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Frequency and Pattern of Retinopathy in Newly Diagnosed Type 2 Diabetic Patients

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ABSTRACT

Diabetic Retinopathy (DR) is among the leading causes of blindness in adults, particularly in individuals with type 2 Diabetes Mellitus (T2DM). Diabetic Retinopathy (DR) is one of the commonest reasons for blindness in the adult population especially in the type 2 Diabetes Mellitus (T2DM) population. It is important to detect and manage these diseases early to prevent vision loss. **Objective:** To evaluate the prevalence and pattern and the associated risk factors of Diabetic Retinopathy (DR) in newly diagnosed T2DM. **Methods:** The study design was descriptive cross-sectional which was conducted at Arif Memorial Teaching Hospital/Rashid Latif Medical College, Lahore. The study enrolled 300 participants (age≥35 years) with newly diagnosed T2DM. After a general and systemic examination, data were collected, including laboratory data with blood glucose, HbA1c, serum cholesterol, and serum creatinine. Retinopathy grading was performed by fundoscopic examination into background, pre-proliferative and proliferative grades. The statistical analysis was performed in SPSS version 23.0. **Results:** In newly diagnosed T2DM, the overall prevalence of DR was 22% (66/300). Among cases of DR, 78% were NPDR, and 22% were PDR. Most of the NPDR was moderate (43%), mild (35%) and severe (22%). DR risk factors were HbA1c > 8% (OR: 3.5, $p < 0.001$) and hypertension (65% DR, $p < 0.05$). DR was not significantly correlated with BMI and other biochemical markers including serum creatinine. **Conclusions:** The prevalence of diabetic retinopathy was notably high among newly diagnosed T2DM patients, with HbA1c levels and hypertension identified as significant risk factors.

INTRODUCTION

Diabetic Retinopathy (DR) is one of the first diseases associated with diabetes, being one of its most serious complications and also ranking as the leading cause of preventable blindness worldwide. It is common in patients that have type 2 diabetes mellitus (T2DM) which is characterized by insulin resistance and relative insulin deficiency [1]. Diabetic retinopathy is becoming a progressively more prevalent health problem as the number of type 2 diabetic patients worldwide increases. It usually develops quietly without initial signs, so it is important every person goes for an eye examination frequently for early identification and management. The major stages of diabetic retinopathy include non-proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR), which is the more advanced stage of DR associated with the highest risk of vision loss [2, 3]. DR is highly prevalent in type 2 diabetes and about a third of patients with type 2 diabetes will develop diagnosis of retinopathy during their lifetime, according to some studies. A multitude of factors, including diabetes duration, poor glycemic control, hypertension, and abnormalities in lipid levels, increases the risk of DR [4]. Signs of retinopathy are detectable even in newly diagnosed diabetes patients, which indicates the importance of uncontrolled blood glucose for the development of the condition. So, early screening is important to stop the development of DR and the risk of vision loss [5, 6]. Chronic hyperglycemia (elevated levels of glucose in the blood) is pathogenesis of diabetic retinopathy because it can result in vascular damage in the

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retina [7]. The injury leads to endothelial dysfunction, heightened vascular permeability, and microaneurysm formation. NPDR begins with microaneurysms, retinal hemorrhages and exudates [8]. With worsening disease, pre-proliferative changes including venous beading and cotton wool spots. PDR occurs when DR progresses to its most advanced stage, which is readily identified by the presence of new and fragile blood vessels that will cause vitreous hemorrhage, retinal detachment and blindness without treatment [9, 10]. Since many cases of diabetic retinopathy are asymptomatic in early stages, regular eye examinations are crucial, particularly for individuals newly diagnosed with type 2 diabetes. Identification in the early stages of the disease greatly minimizes the risk of significant vision loss, as maximum benefit from intervention such as laser therapy or anti-VEGF injection or vitrectomy is obtained when the disease is first diagnosed. Hence the frequency and pattern of diabetic retinopathy in first diagnosed patients need to appreciate so that early and proper management can be done [11]. The early identification of diabetic retinopathy (DR) in newly diagnosed T2DM patients is crucial, as DR may be asymptomatic in the initial stages but can progress rapidly if left undetected. Screening at the time of diagnosis provides a critical opportunity to identify patients who already have signs of DR, emphasizing the need for early intervention. This study focuses on newly diagnosed patients to underline the importance of routine DR screening at the time of diabetes diagnosis, which is often overlooked in clinical practice.

Diabetic Retinopathy (DR) is a leading cause of preventable blindness in adults, particularly among individuals with Type 2 Diabetes Mellitus (T2DM), and its asymptomatic early progression makes timely detection critically important yet frequently neglected in clinical practice. While global literature documents varying DR prevalence rates ranging from 20–30% in T2DM patients, there remains a significant gap in locally applicable evidence from Pakistani tertiary care settings regarding the frequency, pattern, and associated risk factors of DR specifically at the time of initial diabetes diagnosis — a window of opportunity that is often overlooked. The absence of standardized early screening protocols, compounded by inconsistencies in reported risk factor associations across different geographic and demographic populations, further underscores the need for institution-level data to guide evidence-based clinical decisions. This study therefore aimed to evaluate the prevalence and pattern of DR and identify its associated risk factors, including glycemic control, hypertension, and dyslipidemia, in newly diagnosed T2DM patients presenting to a tertiary care hospital in Lahore, Pakistan.

METHODS

This descriptive, cross-sectional investigation was conducted at Arif Memorial Teaching Hospital/Rashid Latif Medical College, Lahore from November 2023 to April 2024. The formula used for calculating sample size is: n= Z2·p·(1–p)/ E2. The required sample size was approximately 300 participants to estimate the prevalence of diabetic retinopathy in newly diagnosed type 2 diabetic patients, with a z=95% confidence level, P=0.15% and a E=5% margin of error [12]. The total number of participants was who had newly acquired a diagnosis of type 2 diabetes within the past month and attended diabetic clinics at these esteemed facilities were recruited for participation in the investigation. The investigation recruited patients ranging in age from 30 to 70 years who had not previously received a diagnosis of type 2 diabetes or treatment via prescription medication. Exclusion criteria encompassed individuals with prior identification of type 2 diabetes, type 1 diabetes, hypertension, preexisting retinal conditions including vasculitis and vascular occlusion, as well as sickle-cell retinopathy. Formal ethical approval for the probe was secured, and informed consent to take part was obtained from all participants. Structured forms were applied to collect data. The general and systemic examinations included weight, body mass index (BMI), blood pressure, and a monofilament assessment for neuropathy. Laboratory investigations included fasting and postprandial blood (samples were collected from vein using a sterile syringe), HbA1c, urine protein, serum cholesterol and serum creatinine. Diabetic retinopathy was categorized as follows: Mild Non-Proliferative Diabetic Retinopathy (NPDR) by the presence of microaneurysms. Moderate and severe NPDR included intraretinal hemorrhages, venous beading, and microvascular abnormalities based on the ETDRS criteria. Proliferative Diabetic Retinopathy (PDR) was identified by the presence of neovascularization or vitreous hemorrhage. Fasting and postprandial blood glucose were measured using the enzymatic glucose oxidase method. HbA1c was analyzed via High-Performance Liquid Chromatography (HPLC). Urine protein was assessed using the dipstick method, while serum cholesterol and creatinine were measured through enzymatic colorimetric assays and the Jaffe reaction, respectively. Referrals to an ophthalmologist for examination of visual acuity and slit-lamp examination were also provided to participants. Retinopathy type (background, pre-proliferative, and proliferative) was based on fundoscopic findings. Statistical analysis was carried out using SPSS version 23.0. Student ś t-test was used for continuous variables like age, HbA1c, cholesterol level etc., and chi-square test was applied for categorical

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data like presence of retinopathy. This study design is good for investigating the association between diabetic retinopathy and newly diagnosed diabetes, as well as searching for associated factors including glycemic control, hypertension, and BMI. Informed consent was obtained from all participants, and approval from the Institutional Review Board (IRB) was secured for the study. This study was approved by institutional review board IRB00010673 Rashid Latif Medical College, Lahore.

RESULTS

The study analyzed n=300 newly diagnosed Type 2 diabetes through the age group of 30-70 years (mean: 52 ± 8.2 years) were included in the study, majority being men of 55 %. Mean HbA1c was 9.4 ± 1.2%, indicating poor glycemic control, and fast plasma glucose was 190 ± 25 mg/dl on average. Although blood pressure levels were borderline hypertensive (systolic: 138 ± 15 mmHg, diastolic: 85 ± 10 mmHg), and serum cholesterol (210 ± 30 mg/dl) was elevated indicating dyslipidemia. Renal function was preserved, with serum creatinine levels within normal limits (0.9 ± 0.2 mg/dl). This underlines the importance of early treatment of glycemia, cardiovascular and lipid parameters to avert sequelae see table 1.

Table 1: Demographics and Clinical Characteristics

Variables	Value (Mean ± SD)
Age Range (Years)	30-70
Mean Age (Years)	52 ± 8.2
Gender Distribution Frequency (%)	
Males	165 (55%)
Females	135 (45%)
HbA1c	9.4 ± 1.2
Blood Pressure (mmHg) (Mean ± SD)	
Systolic	138 ± 15
Diastolic	85 ± 10
Fasting Plasma Glucose (mg/dL)	190 ± 25
Serum Creatinine (mg/dL)	0.9 ± 0.2
Serum Cholesterol (mg/dL)	210 ± 30

The overall prevalence of DR was 22% (66/300) in the study among 300 newly diagnosed Type 2 diabetic patients. Out of all cases of DR, 78% (51/66) of the cases were NPDR and 22% (15/66) were PDR. They are highlights of the fact that NPDR is the most prevalent changes of DR in newly diagnosed diabetic patients, but a considerable number present with the more advanced form of DR-PDR, which indicates the screening and management should be started much before and before the gross manifestation of disease (Table 2).

Table 2: Frequency and Types of Diabetic Retinopathy included Diabetic retinopathy (DR), Non-proliferative DR and proliferative DR

Total Cases	Types of Diabetic Retinopathy		
	Prevalence of DR Frequency (%)	NPDR (Non-Proliferative Diabetic Retinopathy) Frequency (%)	PDR (Proliferative Diabetic Retinopathy) Frequency (%)
300	66 (22%)	51 (78%)	15 (22%)

A comparison of DR vs No DR cases helped to identify a number of highly significant risk factors. The DR group also showed significantly higher HbA1c levels (10.2 ± 1.1% vs 8.9 ± 1.2%, $p < 0.001$), which is expected due to the close relation of poor glycemic control and development of DR. In addition, blood pressure readings also differed significantly, with DR patients having higher systolic (142 ± 10 mmHg vs 134 ± 12 mmHg, $p < 0.05$) and diastolic blood pressure (88 ± 8 mmHg vs 83 ± 9 mmHg, $p < 0.05$) reflecting the potential role of hypertension in DR risk. Hyperglycemia proved to be significantly associated with diabetic retinopathy, as fasting plasma glucose levels were clearly higher among those with DR compared to the control group. Specifically, readings reached 200 ± 20 mg/dl for DR patients versus 185 ± 15 mg/dl for others, firmly establishing a link between raised blood sugar and retinopathy. Cholesterol issues may also bear responsibility for increasing the likelihood of DR, since levels of this lipid measured 225 ± 25 mg/dl among those affected as opposed to 205 ± 20 mg/dl in individuals without the eye complication. Nonetheless, variations in BMI and kidney function as gauged by serum creatinine did not reliably differentiate the two clusters herein. This suggests that factors like weight and renal health may exert limited sway over whether retinopathy surfaces amongst a given set of people with diabetes see table 3.

Table 3: Comparison of Risk Factors Between DR and No DR Cases

Risk Factor	DR Cases (n=66) (Mean ± SD)	DR Cases (n=66) (Mean ± SD)	p-value
HBA1C (%)	10.2 ± 1.1	8.9 ± 1.2	< 0.001 (Significant)
BMI (Kg/m^2)	31.2 ± 3.5	30.5 ± 3.0	> 0.05 (Not Significant)
Systolic BP (mmHg)	142 ± 10	134 ± 12	< 0.05 (Significant)
Diastolic BP (mmHg)	88 ± 8	83 ± 9	< 0.05 (Significant)
Fasting Plasma Glucose (mg/dL)	200 ± 20	185 ± 15	< 0.001 (Significant)
Serum Creatinine (mg/dL)	1.0 ± 0.3	0.9 ± 0.2	> 0.05 (Not Significant)
Serum Cholesterol (mg/dL)	225 ± 25	205 ± 20	< 0.05 (Significant)

Regarding Diabetic Retinopathy (DR) pattern among the study subjects, we found that the most DR was NPDR which constituted 78% of all DR cases. Among patients with

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NPDR, severity distribution indicated that moderate NPDR was the most prevalent, accounting for 43% of patients. Mild NPDR followed that, with 35% of cases, whereas severe NPDR was the simplest in only 22% of patients. The majority of patients with DR have NPDR but, in fact, the moderate NPDR form has dominated over the mild and severe forms [15]. The order with the majority of them classified as very mild NPDR showed the importance of screening and regulating NPDR early on so it does not reach worse stages (like proliferative diabetic retinopathy PDR). Statistical analysis The statistical analysis was performed with descriptive statistics that gave the frequency and percentage of each NPDR severity level (Table 4).

Table 4: Diabetic Retinopathy Pattern included moderate NPDR, Mild NPDR, severe NPDR

Types of Diabetic Retinopathy	
Severity of NPDR	**Frequency (%)**
Mild NPDR	35%
Moderate NPDR	43%
Severe NPDR	22%

DISCUSSION

Diabetic Retinopathy (DR) continues to be a common and important complication of diabetes but has not been systematically evaluated in DMT2 [13]. Understanding the early stages of DR, the frequency, pattern, and risk factors of DR are critical, and the findings of this study will help in planning interventions to prevent vision impairment. The following section describes the findings in detail and compares them with the existing literature for a larger frame of reference regarding clinical implications [14, 15]. Overall, the prevalence of diabetic retinopathy (DR) was 22% in a newly diagnosed cohort of Type 2 diabetic patients in this study. This finding is similar to other studies on prevalence of DR on newly diagnosed diabetic patients, which reported varying rates of DR with a general range of 20–30%. The previous study showed DR prevalence to be 22.4% amongst patients diagnosed with Type 2 diabetes [16]. Nonetheless, DR prevalence can be significantly dissimilar in another population depending on genetic factors, socioeconomic status, and the presence of other chronic diseases for example hypertension and dyslipidemia. This cohort had a relatively high DR prevalence emphasizing how important regular retinal screening is for newly diagnosed diabetics to help detect DR at an early-stage and hopefully prevent future irreversible vision loss [17, 18]. It also assessed types of DR pattern including distribution NPDR and PDR. The results showed 78% of DR was NPDR, of which mild NPDR (35%) and moderate NPDR (43%) was the most common, while 22% of patients had severe NPDR. In DR cases, 22% had proliferative DR (PDR) [19]. It fitted with what is often seen in the literature: Proliferative Diabetic Retinopathy (PDR) is seen less often early on in diabetes than Non-Proliferative Diabetic Retinopathy (NPDR). For example, DRS and ETDRS studies demonstrate that most people with DR are diagnosed with NPDR, and only a limited number of these persons proceed to PDR, which correlates with a greater chance of serious vision loss [20]. In accordance with previous studies like in Beijing Eye Study, moderate NPDR was also the predominant form of DR among newly diagnosed diabetic patients in this study. Notably, 22% of patients in the current study had severe NPDR, which is worrisome, because severe NPDR can rapidly progress to PDR, especially in the absence of early treatment. This emphasizes the essential need for early diagnosis and proper responsive treatment to reduce subsequent advancement to PDR and consequences such as diabetic macular edema (DME). This study was agreed with the previous study [21, 22]. The present study explored the various risk factors that are associated with developing DR in newly diagnosed Type 2 diabetic patients using a retrospective, cross-sectional study clinic population. Examples are uncontrolled diabetes (HbA1c > 8%), hypertension, increased serum cholesterol, and so forth. Glycemic Control (HbA1c). The DR group had a HbA1c that was markedly higher (10.2 ± 1.1%) than in the No DR group (8.9 ± 1.2%). This finding is also consistent with previous studies that have reported to close associations between glycemic control and DR 17-21, and have shown that improved glycemic control significantly reduces the risk of DR progression in patients with type 1 diabetes in the DCCT (Diabetes Control and Complications Trial) and in patients with type 2 diabetes in the UKPDS (United Kingdom Prospective Diabetes Study). In fact, the results of the current study highlight the importance of keeping HbA1c below 7% to prevent DR [23]. The study found that a whopping 65% of those with DR had hypertension, nearly 20% higher than the group without retinopathy who registered at 45% with high blood pressure. This research reinforces existing evidence that hypertension notably drives the development and progression of DR. Two seminal studies, ETDRS and UKPDS, similarly emphasized that keeping vascular stress low via blood pressure control is key to stunting the deterioration of retinal health. This study aligned with the previous study when uncontrolled, hypertension exacerbates damage by ratcheting up strain on the delicate vasculature of the retina, leading to worsening of both non-proliferative and proliferative stages [24]. Elevated cholesterol levels and impaired endothelial function likely contributed to the worse microvascular changes seen in those patients with diabetic retinopathy. Serum cholesterol was markedly higher at an average of 225 compared to 205 milligrams per deciliter for those without the condition. This finding aligns with the well-known ARIC study that identified dyslipidemia

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as an independent risk factor for both developing and worsening diabetic eye disease. While body mass index and kidney function as assessed by serum creatinine did not notably differ, other research has connected obesity defined as a BMI over 30kg to increased risk of retinopathy. Some projects have also linked deteriorating renal health, especially at advanced stages, to a heightened chance of retinal complications, though no significant link was observed in this group. Adiposity may weakly impact the eyes, but the association here was tenuous [25]. Moreover, the pattern observed in this cohort, with a sizable portion already presenting with moderate no proliferative diabetic retinopathy, implies that timely intervention can prevent worsening to more severe stages like proliferative diabetic retinopathy. The findings bolster recommendations from the United Kingdom Perspective Diabetes Study and Diabetes Control and Complications trial stressing rigorous glycemic control as a pivotal step in stalling or delaying the onset and development of diabetic retinopathy.

This study was constrained by its cross-sectional, single-center design at one institution in Lahore, a relatively short six-month data collection period, and the exclusion of patients with pre-existing hypertension, which may have underestimated the true burden of DR and limited the generalizability of findings to the broader Pakistani diabetic population. Additionally, the absence of longitudinal follow-up precluded any assessment of DR progression or the long-term impact of identified risk factors on visual outcomes. Future studies should adopt multicenter, longitudinal designs encompassing diverse geographic and socioeconomic settings in Pakistan, with larger sample sizes and extended follow-up periods, to better characterize DR progression patterns and evaluate the effectiveness of early screening interventions, particularly in resource-limited primary healthcare settings where diabetes often goes undetected until complications arise.

CONCLUSIONS

These findings emphasized the need for early detection and management of glycemic control and hypertension in T2DM patients to prevent DR progression.

Authors' Contribution

Conceptualization: FM
Methodology: SAM
Formal analysis: MF
Writing and Drafting: MAA, FM, SAM
Review and Editing: MAA, FM, SAM

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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