, which is significantly higher than the prevalences that were reported by Marinelli et al,[12] (33%), and Migdalis et al,[13] (44%), which were 33% and 44% respectively. That is to say, out of a total of 150 patients, 57 patients had PAD that was related with diabetic foot.

The demographic and clinical comparisons between patients with and without PAD provide valuable insights. In our study the mean age of PAD patients was slightly higher (42.17 years) compared to those without PAD (41.35 years); however, this difference was not statistically significant (p=0.18). This suggests that age alone may not be a distinguishing factor for PAD among diabetic foot patients.

In our study Gender distribution showed a higher proportion of males (61.1%) in the PAD group compared to females (38.9%). In contrast, the non-PAD group had a more balanced gender distribution, with 51.6% males and 48.4% females. Despite these differences, the gender distribution was not statistically significant (p=0.36), indicating that gender may not play a critical role in the prevalence of PAD among diabetic foot ulcer patients. It is comparable to rest, with a larger occurrence in males than in females, according to both our study and Muthiah et al11 findings. This also correlates with the existing data that male sex has a higher prevalence of PAD in diabetic foot.[14]

The duration of diabetes varied among the patients. In tour study the PAD group, 25% had diabetes for less than 5 years, 41.7% for 5-10 years, and 33.3% for over 10 years. In the non-PAD group, 40.6% had diabetes for less than 5 years, 26.6% for 5-10 years, and 32.8% for over 10 years. These differences were not statistically significant (p=0.19), suggesting that the duration of diabetes alone does not significantly influence the development of PAD in diabetic foot ulcer patients. PAD increases with increased duration of diabetes, 15% at 10 years and 45% after 20 years.[15]

Lifestyle factors such as smoking and alcohol consumption were also examined. Smoking prevalence was similar between the two groups, with 55.6% of PAD patients being smokers compared to 53.1% of non-PAD patients. Non-smokers constituted 44.4% of the PAD group and 46.8% of the non-PAD group, showing no significant difference (p=0.82). Alcohol consumption was nearly identical between the groups, with 47.2% of PAD patients and 46.8% of non-PAD patients consuming alcohol, and 52.8% of PAD patients and 53.1% of non-PAD patients abstaining from alcohol, yielding no significant difference (p=0.97).

A notable finding was the significant difference in the presence of coronary artery disease (CAD) or cerebrovascular accident (CVA). Among PAD patients, 19.4% had CAD/CVA compared to only 4.7% of non-PAD patients (p=0.02). This significant association suggests that PAD patients are more likely to have concurrent cardiovascular conditions, emphasizing the need for comprehensive cardiovascular assessment and management in diabetic foot ulcer patients with PAD. In a study Muthiah et al11 a total of eleven individuals out of fifty-seven diabetic foot patients who had PAD were found to have concomitant CVA/CAD. It was found that diabetic foot patients with PAD had a higher incidence of related CVA/CAD than diabetic foot patients without PAD, with the former having a higher incidence of 19.29%.

Our study also examined the specific sites of arterial narrowing or occlusion in PAD patients. The distribution was as follows: 8.3% had aorto-iliac involvement, 11.1% had iliac involvement, 19.4% had femoral involvement, 33.3% had femoro-popliteal involvement, and 27.9% had popliteal involvement. These findings highlight the significant prevalence of femoro-popliteal and popliteal artery involvement among PAD patients with diabetic foot ulcers. In a study Muthiah et al11 6% had aorto-iliac involvement, 3% had iliac involvement, 6% had femoral involvement, 37% had femoro-popliteal involvement, and 17% had popliteal involvement.

Regarding surgical procedures, 33.3% of PAD patients underwent debridement, 47.2% underwent amputation or disarticulation, and 19.5% underwent revascularization. The high rate of amputations or disarticulations reflects the severe impact of PAD on diabetic foot ulcer patients and underscores the critical need for effective management strategies to prevent such outcomes. Zagreb et al, the percentages of amputations were higher.[16]

CONCLUSION

In conclusion, the study provides comprehensive insights into the prevalence and clinical characteristics of PAD among diabetic foot ulcer patients. The significant association between PAD and CAD/CVA highlights the importance of cardiovascular assessment in this patient population. The findings also emphasize the need for targeted interventions to manage PAD effectively and reduce the high rate of severe surgical procedures such as amputations. Overall, the study underscores the complex interplay between diabetes, PAD, and diabetic foot ulcers, and the critical need for integrated and comprehensive management approaches to improve patient outcomes.

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