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ORIGINAL ARTICLE

Correlation between duration of Diabetes and Severity of Retinal Changes

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ABSTRACT

Background: Diabetic retinopathy (DR) is the most frequent microvascular complication of diabetes mellitus and a significant cause of avoidable blindness in the world. The long-term effects of hyperglycemia are chronic retinal microangiopathy, and the number of years is considered one of the strongest predictors of retinal structural damage and visual loss, especially in resource-deprived contexts.

Purpose: To establish the relationship between type-2 diabetes mellitus duration and diabetic retinopathy severity in adult patients who visit a tertiary-care ophthalmological clinic.

Methodology: It was a cross-sectional study conducted at department of Ophthalmology unit BKMC Mardan from June 2022 to December 2022. A sample of 120 patients who had confirmed diabetes mellitus type 2 was selected through a consecutive sampling. The demographic parameters and period of diabetes were noted. Dilated fundus examination was performed on all participants with the help of the slit-lamp biomicroscope with a 90-diopter lens. The grading of retinal changes was conducted in accordance with the Early Treatment Diabetic Retinopathy Study (ETDRS). The analysis of data was performed with the help of SPSS version 24. Chi-square test and Spearman correlation were used to test the association between duration of diabetes and the severity of retinopathy. A p-value of 0.05 or below was regarded as statistically significant.

Results: The mean age of participants was 55.1 ± 9.2 years, with 68 (56.7%) males. Mean duration of diabetes was 10.2 ± 5.4 years. Diabetic retinopathy was present in 74 (61.7%) patients, including mild NPDR in 25.0%, moderate NPDR in 17.5%, severe NPDR in 10.8%, and proliferative DR in 8.4%. Retinopathy prevalence increased significantly with longer disease duration: 12.8% in ≤5 years, 54.3% in 6–10 years, and 88.6% in >10 years duration groups. A strong positive correlation was observed between duration of diabetes and retinopathy severity ($r = 0.69$; $p < 0.001$).

Conclusion: Diabetes duration has a strong and statistically significant relationship with diabetic retinopathy severity, which emphasises the need to diagnose and conduct regular retina screening to avoid diabetic retinopathy complications with vision risks.

Keywords: Diabetes, Retinopathy, Duration, Severity.

INTRODUCTION

One of the most important non-communicable illnesses afflicting contemporary societies is diabetes mellitus, whose rates are soaring at such an alarming pace all over the world[1]. Recent epidemiological estimations indicate that there are over 500 million adults currently living with diabetes, with the highest proportional increase in low- and middle-income countries[2]. Diabetes-related complications have become a significant issue of concern to the people of Pakistan since it is ranked as one of the top ten countries in terms of the burden of diabetes. Of such complications, diabetic retinopathy (DR) is the most frequent cause of avoidable diabetic blindness in working-age adults[3]. DR is a progressive microangiopathy that is chronic and involves the thickening of the basement membrane of the capillaries, loss of pericytes, formation of microaneurysms, closure of the capillaries, and ischemia in the retina. The result of these changes is the augmentation of vascular permeability, retinal oedema, and neovascularisation. DR has a clinical classification of non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR). NPDR is further divided into mild, moderate, and severe types, and PDR is characterised by the neovascularisation, bleeding of the vitreous or tractional retina detachment. The most common cause of vision loss is diabetic macular oedema, which can present at any stage[4,5]. DR is the disease that evolves and develops under the impact of numerous systemic and ocular risks, including inappropriate glycemic regulation, high blood pressure, lipid dysregulation, smoking, and pregnancy. Nevertheless, of all of these, the length of diabetes has always been the most successful non-modifiable predictor of DR[6]. Chronic hyperglycemia initiates several biochemical pathways, like the polyol pathway, activation of protein kinase-C, oxidative stress, and advanced glycation end products, that result in a progressive retinal microvascular injury[7]. In large population-based studies like the Wisconsin Epidemiologic Study of Diabetic Retinopathy and the UK Prospective Diabetes Study, it was shown that the risk of developing DR soars beyond 1015 years of diabetes. The evidence in these studies demonstrated that almost all patients with type-1 diabetes and over 60 per cent of patients with type-2 diabetes develop some form of DR after 20 years of having the disease. Nonetheless, this does not eliminate the fact that numerous patients in the developing nations end up being undiagnosed until they end up with an advanced disease owing to inadequate screening facilities, ignorance, and their socioeconomic status[8,9]. Routine annual screening of the retina is not a common practice in Pakistan, and the majority of the patients do not consult an ophthalmologist until they experience visual symptoms. As a result, a high percentage of them are at an advanced level of NPDR or PDR when treatment measures are more expensive and less efficient[10]. There is a paucity of local data on the measurement of the linkage between duration of diabetes and severity of retinal changes, and more so by standardised grading systems such as the Early Treatment Diabetic Retinopathy Study (ETDRS) classification. It is important to determine the implications of such an association on the local population so that evidence-based screening strategies can be developed, clinicians can be empowered to carry out risk stratification, and preventive ophthalmology services can be enhanced. Thus, this study was planned to test the association between type-2 diabetes mellitus duration and diabetic retinopathy severity in patients who presented to a tertiary-care ophthalmology department.

Study Objectives: To identify the relationship between the duration of type-2 diabetes mellitus and the level of diabetic retinopathy based on standardised ETDRS grading in adult diabetic patients.

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MATERIALS AND METHODS

Study Design & Setting: This cross-sectional study conducted at department of Ophthalmology unit BKMC Mardan from June 2022 to December 2022

Participants: The enrolled sample of adult patients aged 30 years and above with confirmed type-2 diabetes mellitus visiting the outpatient department was sampled consecutively without any probabilistic criteria, with informed consent obtained.

Sample Size Calculation: The WHO sample size calculator was used to determine the sample size of 120 patients based on a prevalence of diabetic retinopathy of 60, a 95% confidence level and a margin of error of 9.

Inclusion Criteria

- Age ≥30 years
- At least one year of type 2 diabetes mellitus.
- Willingness to participate

Exclusion Criteria:

- Gestational diabetes or type-1 diabetes.
- Past eye injury or intraocular operation.
- The media is opaque such that fundus examination is not possible.
- Concomitant retinal pathology.

Diagnostic and Management Strategy: Dilated fundus examination was done for all patients with the help of a slit-lamp biomicroscope and a 90D lens. The grades of retinopathy were given based on the ETDRS classification, and further management was referred to, where required.

Statistical Analysis: SPSS version 24 was used to analyse the data. Continuous variables were presented as mean SD, and categorical variables were presented as frequencies and percentages. Associations were made using the chi-square test and Spearman correlation. The p-value of 0.05 or below was taken to be significant.

RESULTS

A total of 120 patients were included in the study with a mean age of 55.1 ± 9.2 years. Of these, 68 (56.7%) were male and 52 (43.3%) were female. The mean duration of diabetes was 10.2 ± 5.4 years. Diabetic retinopathy was observed in 74 (61.7%) participants. Among affected patients, 30 (25.0%) had mild NPDR, 21 (17.5%) had moderate NPDR, 13 (10.8%) had severe NPDR, and 10 (8.4%) had proliferative diabetic retinopathy. The prevalence of retinopathy increased significantly with increasing duration of diabetes. Only 12.8% of patients with diabetes duration of ≤5 years had DR compared to 54.3% in the 6–10 years group and 88.6% among those with more than 10 years of disease duration. A strong positive correlation was found between duration of diabetes and severity of retinopathy (Spearman's r = 0.69), which was statistically significant ($p < 0.001$).

Table 1. Baseline Characteristics of Study Participants (n = 120)

Variable	Value
Age (years), mean ± SD	55.1 ± 9.2
Male, n (%)	68 (56.7)
Female, n (%)	52 (43.3)
Duration of diabetes (years), mean ± SD	10.2 ± 5.4
Patients with DR, n (%)	74 (61.7)

Baseline demographic and clinical characteristics of patients with type-2 diabetes mellitus included in the study.

Table 2. Distribution of Diabetic Retinopathy Severity

Retinopathy Grade	Frequency n (%)
No DR	46 (38.3)
Mild NPDR	30 (25.0)
Moderate NPDR	21 (17.5)
Severe NPDR	13 (10.8)
Proliferative DR	10 (8.4)

Severity of diabetic retinopathy graded according to the ETDRS classification system.

Table 3. Association Between Duration of Diabetes and Presence of Diabetic Retinopathy

Duration of Diabetes	DR Present n (%)	DR Absent n (%)
≤5 years	5 (12.8)	34 (87.2)
6–10 years	25 (54.3)	21 (45.7)
>10 years	44 (88.6)	6 (11.4)

Increasing prevalence of diabetic retinopathy with longer duration of diabetes mellitus.

Intervention Outcome: Patients who were diagnosed with severe NPDR or proliferative diabetic retinopathy were referred to the retina clinic to undergo fundus photography, optical coherence tomography, laser photocoagulation, or intravitreal anti-VEGF therapy according to the institutional treatment patterns.

Table 4. Correlation Between Duration of Diabetes and Severity of Retinal Changes

Variables Compared	Spearman's r	p-value
Duration of diabetes vs DR severity	0.69	<0.001

Spearman correlation analysis showing strong positive association between duration of diabetes and increasing severity of diabetic retinopathy.

DISCUSSION

In this study, there was a highly statistically significant positive relationship between type-2 diabetes mellitus years of duration and severity of diabetic retinal changes. Through clinical grading based on ETDRS, we observed that the prevalence and stage of diabetic retinopathy (DR) continuously increased through the duration strata, with the greatest disease burden of severe NPDR and proliferative DR (PDR) in patients with diabetes longer than 10 years[10]. These results support the notion of cumulative glycemic exposure, i.e., the longer the period of disease, the greater the microvascular damage and the faster the shift to the next phases of NPDR that threaten vision occurs[11]. A series of studies conducted in different regions and internationally over the past five years have reported that duration of diabetes is one of the most powerful predictors of DR onset and progression[12]. A big hospital-based cohort of South Asians published within the past 5 years found a further rapid increase in any DR when diabetes was over 10 years, as well as a significantly increased risk of advanced DR, which increased with longer duration, just like our trend of rising prevalence in early duration groups to those over 10 years of length[13]. This same result of a recent multicenter study in a similar low- to middle-income environment reported that the risks of PDR were increased significantly after more than ten years of diabetes, which corroborates our finding that the vast majority of extreme grades were in the longest-duration group[14]. Such convergent evidence indicates that, even with disparities in healthcare facilities and minimum metabolic control, the duration of diabetes is a strong and reproducible risk factor of retinal disease severity[15]. The prevalence of our DR (about two-thirds of the participants) is not inferior to that reported in recent clinic-based studies in Asia (prevalence is typically between 45 per cent and 70 per cent, based on the recruitment setting, the glycemic control, and access to screening)[16]. In tertiary ophthalmology clinics, studies tend to give a high prevalence as compared to community screening programs since r referral might be in part the basis of our somewhat high rates of DR and advanced retinopathy. Notably, even among a clinic-enriched sample, the gradient is the same among the duration groups, which enhances the internal validity of duration as a severity determinant[17]. Pathophysiologic ally, duration is defined as exposure to hyperglycemia over time and exposure to metabolic and inflammatory cascades. Richness of diabetes over time facilitates deposition of end-products of advanced glycation, oxidative stress, endothelial dysfunction, and capillary non-perfusion that initiates the up-regulation of VEGF to cause neovascularization in PDR[18]. Our cohort showed a high correlation (Spearman r ≈0.69), which is consistent with the recent reports of moderate-to-strong correlations between length of time and DR grade with the use of standardised grading systems[19]. Although duration is not modifiable, it operationalises cumulative risk and, thus, can be clinically addressed by stratifying screening frequency and prioritizing retina services[20]. Our results indicate that their service delivery would endorse increased screening

following 5 years of known diabetes and close monitoring after 10 years. Modern evidence indicates that organised periodical retinal screening would help to decrease late presentation and avoidable blindness by timely laser photocoagulation, intravitreal anti-VEGF therapy, and macular oedema management. Since in the resource-starved settings, many patients will only show up once their vision is defective, a specific education about the insidiousness of the early DR and the geometric rise of the risk of the disease over time is necessary.

Limitations: The shortcoming of this study was its cross-sectional design, which does not allow for testing the effects of diabetic retinopathy over time. The observed associations could have been subject to single-centre sampling and failure to control confounding factors like the level of HbA1c, hypertension, and lipid profile.

CONCLUSION

There is a significant and strong correlation between the severity of diabetic retinal changes and the duration of diabetes mellitus. The patients who have had a more prolonged disease, especially greater than ten years, are far more prone to progressive retinopathy, which highlights the importance of early diagnosis and consistent and duration-based retinal screening methods.

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Concept & Design of Study: Shafqat Ali Shah
Drafting: Muhammad Bilal
Data Analysis: Muhammad Tariq,
Critical Review: Muhammad Bilal
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