



Association between Diabetic Foot Ulcer and Diabetic Retinopathy

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Abstract

Diabetes mellitus is a metabolic disorder with disturbance in carbohydrate, protein and fat metabolism because of partial or complete deficiency of insulin secretion or action. As it can cause various complications and Diabetic retinopathy being the most common and perhaps the most serious of all ocular complications. Diabetic foot ulcer is one of the most serious and disabling complications of diabetes mellitus which result in significantly elevated morbidity and mortality. Aim of the study was to assess the severity of diabetic retinopathy in relation to various grades of diabetic foot ulcer among 100 patients with clinically diagnosed type 2 Diabetes Mellitus with diabetic foot ulcer patients. 25% of the study participants were found to have Moderate NPDR with 15% of the study participants having severe NPDR. 11.1% of study participants with grade 4 DFU had PDR with HRC and 33.3% of study participants with grade 4 DFU had Severe NPDR. 47.1% and 35.3% of study participants with grade 3 DFU had Severe NPDR and moderate NPDR respectively. The association was found to be statistically significant between the severity of diabetic retinopathy and the grades of diabetic foot ulcer of the study participants. The study concluded that the severity of diabetic retinopathy increases with the increase in the stages of DFU and there is a possibility that the presence of DFU can predict the progression to advanced stages of DR. The results of our study support the need for a system of ophthalmological referral in case of detection of DFU, as well as a prompt referral of DR patients to a DFU specialist. Also, in advanced age DFU patients, and particularly those with longer duration of diabetes, early detection of DR and timely treatment may decrease the risk of severe vision loss or blindness.

Keywords: diabetic foot ulcer, diabetic retinopathy, risk factors, severity, India.

Introduction

Diabetes mellitus is one of the most common and most challenging metabolic disease globally, which are characterized by elevated blood glucose levels resulting from the body's inability to produce insulin or resistance to insulin action, or both^[1]. Diabetes can affect different organ systems in the body and can lead to serious

complications. Cardiovascular disease, stroke, and peripheral vascular disease are the macrovascular complications. Peripheral vascular disease may lead to injuries that do not heal, gangrene, and finally amputation. Nervous system damage (neuropathy), renal system damage (nephropathy) and eye damage (retinopathy) are the microvascular complications^[2]. Among all the

microvascular complications, Diabetic retinopathy (DR) is the most common complication^[3]. Diabetic retinopathy is described by progressive alterations in the microvasculature that lead to retinal ischemia, neovascularization, altered retinal permeability, and macular oedema^[4]. The leading cause of vision loss in adults is diabetic retinopathy^[5]. An estimated 285 million people worldwide with diabetes in the year 2010, third of these are affected with vision-threatening diabetic retinopathy (VTDR), defined as severe non-proliferative DR or proliferative DR (PDR) or the presence of diabetic macular oedema (DME) and over one-third have signs of DR^[6]. Due to increase in prevalence of diabetes, ageing of the population and increasing of life expectancy of those with diabetes, it is expected to rise further. With increasing duration of disease probability of retinal complications increases. Potentially vision-threatening retinal changes develop over time in up to 50% of patients with type 1 diabetes and 30% of those with type 2 diabetes, while early retinal changes are not noticed by the patients^[7]. Most common vision-threatening lesion particularly among patients with type 1 diabetes is PDR. However, DME remains the major cause of vision loss in the highly prevalent type 2 diabetes^[8] and is invariably present in patients with type 2 diabetes with PDR^[9]. DR and DME have also contribute to the development of other diabetes-related complications including nephropathy, peripheral neuropathy and cardiovascular events^[9-12]. Diabetic Foot Ulcer (DFU) is one of the most serious and disabling complications of DM, resulting in significantly elevated morbidity and mortality. Important predisposing factors for DFU are vascular insufficiency and associated neuropathy, and DFU is the most common cause of non-traumatic foot amputation worldwide. Up to 70% of all lower leg amputations are performed on patients with DM, and up to 85% of all amputations are preceded by a DFU^[13,14]. It is estimated that 15–25% of people with diabetes will develop diabetic foot ulcer (DFU) during their lifetime^[15]. Studies have demonstrated that

diabetic retinopathy (DR) is among one of the major contributing factors in the development of foot ulceration and subsequent lower limb amputation in diabetic patients^[16-19].

Considering the largely agriculture-oriented, cultural factors encouraging bare foot walking, injury-prone occupations an increase in the incidence of DFU is expected. A combination of diabetic retinopathy and DFU would affect the population in working age group the most. Early detection of both DR and DFU would limit physical and visual disability in this population. In view of this, the present study was undertaken to assess the severity of diabetic retinopathy in relation to various grades of diabetic foot ulcer.

Methodology

A cross sectional study was conducted in a medical college in Bengaluru during January 2021 to July 2022. Clearance from the institutional ethical committee was taken before starting the study. Study participants were selected based on Purposive Sampling technique. Based on Yamane equation, for a known population size, sample size, $n = \frac{N}{1 + Ne^2} = 96.18$. After approximating, the study was conducted among 100 patients with clinically diagnosed type 2 Diabetes Mellitus with diabetic foot ulcer. Patients with type 1 Diabetes mellitus, type 2 Diabetes mellitus without diabetic foot ulcer, pregnancy and lactation, severely ill and debilitated patients were excluded. Written informed consent was taken from the study participants before collecting the data. A pre-tested, semi-structured questionnaire was used to collect information on socio-demographic variables and history of presenting illness by interview method. They were examined methodically for the incidence and severity of diabetic retinopathy changes, by using methods of examination like visual acuity, refraction, slit lamp examination, fundus examination by direct ophthalmoscopy and indirect ophthalmoscope. Other investigations like 90 D lens examination, fundus photography, 3 mirror examination, B scan, FFA (fundus

fluorescein angiography), OCT (optic coherence tomography) were done if necessary. The findings were documented. The data was collected and compiled in MS Excel. Descriptive statistics has been used to present the data. To analyse the data SPSS (Version 26.0) was used. Significance level was fixed as 5% ($\alpha = 0.05$). Qualitative variables are expressed as frequency and percentages and Quantitative variables are expressed as Mean and Standard Deviation. To compare the proportion between groups, chi-square test was applied.

Result

In the present study, majority of the study participants belonged to the age group 51-60 years (38%) of age. The mean age of the study participants was found to be 60.48+9.70. Majority of the study participants were males (63%) with females contributing to 37% of study population. 43% of the study participants had duration of diabetes in the range of 1-5 years. The mean duration of diabetes of the study participants was found to be 7.95+5.90.

Among the study participants, 74% had duration of DFU for less than 1 month. Very low percentage of the study participants had duration of DFU more than 2 months (14%). Based on

Wagner’s diabetic foot ulcer grading, it was found that 29% of the study participants were found to have grade 1 DFU, followed by grade 2 in 21% of the study participants. 18% of the study participants were found to have grade 4 DFU. Out of 100 study participants, 25% of the study participants were found to have Moderate NPDR with 15% of the study participants having severe NPDR. 4% of the study participants had very severe NPDR with 21% having no NPDR.

Figure 1 showing association between diabetic foot ulcer and diabetic retinopathy. 11.1% of study participants with grade 4 DFU had PDR with HRC (high risk category) and 33.3% of study participants with grade 4 DFU had Severe NPDR. 47.1% and 35.3% of study participants with grade 3 DFU had Severe NPDR and moderate NPDR respectively. 60% and 40% of the study participants with grade 0 DFU had no NPDR and mild NPDR respectively. It is inferred from the above table that as the severity of diabetic foot ulcer increases, the severity of diabetic retinopathy also increases. The association was found to be statistically significant between the severity of diabetic retinopathy and the grades of diabetic foot ulcer of the study participants.

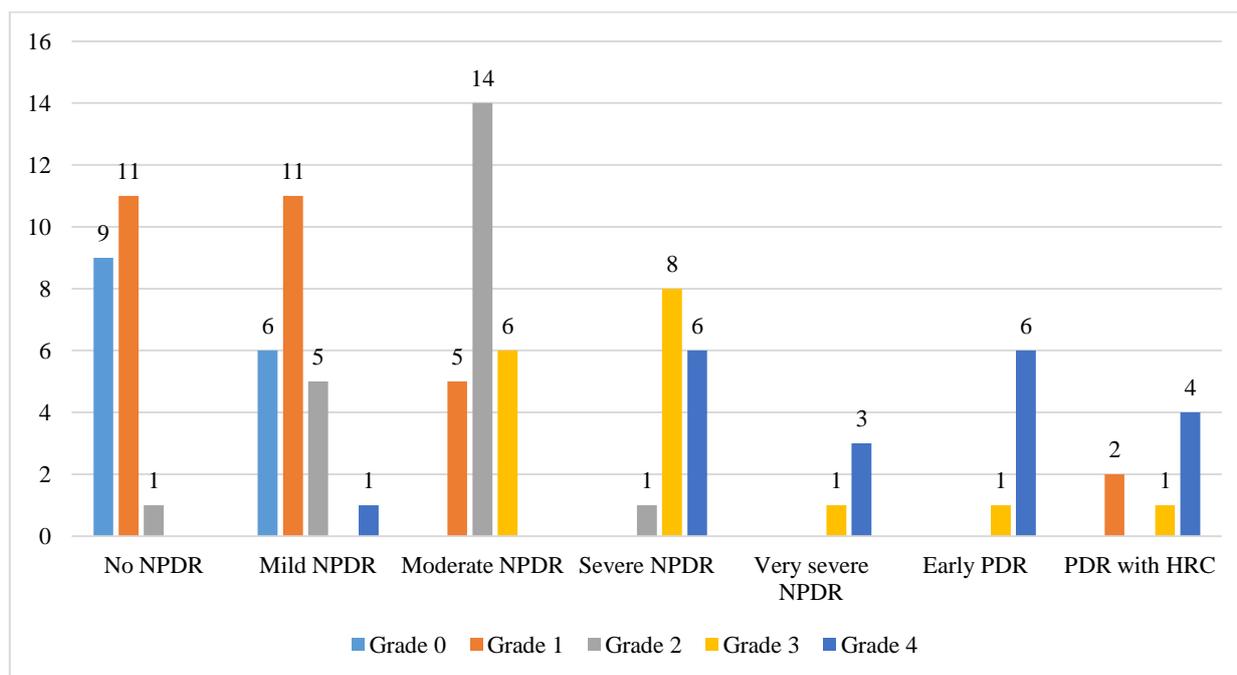


Figure 1 showing association between diabetic foot ulcer and diabetic retinopathy.

Discussion

In the present study, 43% of the study participants had duration of diabetes in the range of 1-5 years. The mean duration of diabetes of the study participants was found to be 7.95±5.90. In a study done by Vaishnavi R et al.^[20], 27% of the study participants had duration of diabetes in the range of 1-5 years, which is lower than the findings of the present study. In a study done by Hwang DJ et al.^[16], the mean duration of diabetes mellitus (DM) was 18.5 ± 10.6 years, which is higher than the findings of the present study.

In the present study, 29% of the study participants were found to have grade 1 DFU, followed by grade 2 in 21% of the study participants. 18% of the study participants were found to have grade 4 DFU. In a study done by Karam T et al.^[19], 47.25% were found to have grade 3 DFU and 31% of the study participants were found to have grade 1 DFU, which is comparable with the findings of the present study. In a study done by Hwang DJ et al.^[16], majority of the study participants were found to have grade 1 DFU, which is similar to the findings of the present study.

In a study done by Hwang DJ et al.^[16], Eight patients (8%) had mild non-proliferative diabetic retinopathy (NPDR), 17 patients had moderate NPDR (17%) and Severe NPDR was observed in 10 patients (10%), which is comparable with the findings of the present study. Based on the study done by Vaishnavi R et al.^[20], In patients with Grade 1 DF, 45% had mild NPDR, 18.18% had mild NPDR + CSME, 27.27% showed moderate NPDR + CSME, 9.09% had severe NPDR + CSME and 72.91% showed no DR. In patients with Grade 2 DF, 61.53% had mild NPDR, 23.07% had moderate NPDR, 15.38% had only CSME and 16.66% had no DR. In patients with Grade 3 DF, 58.82% suffered from mild NPDR, 29.41% from moderate NPDR, 11.76% from moderate NPDR + CSME, and 2.08% had no DR. In patients with Grade 4 DF, 18.18% had mild NPDR, 27.27% had moderate NPDR, 54.54% had moderate NPDR + CSME, and 8.33% had no DR. The increasing severity of DFU and the severity

of stage of DR showed a statistical significance, given by Chi-square test (P 0.002). Also, in a study done by Karam T et al.^[19], association was found between DF and DR. These findings are found to be similar with the findings of the present study.

Conclusion

An establishment of an association between DR and DFU could help in better screening protocols to be followed, so as to detect and manage both the diseases in a timely fashion. The present study showed that the severity of diabetic retinopathy increases with the increase in the stages of DFU and there is a possibility that the presence of DFU can predict the progression to advanced stages of DR. With India headed to be the diabetes capital of the world in the near future, an increase in these two complications would affect the quality of life of the working population to a large extent. A determined and well-planned strategy incorporating the existing health-care structure toward the provision of an integrated approach to diabetics in the early stages to prevent complications is of utmost importance. The results of our study support the need for a system of ophthalmological referral in case of detection of DFU, as well as a prompt referral of DR patients to a DF specialist. Also, in advanced age DFU patients, and particularly those with longer duration of diabetes, early detection of DR and timely treatment may decrease the risk of severe vision loss or blindness.

This is a cross-sectional study which found an association between DF and DR. However, a prospective cohort study with longitudinal follow-up would have been ideal to establish a stronger pathogenic correlation between the two conditions.

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