ORIGINAL ARTICLE

# Vitreo-macular Interface Abnormalities in Diabetic and Non-Diabetic Patients Using Optical Coherence Tomography

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## ABSTRACT

**Purpose:** To study the frequency of vitreomacular interface abnormalities (VIAs) in diabetic and non-diabetic patients presenting in a tertiary care hospital.

**Study Design:** Comparative cross-sectional study.

**Place and Duration of Study:** Jinnah hospital, Lahore from May 2013 to June 2016.

**Methods:** The frequency of vitreomacular interface abnormalities (VIAs) was assessed among 278 patients, who presented in outpatient department of our hospital. Patients were categorized into diabetic and non-diabetic groups on the basis of hemoglobinHbA1c. Patients with altered macular reflex on slit lamp examination underwent spectral domain (SD) optical coherence tomography (OCT) of macula to determine VIAs.

**Results:** There were 278 patients in the study with mean age 59.7 ± 11.7(range: 40 – 65) years and male to female ratio of 1:1.06. Prevalence of VIAs was observed to be higher among diabetic patients than non-diabetics in all age groups (p-value < 0.05). Overall frequency of different VIAs was found to be 10.7% for epiretinal membrane, 6.4% for posterior vitreous detachment, 6.1% for macular edema/macular cyst, 4.3% for vitreomacular traction, 1.8% for full thickness macular holes and 0.71% for partial thickness macular holes. Macular edema/macular cystwas the most common. VIA was more commonly observed in diabetic patients (17.2%). Except for ERM, all lesions of VIAs were significantly more prevalent in females as compared to males.

**Conclusion:** VIAs are found in significantly larger number in diabetics compared to non-diabetic patients. Female gender with advancing age is associated with a higher frequency of VIAs.

**Key Words:** Vitreomacular interface abnormalities, optical coherence tomography, epiretinal membrane, vitreomacular traction.

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## INTRODUCTION

Vitreomacular interface abnormalities (VIAs) are most commonly seen in patients with diabetic retinopathy[1,2,3]. Apart from triggering diabetic macular edema, these lesions contribute to the development of advanced stages of diabetic retinopathy[4,5,6]. VIAs include epiretinal membrane (ERM), partial thickness macular hole (PTMH), full thickness macular hole (FTMH), vitreomacular traction (VMT), macular cyst or macular hole (MC/MH) and posterior vitreous detachment (PVD). Symptoms vary from mild metamorphopsia to severe visual deterioration. Lesions like PTMH and FTMH always result in visual

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deterioration, therefore the techniques that can diagnose their precursor lesions are very useful in clinical practice[7].

After the advent of ocular coherence tomography (OCT), VIAs have attracted significant clinical attention. Virgili et al have shown the value of Spectral-domain OCT (SD-OCT) for excellent visualization of VIAs which could potentially be missed on direct ophthalmoscopy or slit lamp biomicroscopy[8]. SD-OCT provides higher resolution and greater scanning speed than the time domain (TD)-OCT. Duker et al showed that SD-OCT has enabled ophthalmologists to visualize and monitor the vitreomacular interface with better accuracy and repeatability[9].

The rationale of the study was to find the reason for unexpected visual loss in patients with diabetic retinopathy. The objective was to compare frequency and pattern of various VIAs in diabetic and non-diabetic patients in our local population.

## MATERIAL AND METHODS

This comparative cross-sectional study was conducted at Department of Ophthalmology, Jinnah Hospital, Lahore, Pakistan from May 2016 to June 2019. The study was conducted after approval from Ethical Review Board of the same institution and adhered to the principles of ethical medical practice as laid down in Declaration of Helsinki 2011. Patients were recruited from outpatient department of Jinnah Hospital after obtaining informed written consent.

Patients of both genders and above 40 years of age were included in the study and divided into two groups: diabetics and non-diabetics on the basis of hemoglobin HbA1c levels. The diabetes mellitus was defined as HbA1c ≥ 6.2%. Patients with history of vitreoretinal surgery and retinal vascular disorders like retinal vein occlusion were excluded from the study. After taking detailed ophthalmic history, detailed ophthalmic examination was performed which included assessment of unaided and best corrected visual acuity, pupillary examination, anterior segment examination using slit lamp biomicroscope and intraocular pressure measurement using applanation tonometer. The pupils were pharmacologically dilated using 1% tropicamide and 1% cyclopentolate eye drops. Dilated fundus examination was performed using slit lamp biomicroscope with 90D and 66D lenses.

Patients with altered macular reflex on slit lamp bio-microscopy were referred for OCT test. Macular scans were acquired using standard 6×6 mm protocol on Cirrus HD-OCT 500 by Zeiss, USA. Presence of any VIA was recorded and categorized into ERM, PTMH, FTMH, PVD, VMT and MC/MH. Record of each patient including demographic data, ocular and OCT findings were recorded in a pre-designed proforma.

Data was analyzed using Statistical Package for Social Sciences (SPSS, IBM Statistics, Chicago, IL, USA version 23.0). Mean ± SD was calculated for numerical variables like age and duration of diabetes mellitus whereas frequencies and percentages were calculated for qualitative variables like gender and various VIAs. The statistical significance of differences between various numerical and qualitative variables was calculated using t-test and chi-square test respectively. The p-value < 0.05 was considered statistically significant.

## RESULTS

The study included 278 patients with mean age of 59.7 ± 11.7 (range: 40 – 65) years (Table 1). There were 135 males and 143 females in the study (Table 2). Among 278 patients, 151 were diabetics and 127 were non diabetics. The mean duration of diabetes mellitus was 12.3 ± 5.2 years with 55 patients diagnosed with diabetes mellitus within last 5 years and 96 patients had diabetes for more than 5 years.

Prevalence of VIAs was observed to be higher among diabetic patients (66 patients) than non-

**Table 1:** *Distribution of Patients in Different Age Groups.*

| Age (Years) | Diabetic n | Non-Diabetic n | Total n |
|---|---|---|---|
| 40-54 | 33 | 37 | 70 |
| 55-64 | 46 | 40 | 86 |
| >65 | 72 | 50 | 122 |
| Total | 151 | 127 | 278 |

n: Number of patients

**Table 2:** *Gender Distribution of Study Population.*

| | Diabetic n | Non-Diabetic n | Total n | P-value |
|---|---|---|---|---|
| Female | 81 | 54 | 135 | |
| Male | 70 | 73 | 143 | 0.071 |
| Total | 151 | 127 | 278 | |

n: Number of patients

**Table 3:** *Various vitreomacular interface abnormalities seen in diabetic and non-diabetic patients in different age groups.*

| VIA | Diabetic Patients (n) | | | | Non-Diabetics (n) | | | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | 45-54 | 55-64 | ≥65 | Total | 45-54 | 55-64 | ≥65 | Total | |
| ERM | 4 | 6 | 8 | 18 | 2 | 3 | 5 | 10 | 28 |
| PTMH | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 2 |
| FTMH | 0 | 2 | 1 | 3 | 0 | 1 | 1 | 2 | 5 |
| VMT | 1 | 3 | 3 | 7 | 1 | 2 | 2 | 5 | 12 |
| MC/ME | 7 | 8 | 11 | 26 | 2 | 2 | 2 | 6 | 32 |
| PVD | 3 | 4 | 4 | 11 | 3 | 2 | 3 | 8 | 19 |
| TOTAL | 16 | 23 | 27 | 66 | 8 | 11 | 13 | 32 | 98 |

n: Number of patients

diabetics (32 patients) in all age groups (Table 3). The frequency of VIAs increased with age (Table 3). Overall frequency of different VIAs was found to be 10.7% for epiretinal membrane, 6.4% for posterior vitreous detachment, 6.1% for macular edema/macular cyst, 4.3% for vitreomacular traction, 1.8% for full thickness macular holes and 0.71% for partial thickness macular holes. Macular edema/ macular cyst were the most common. VIAs were more commonly observed in diabetic patients (17.2%). Except for ERM, all lesions of VIAs were significantly more prevalent in females (Table 4).

**Table 4:** *Frequency of Various Vitreomacular Interface Abnormalities in Males and Females.*

| VIAs | Male | Female | Total |
|---|---|---|---|
| ERM | 20 | 8 | 28 |
| PTMH | 0 | 2 | 2 |
| FTMH | 1 | 4 | 5 |
| VMT | 4 | 8 | 12 |
| MC/ME | 14 | 18 | 32 |
| PVD | 8 | 11 | 19 |
| VIAs | 47 | 51 | 98 |

ERM: Epiretinal membrane
PTMH: Partial thickness macular hole
FTMH: Full thickness macular hole
VMT: Vitreomacular traction
MC/ ME: Macular cyst/ macular edema
PVD: Posterior vitreous detachment
VIAs: Vitreoretinal interface abnormalities

## DISCUSSION

Our study found frequency of various VIAs on SD-OCT in diabetic and non-diabetic patients who presented to us with altered macular reflex. Overall, the commonest VIA was ERM in this study. However, macular edema and macular cysts were the commonest VIAs in diabetic patients. We also observed that, except for ERM, all VIAs were significantly more prevalent in female patients. The prevalence of VIAs increased with advancing age of the patients.

OCT provides high resolution cross-sectional scans of retina that is used to identify pathological changes at vitreoretinal interface[7]. There are different conventional methods for assessment of retinal pathologies which include slit lamp bio-microscopy, indirect ophthalmoscopy, fluorescein angiography and fundus stereo-photography. SD-OCT is a new modality that allows excellent visualization of vitreomacular interface, thus enabling us to study the vitreomacular abnormalities with high precision[8]. The pathophysiology of most of the VIAs is based on changes in vitreous with age. With advancing age, vitreous liquifies and collapses, thus causing complete or incomplete posterior vitreous detachment. Incomplete posterior vitreous detachment is associated with abnormal vitreomacular adhesions, which can become symptomatic and can lead to the development of VIAs such as vitreomacular traction and an operculum[9]. Similarly, epiretinal membrane can lead to development of partial or full thickness macular hole and macular edema or cyst[9,10]. The symptoms of the patients can vary from metamorphopsia to severe visual deterioration. Furthermore, VIAs not only trigger other retinal pathologies like myopic tractional maculopathy but also contribute to the development of severe diabetic retinopathy[11,12].

Unlike the current study, which utilized SD-OCT for classification of various VIAs, previous studies have reported prevalence of various VIAs on the basis of clinical diagnosis made on clinical examination and/or grading of fundusphotograph[11,12,13,14]. However, Beaver Dam Eye Study, Handan Eye Study and Maastricht Study used OCT imaging to report high resolution images of vitreoretinal interface[16,17,18]. The Beaver Dam and Handan Eye studies did not compare prevalence of VIAs in diabetic and non-diabetic

patients[16,17]. Maastricht study calculated the prevalence of all VIAs and stratified them according to the age, sex and diabetics status[18].

In our study we observed prevalence of ERM to be 10.7%. This prevalence was higher in diabetic patients (6.4%) as compared with non-diabetics (3.5%). The prevalence of ERM was reported to be 6.1% and 3.4% in Maastricht and Handan studies respectively[16,18]. The Beaver study reported much higher prevalence of ERM (34.1%)[17]. All studies confirmed that the frequency of ERM increased with age. Our results are consistent with Maastricht study as we also found significantly higher prevalence of ERM in diabetics versus non-diabetics.

The frequency of vitreomacular traction was found to be 4.3% in this study which is in accordance with the results of the Maastricht study[18] (7.0%) but differ from the findings of Beaver Dam Study[17] (26%). An earlier study reported prevalence of VMT to be 23.9% in patients with diabetic macular edema which is significantly higher than our finding (4.3%)[15,19,20,21]. This implies that patients with diabetic macular edema have higher chances of developing vitreomacular tractions and should undergo OCT testing to check for macular pathology early in the course of the disease.

The frequency of macular hole in our study was found to be 1.79% with females affected 4 times more than males (2.69% versus 0.69%). Results of an earlier study showed prevalence of macular hole to be 0.5%. Similarly, we found prevalence of lamellar hole to be 0.71%, which is consistent with results of the Maastricht Study (0.9%) but less than the findings of the Beaver Dam study (3.6%)[17,18].

The frequency of macular edema, macular cyst and posterior vitreous detachment were found to be significantly higher in diabetic patients when compared to non-diabetics (p-value $< 0.05$). This shows that the suspicion for diagnosing VIAs should be kept high in diabetic patients and where needed, OCT imaging should be done to acquire high resolution images of the vitreomacular interface for early diagnosis of various macular pathologies.

The limitation of this study is the small number of patients and a larger study is required to be done to confirm the results in the general population.

## CONCLUSION

VIAs were found in significantly larger number in diabetics compared to non-diabetic patients and female gender with advancing age is associated with a higher frequency of VIAs. Optical coherence tomography proved to be a viable tool for the detection of various vitreomacular interface abnormalities.

## Ethical Approval

The study was approved by the Institutional review board/Ethical review board.

### Conflict of Interest

Authors declared no conflict of interest.

## Authors' Designation and Contribution

Uzma Hamza; Assistant Professor: *Study design, data collection, Critical analysis, Statistical analysis, Manuscript writing.*

Waqas Asghar; Medical Officer: *Data collection, Critical analysis, Statistical analysis, Manuscript writing.*

Qasim Lateef Chaudhry; Associate Professor: *Concept, Design, Statistical analysis, final review.*

Muhammad Hassaan Ali; Senior Registrar: Data collection, Statistical analysis, final review

Sana Jahangir; Vitreoretina fellow: *Data collection, analysis, final review.*

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