OCT Assessment of the Vitreoretinal Relationship in CSME

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Introduction

Macular oedema is a main cause of visual loss in patients with nonproliferative diabetic retinopathy (NPDR). It also commonly contributes to the visual loss in proliferative diabetic retinopathy (PDR). Diabetic macular oedema is mainly due to the breakdown of the inner blood retinal barrier. However, its pathogenesis is not clearly understood and several investigators have suggested that the vitreous might be involved in triggering macular oedema in diabetic retinopathy. In diabetic patients, histological and biochemical changes such as nonenzymatic glycation, cause an early aging of the vitreous. The role of the vitreo-macular junction in the development of CSME is still controversial although many clinical studies concluded that it probably had a causative effect. Consequently, vitrectomy has been proposed for management of CSME especially in cases with thickened, taut posterior hyaloid and vitreofoveal traction. Some studies have also suggested that vitrectomy may be beneficial for eyes with CSME even with normal looking posterior hyaloid and no posterior vitreous detachment.

Optical Coherence Tomography (OCT) is a relatively new diagnostic technique that enables a high resolution, cross sectional image of the retina to be obtained. It has become an important tool in the diagnosis of macular disorders. OCT has made it possible to better understand the vitreoretinal relationship at the macula.

It is however not established if there is a difference in the pathogenesis of diabetic macular edema in NPDR and PDR. Though logically the pathogenetic mechanisms (microaneurysm leakage, capillary segment leakage) may be the same, the role of vitreomacular interface changes in these group of eyes may be different. It is a known observation that patients with high risk PDR have a higher incidence of incomplete PVD than patients with NPDR and that incomplete PVD is the cause for vitreous hemorrhage and tractional retinal detachment in PDR. Thus it is hypothetical that the occurrence of overt vitreomacular traction or subtle incomplete vitreomacular vitreous separation is more common in PDR than NPDR. This study aims to verify this hypothesis.

Aim

To assess the vitreo retinal relationship in patients with CSME and study the differences in this relationship in patients with PDR and NPDR.

Materials and Methods

This was a retrospective analytical study of patients who attended the retina clinic of Chaithanya Eye Hospital between July 2006 and December 2006. 100 eyes of 70 patients with CSME were evaluated. The study group included both insulin dependent and non insulin dependent PDR and NPDR patients between the age of 40 and 80 years. Few patients had associated systemic diseases like hypertension, nephropathy and...
hypercholesteremia and were on medications. The
duration of diabetes ranged from 7 years to 33 years.
None of the patients in our study had undergone
previous focal laser or panretinal photocoagulation.
Such patients were excluded as these could interfere
with anatomic changes at the macula and additional
changes may not be solely due to disease manifestation.
Patients with CSME and cataract and uncooperative
patients in whom a clear OCT image was not recordable
were also excluded from the study. In such patients
study of the vitreous may be incomplete, with possibility
of missing subtle vitreo-retinal interface changes. A clear
OCT image was defined as a standard 5 mm line scan
passing through the foveal region and having a good
signal strength (5 and above).

All patients underwent the following tests– Visual acuity
estimation by Snellen’s visual acuity chart, dilated slit
lamp-90D examination, fundus fluorescein
angiography and optical coherence tomography
(Zeiss, Stratus-4 OCT) by the same examiner.
We considered macular edema to be clinically significant
as defined by the Early Treatment Diabetic Retinopathy
Study (ETDRS) protocol - that is, if there was retinal
thickening or hard exudates associated with adjacent
retinal thickening observed within 500 ± 50 microns
of the centre of foveal avascular zone or a zone or zones
of retinal thickening 1 disc area or larger, any part of
which was within 1 disc diameter of the center of the
macula. Fundus fluorescein angiography was done to
classify the disease, to diagnose early PDR, to diagnose
cystoid macular oedema and to rule out macular
ischemia as per the routine protocol followed by the
hospital. Optical coherence tomography was done in
all eyes using the standard 5 mm scan protocol. The
line scan programme was chosen and multiple line scans
through the fovea was done and the images processed
and analyzed. Horizontal line scans through the fovea
and 2 steps above and below the central foveal region
were studied. The vitreoretinal relation at the macula
was assessed and graded as
1. No PVD at the macula (Fig: 1)
2. Incomplete PVD without traction (Fig: 2)
3. Incomplete PVD with vitreomacular traction (Fig: 3)
4. Incomplete PVD with vitreofoveal traction (Fig: 4)
5. Complete PVD at the macula

Presence or absence of vitreous separation from the
disc was not analysed in this study.

Results

Of the total 70 patients, there were 17 patients in
40 to 49 years age group (24 %), 29 in 50 to 59 years
age group (42 %), 21 in 60 to 69 age group (30 %), 3 in 70 to 79 age group (4 %) and none above 80 years (Fig. 1). This included patients with both type 1 and type 2 diabetes. Males predominated in the study with 67 % (Fig 2). The male: female ratio was 2:1. Of the 70 patients, 45 had NPDR (64 %) and 25 had PDR (36 %).

Optical coherence tomographic evaluation of the vitreoretinal interface showed that of the 100 eyes with CSME, the majority (78 %) had no posterior vitreous detachment at the macula (grade 1) (Table 2). The posterior hyaloid could not be visualized in these cases as the vitreous was completely attached to the retina. In cases of incomplete Posterior vitreous detachment, the posterior hyaloid was visualised as a linear hyperreflective signal upon the retina separated from it by a clear space. 22 % of the study eyes had an incomplete posterior vitreous detachment. Incomplete Posterior vitreous detachment (IPVD) included three types - incomplete posterior vitreous detachment with only attachment at the macula but no traction (grade 2), incomplete posterior vitreous detachment with vitreomacular traction- VMT grade 3, incomplete posterior vitreous detachment with vitreofoveal traction- VFT grade 4. 12 % of the eyes had an incomplete posterior vitreous detachment with attachment at the macula but no traction. Vitreofoveal traction and vitreofoveal traction respectively were seen as hyperreflective band in the vitreous, which was adherent to the fovea centrally or paracentrally, causing traction and pulling up the fovea or macula. Out of the 100 eyes, 6 % had vitreofoveal traction (VFT) and 4 % had vitreofoveal traction in this study.

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<th>Table 2. Vitreo-retinal interface changes- Type of PVD</th>
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<td>TYPE OF PVD</td>
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<td>NO PVD</td>
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<td>Incomplete PVD</td>
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<th>Table 3. Vitreo-retinal interface changes- Type of IPVD</th>
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<td>TYPE OF IPVD</td>
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<td>Grade 2 IPVD</td>
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<td>Grade 3 IPVD</td>
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<td>Grade 4 IPVD</td>
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Out of the 66 eyes with NPDR and CSME, 56 eyes (84.9 %) had no PVD. Among the 34 eyes with PDR and CSME, 22 eyes (64.7 %) had no posterior vitreous detachment (Table 2). Only 10 eyes with NPDR (15.2 %) had incomplete posterior vitreous detachment as compared to 12 eyes with PDR (35.3 %) – Table 3 and this difference was statistically significant (p value- 0.04) Thus PDR with CSME eyes had a higher incidence of incomplete posterior vitreous detachment at macula than the eyes with NPDR and CSME.

On analyzing patients with incomplete posterior vitreous detachment at the macula, 4 eyes with PDR and CSME (11.8 %) had grade 4 IPVD (VFT), 2 eyes (5.9 %) had grade 3 IPVD (VMT) and 6 eyes (17.6 %) had grade 2 IPVD (incomplete PVD with no traction). Of the NPDR with CSME eyes 2 eyes (3 %) had grade 4 IPVD (VFT), 2 eyes (3 %) had grade 3 IPVD (VMT) and 6 eyes (9.1 %) had grade 2 IPVD (incomplete posterior vitreous detachment with no traction). None of the patients had a complete separation of the vitreous from the macular region (grade 5 IPVD) in either group of patients.
The mean visual acuity in the PDR with CSME group was 0.82 log units and 0.52 log units in the NPDR with CSME group. Patients with some form of macular traction namely those with grade 3 vitreomacular traction and grade 4 vitreofoveal traction incomplete Posterior vitreous detachment had poorer vision than the other grades of IPVD in both NPDR (1.15 log units) and PDR (1.37 log units). Even in the other groups namely grade 1, grade 2 eyes many patients had poor vision due to the presence of other morphological changes at the macula like cystoid macular edema subfoveal detachment, epiretinal membrane, presence of hard exudates on the fovea etc.

**Discussion**

The advent of OCT has revolutionized our understanding and management of diabetic macular edema. One of the many advantages of OCT is the ability to study the vitreoretinal interface changes that occur in retinal diseases. As newer concepts in the understanding of CSME are evolving, one very relevant mechanism is the presence of vitreomacular traction in diabetic macular edema. Johnson et al\(^1\) had reported that some eyes with macular edema have subtle, localized perifoveal vitreous detachment which may cause anterior traction on the foveola, resulting in multicystoid foveal thickening without macular hole formation or capillary leakage. Thomas et al\(^2\) had reported that patients with macular edema who have a taut thickened posterior hyaloid and partial vitreomacular separation have been associated with subretinal fluid and subfoveal detachment. Yamada et al\(^3\) had reported that patients with vitreomacular traction had associated subfoveal detachment and those with incomplete Posterior vitreous detachment temporal to fovea had an associated CME. Ghazi et al\(^4\) had reported that there was a higher prevalence of vitreoretinal interface changes in patients who have undergone laser for diabetic macular edema and had persistent CSME but the number of laser sessions were not associated with an increased prevalence. Various studies have also demonstrated the usefulness of vitrectomy in such situations again confirming the role of this factor in the pathogenesis of diabetic macular edema. Also instances of spontaneous separation of the incomplete Posterior vitreous detachment have been reported. Collet et al\(^5\) had reported that spontaneous resolution of vitreomacular traction associated with diabetic macular edema, facilitated by PRP, resulted in concurrent reduction of macular thickness and visual improvement. These observations confirm the role of vitreomacular traction in the pathogenesis of macular edema.

Though various studies have reported the prevalence of incomplete posterior vitreous detachment or vitreomacular traction in CSME, no study have been done to analyse if there is a difference in vitreoretinal interface in NPDR and PDR patients. To our knowledge this is the first study which endeavors to study this aspect.

In our study 78% of the eyes with CSME had no posterior vitreous detachment at the macula, 22% had an incomplete posterior vitreous detachment and none with complete posterior vitreous detachment. This is comparable to a study by Gaucher et al\(^6\) who had reported that perifoveolar posterior vitreous detachment with foveolar attachment was significantly higher in eyes with diabetic macular edema than those without. In his series 69% of eyes had no posterior vitreous detachment and 22% had perifoveolar posterior vitreous detachment with foveolar attachment. However contrary to our study 8% had complete posterior vitreous detachment. Thomas et al\(^2\) had also reported that 4% of his series had taut thickened posterior hyaloid and 10% had partial vitreomacular separation and these features have been associated with subretinal fluid. These studies however did not study the incidence of these features in different types of DR as is done in our study.

85% of eyes with NPDR and CSME had no posterior vitreous detachment compared to 65% of eyes with PDR and CSME. 35% eyes with PDR had incomplete posterior vitreous detachment as compared to 15% eyes with NPDR. PDR with CSME eyes had a higher incidence of incomplete Posterior vitreous detachment at macula than the eyes with NPDR and CSME. 18% of PDR had macular traction in the form of either vitreofoveal traction or vitreomacular traction compared to 6% in NPDR group. Macular traction is thus higher in PDR than NPDR. The importance of the latter group is that this is a potential group of patients who respond poorly to the conventional treatment for macular edema,
namely laser. Many of the newer modalities of medical treatment of macular edema will also fail in these eyes if not worsen. This is a group which responds best to surgical treatment. Yamada et al³ had reported that patients with vitreomacular traction had a better surgical prognosis than those with incomplete posterior vitreous detachment temporal to fovea who have poor surgical outcome often leading to macular hole and atrophy. Do DV et al⁷ had reported that OCT examination was an essential preoperative tool in the detection of ERM and vitreomacular traction when planning vitreoretinal surgery for macular edema.

The mean visual acuity in the PDR group (0.82 log units) was worse than the NPDR (0.52 log units) group. Patients with macular traction namely those with vitreomacular traction and vitreofoveal traction had poorer vision than those without traction and this was more pronounced in the PDR (1.37 log units) than in NPDR group (1.15 log units). Many studies have shown that the presence of vitreomacular traction or vitreofoveal is associated with poor vision. Eyes with vitreomacular traction or vitreofoveal traction also have increased central foveal thickness. The DRCR network had concluded that there was a positive correlation between central foveal thickness and vision. Patients with increased central foveal thickness associated with vitreomacular traction have been demonstrated to have poor vision.

**Conclusion**

OCT is an excellent noninvasive tool in the study of the vitreo-retinal interface changes. Twice the number of eyes in the PDR group had incomplete posterior vitreous detachment when compared to NPDR group. Macular traction in the form of vitreomacular traction/vitreofoveal traction was seen in three times the number of eyes in the PDR group than NPDR eyes. These observations suggest that eyes with PDR may have an additional factor involved in the pathology of CSME namely the occurrence of posterior vitreous detachment and vitreous separation from the macula with or without macular traction. These observations are more relevant today in this era where newer treatment of macular edema are available. Such groups of patients may not be ideal candidates for conventional laser treatment and may benefit from vitrectomy. However a large controlled trial is needed to answer this question.

**References**