MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.124.129

Prevalence of Ocular Abnormalities in Patients of Diabetes Mellitus in Central India

[1]Sonal Agrawal, [2]Jitendra Manghani, [3]Anjali Dubey and [4]Piyusha Mahashabde

[1]Department of Ophthalmology, GMERS Medical College, Dharpur-Patan, Gujarat, India
[2]Department of Ophthalmology, L N Medical college, Bhopal, Madhya Pradesh, India
[3]Department of Pathology, Mahaveer Institute of Medical Science and Research, Bhopal, Madhya Pradesh, India
[4]Department of Community Medicine, Government Medical College, Ratlam, Madhya Pradesh, India

ABSTRACT

Diabetes mellitus is classified as a lifestyle disorder that necessitates a collaborative effort involving the patient, their family and the healthcare team. Among young adults in the working age group, retinopathy stands out as the primary cause of new-onset blindness. As a result, regular screening of patients with diabetes for the early detection of retinal disease holds significant importance. The assessment aims to determine the prevalence of diabetic retinopathy (DR) as a means to raise awareness about preventable blindness in individuals with diabetes. This was a hospital-based, observational, cross-sectional study. It focused on evaluating visual disorders in a sample of 575 patients who attended Ophthalmology OPD of a Medical College in Central India. The assessment included visual acuity estimation, color vision assessment, slit lamp examination, intraocular pressure measurement, retinoscopy, fundus examination and visual field analysis. Among the posterior segment abnormalities contributing to defective vision, DR was identified in 108 patients (18.78%), while combined retinopathy is observed in 12 patients (2.09%). The most prevalent systemic disease associated with these visual disorders is hypertension, affecting 242 patients (42.09%) in the study population. DR is the predominant manifestation of diabetes mellitus affecting the posterior segment of the eye. The primary objective should be to prevent the development of sight-threatening retinopathy. This can be achieved through the effective management of hyperglycemia and hypertension, along with regular annual screening fundus examinations for all patients. These measures are crucial in ensuring early detection and timely intervention to minimize the risk of vision loss associated with DR.

OPEN ACCESS

Key Words
Diabetic retinopathy, blindness, ophthalmology, India

Corresponding Author
Piyusha Mahashabde
Department of Community Medicine, Government Medical College, Ratlam, Madhya Pradesh, India

Received: 9 May 2023
Accepted: 16 May 2023
Published: 17 June 2023

Citation: Sonal Agrawal, Jitendra Manghani, Anjali Dubey and Piyusha Mahashabde, 2023. Prevalence of Ocular Abnormalities in Patients of Diabetes Mellitus in Central India. Res. J. Med. Sci., 17: 124-129, doi: 10.59218/makrjms.2023.124.129

INTRODUCTION

Environmental and lifestyle factors, when combined with genetic predisposition, contribute to the emergence of the interconnected "dual epidemic" of obesity and diabetes on a global scale. The worldwide prevalence of diabetes has been steadily increasing over the years. In 1995, it was estimated that there were approximately 19.4 million individuals with diabetes worldwide. However, projections indicate that this number is expected to rise significantly to nearly 80 million by the year 2030[1].

Due to its impact on microvascular health, diabetes mellitus has emerged as the primary cause of new-onset blindness among individuals within the working age group[2]. The microvascular pathology associated with diabetes contributes to the development of vision impairment and highlights the importance of effective management and early detection of diabetic retinopathy to prevent vision loss in this population.

The incidence of blindness is significantly higher in individuals with diabetes compared to the general population, with a reported rate 25 times greater[3]. A recent systematic review conducted by Brar *et al*.[4] reported the prevalence of diabetic retinopathy (DR) to be 17.44% in urban populations and 14% in rural populations of India[4]. Diabetic retinopathy (DR) emerges as the most prevalent complication in individuals with Type 1 diabetes, with nearly all patients exhibiting some degree of retinopathy within 15-20 years of diagnosis. Similarly, over 60% of individuals with Type 2 diabetes will present with signs of retinopathy within the same time frame. These statistics emphasize the importance of regular monitoring and timely intervention to manage and prevent the progression of diabetic retinopathy in individuals with both Type 1 and 2 diabetes.

Visual impairment resulting from retinopathy exerts a substantial impact on the psychological and social well-being of affected individuals. Therefore, regular screening of patients with diabetes for the early detection and monitoring of retinal diseases is crucial.

The objective of our study was to evaluate the prevalence of DR in Central India. By doing so, we aimed to raise awareness about the avoidable blindness that can occur among diabetic patients. Our study also sought to guide patients towards additional evaluation, treatment and follow-up measures to address any identified ocular complications. The task of preventive care for diabetes mellitus, particularly in relation to managing stress and preventing ocular complications, can be demanding given the nature of this lifestyle disorder. However, it is crucial to prioritize these efforts to ensure quality vision and overall well-being for individuals with diabetes.

MATERIALS AND METHODS

The present study was conducted as a prospective cross-sectional study. It included a study population of 575 diabetic patients who attended the Ophthalmology OPD at a Medical College in Central India. Ethical approval was obtained from the Institutional Ethical Committee and the data collection period lasted for 6 months. Informed consent was obtained from all eligible individuals who met the inclusion criteria. The data collection process utilized a standardized proforma to systematically collect the required information. Throughout the study, adherence to standard ethical principles, as outlined in World Medical Association[5] and Mathur[6], was ensured.

The inclusion criteria for this study involved selecting 575 diabetic patients within the age range of 30 and 70 years. On the other hand, the exclusion criteria included patients with acute eye injuries, secondary causes of glaucoma, complications arising from the lens and those who had undergone previous surgeries such as keratoplasty or retinal detachment (RD) surgery. These criteria were applied to ensure a specific and focused study population that would allow for the investigation of diabetic eye-related issues without confounding factors from other eye conditions or surgical interventions.

Distant visual acuity for each eye was measured individually using a standard Snellen's chart, properly illuminated at a distance of 6 m. An anterior segment examination was performed using a torch to identify any signs of conjunctival and corneal diseases. A slit lamp examination was carried out to further assess the cornea, specifically examining the position, depth and location of any corneal abnormalities, as well as identifying the presence of lens opacities. These examinations allowed for a comprehensive evaluation of the anterior segment of the eye.

The Schiotz indentation tonometer was utilized to measure the intraocular pressure of the anesthetized cornea. Visual field analysis was conducted using an automated static perimeter for selected cases. Retinoscopy was performed after pupillary dilatation to determine the refractive status of the eye.

Fundus examination was carried out using a direct ophthalmoscope. In selected cases, gonioscopy was performed to determine the type of angle in the anterior chamber of the eye providing information about the drainage angle and assessing for any abnormalities or signs of glaucoma.

The study utilized the definitions for visual impairment and early treatment of diabetic retinopathy (DR) as outlined by the World Health Organization (WHO), in Flynn *et al*.[7] and Robison *et al*.[8]. Blood samples were collected from the participants and sent to the Biochemical Laboratory and were analyzed to measure the levels of blood sugar and serum cholesterol.

RESULTS

Among the 575 diabetic patients who were examined, there were 306 men and 269 women, as indicated in Table 1. Among these patients, 165 individuals (61 women and 104 men) were found to have choroidal and vitreoretinal lesions, resulting in a prevalence rate of 28.70%. Retinopathy was identified as the most common retinal disease, with a prevalence rate of 18.78%, as shown in Table 2. Within the retinopathy cases, the prevalence rates of non-proliferative diabetic retinopathy (NPDR), proliferative diabetic retinopathy (PDR) and clinically significant macular edema (CSME) were found to be 14.26, 4.52 and 3.48%, respectively, as presented in Table 3.

The prevalence of retinopathy was observed to increase with the duration of diabetes, as depicted in Table 4. As the duration of diabetes increased, the percentage of cases with retinopathy also increased.

Among the subjects with diabetic retinopathy (DR), 63.89% were found to have associated high blood pressure (BP), as indicated in Table 5. Furthermore, among the patients with DR, a majority of them experienced visual impairment, while 37.96% exhibited color vision defects and 0.93% had elevated intraocular pressure, as shown in Table 6. These findings highlight the significant impact of DR on visual function and associated ocular complications in diabetic patients.

Table 1: Age and gender wise distribution of study population

Age (years)	Male	Female	Total
30-40	17	35	52
41-50	61	48	109
51-60	99	96	195
61-70	129	90	219
Total	306	269	575

Table 2: Posterior segment abnormalities in study population

Age (years)	Male	Female	Total	Prevalence
Vitreous hemorrhage	8	3	11	1.910
Vitreous opacities	2	1	3	0.520
Diabetic retinopathy	69	39	108	18.78
Combined retinopathy	6	6	12	2.090
Branch retinal vein occlusion	1	0	1	0.170
Branch retinal artery occlusion	3	0	3	0.520
Macular hole	1	3	4	0.700
Retinal detachment	5	1	6	1.040
Chorioretinitis	1	1	2	0.350
Optic atrophy	5	1	6	1.040
Age-related macular degeneration	3	6	9	1.570
Total	104	61	165	28.70

Table 3: Distribution of stages of DR in study participants

Stage of DR	No. of patients	Prevalence
Non-proliferative DR (mild)	25	4.35
Non-proliferative DR (moderate)	44	7.65
Non-proliferative DR (severe)	13	2.26
Proliferative DR	26	4.52
Total	108	18.78
DR with Clinically significant macular edema	20	3.48

Table 4: Distribution of DR according to duration of diabetes mellitus

Diabetes Duration	No. of patients	DR	Prevalence
0-5	186	15	8.06
5-10	150	28	18.67
10-15	127	29	22.83
15-20	113	37	32.74

Table 5: Risk factors in patients with DR

Risk factors	Male	Female	Total	Percentage (n = 108)
BMI>25	1	3	4	3.70
Sedentary lefstyle	3	23	26	24.07
History of kidney disease	2	0	2	1.85
High blood pressure	40	29	69	63.89
High blood sugar	23	26	49	45.37
High levels of lipids	8	15	23	21.30
Anemia	12	17	29	26.85

Table 6: Visual functions in patients with DR

Ocular changes	No. of patients	Percentage (n = 108)
Low vision	74	68.52
Blindness	35	32.41
Normal colour vision	67	62.04
Color vision defect	41	37.96
IOP (normal)	107	99.07
IOP (elevated)	1	0.93
Non-proliferative DR	82	75.93
Proliferative DR	26	24.07
DR with clinically significant macular edema	20	18.52
Retinal detachment	6	5.56
Vitreous hemorrhage	12	11.11

DISCUSSIONS

The 575 diabetic patients who were selected for this study underwent a comprehensive examination to thoroughly assess visual disorders.

Retinopathy was identified as the most prevalent retinal disease that causes visual impairment in individuals with diabetes mellitus. Extensive prospective clinical studies have demonstrated a robust association between glycemic control and the incidence and progression of retinopathy. One of the underlying mechanisms in the pathogenesis of retinopathy involves the accumulation of sorbitol, which is initiated by aldose reductase. This accumulation of sorbitol leads to the selective degeneration of mural cells in the retinal capillaries. This process contributes to the development and progression of retinopathy in diabetic patients[9]. These findings highlight the importance of glycemic control and the understanding of the molecular mechanisms involved in retinopathy. Effective management of blood glucose levels is crucial in preventing or delaying the onset of sight-threatening retinopathy and minimizing the associated visual impairment in individuals with diabetes mellitus. The polyol pathway also plays a role in the development of abnormal thickening of the basement membrane, leading to the closure of retinal vessels. Additionally, increased growth hormone levels can result in plasma protein abnormalities, leading to increased plasma viscosity and reduced retinal blood flow. Retinal hypoxia occurs due to decreased oxygen release from hemoglobin, which is associated with factors such as decreased red blood cell 2,3-diphosphoglycerate, increased hemoglobin A1 and elevated blood lipids[10].

DR-NPDR is characterized by retinal small vessel occlusion and increased permeability, leading to the loss of the blood-retinal barrier. Fundus changes include microaneurysms, hemorrhages, cotton wool spots, intraretinal microvascular abnormalities and venous abnormalities. Cotton wool spots often indicate impending retinal neovascularization. In PDR, neovascularization, intra/preretinal hemorrhages, scarring and retinal detachment can occur[11,12]. The revalence of DR in our study aligns closely with the prevalence reported in the Chennai Urban Population Study (CUPS)[13]. Additionally, the prevalence of clinically significant macular edema (CSME) in our study was determined to be 3.48%, a rate consistent with findings from studies conducted by Rema et al. in India[14].

The retinal changes observed in DR are closely intertwined with the systemic circulation and their severity demonstrates a significant correlation with the development of systemic complications associated with hypertension as well as overall survival rates[15]. Acute increases in blood pressure elicit a vasospastic reaction, while chronic elevation of blood pressure leads to an arteriosclerotic response. Consequently, pathological ocular manifestations manifest as optic nerve edema, cotton wool spots, hemorrhage, intraretinal lipid deposition in a macular star configuration and focal infarcts[16].

The progression of retinal changes in diabetic retinopathy can be effectively halted through the administration of antihypertensive medications. In diabetic patients, vitreous hemorrhage, occurring in approximately 2% of cases, results from neovascular growth and the subsequent contraction of fibrovascular tissue. This hemorrhage fills the subvitreal space, obstructing the view of the retina and typically takes weeks to months to clear[17]. Retinal detachment, accounting for approximately 1% of cases, occurs when the hypoxic retina releases an angiogenic factor that triggers neovascularization. In proliferative diabetic retinopathy (PDR), contractile membranes form across the retina and subsequent shrinkage of fibroglial tissue leads to tractional retinal detachment[18]. Treatment approaches aim to reduce traction and may involve procedures such as banding, buckling, scleral resection, or vitrectomy.

Visual impairment in individuals with DR can be attributed to various factors including vitreous hemorrhage, retinal detachment, macular edema, refractive changes, color vision defects and cataract. These conditions collectively contribute to a significant visual impairment[19]. Notably, the prevalence of legal blindness among diabetic patients increases with advancing age, mirroring findings from the Wisconsin Epidemiologic Study of DR[19]. It is worth mentioning

that color vision defects, affecting 36 subjects, can manifest even before the vascular retinopathy becomes detectable through ophthalmoscopic examination[19]. Additionally, it is important to note that elevated intraocular pressure, observed in one subject, represents a complication associated with proliferative diabetic retinopathy (PDR)[20].

The incidence of DR exhibits a positive correlation with the duration of hyperglycemia in patients. Specifically, the prevalence of DR increases from 8% among individuals with a diabetes duration of 0-5 years to 32% among those with a duration of 15-20 years. These findings align with previous studies conducted by Klein *et al*.[21]. In our study, we observed that poor control of diabetic status in the participants was associated with the presence of DR. Several case-control studies have reported similar associations between suboptimal diabetes control and the development of DR[22].

The significance of strict glycemic control and blood pressure (BP) management in preventing microvascular complications of diabetes mellitus has been substantiated by the Kumamoto study[23]. In our study, we found a prevalence of hypertension among diabetics to be 42%, a figure that aligns with findings from a study conducted in Thailand[24]. It has been observed that diabetic individuals with hypertension are more susceptible to developing severe retinopathy and macular edema, as well as experiencing a faster progression of these complications compared to diabetics without hypertension[25].

In the management of diabetic retinopathy, it is recommended to maintain the target blood pressure (BP) at the lowest feasible level. Elevated levels of serum lipids, including triglycerides (TG), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL), have been associated with the presence of extravasated lipid in the retina, which can contribute to vision loss[26]. Nephropathy, as indicated by the presence of microalbuminuria and proteinuria, serves as a risk factor for both the onset and progression of diabetic retinopathy. This association has been supported by findings from the Appropriate Blood Pressure Control in Diabetes Trial, emphasizing the importance of managing BP in diabetic individuals with nephropathy[27]. Furthermore, a low hematocrit level and hemoglobin level below 12 g dL^{-1} have been identified as risk factors for the development of proliferative diabetic retinopathy (PDR) and subsequent vision loss.

CONCLUSION

In our study, diabetic retinopathy (DR) emerged as the most prevalent retinal disease leading to visual impairment. To mitigate the progression of DR and preserve vision, it is recommended to undergo annual ocular screening procedures in conjunction with stringent management of blood glucose, blood pressure, serum lipid levels and hematocrit levels. By closely monitoring these parameters and implementing appropriate interventions, the advancement of DR can be reduced. As new therapeutic approaches for DR continue to emerge, it becomes crucial to gather and monitor updated epidemiological data. This data serves to evaluate the impact and effectiveness of these novel therapies in managing DR. By doing so, the preservation of vision can be achieved, thereby contributing to an improved quality of life for individuals affected by the condition.

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