Incidence of Normal Tension Glaucoma in Fellow Eyes of Unilateral Central or Hemi Central Vein Occlusions

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**Purpose:** To study the glaucoma profile of fellow eyes in unilateral CRVO or Hemi-CRVO, and to assess the incidence of normal tension glaucoma in such eyes.

**Methods:** Observational case series evaluating vision, IOP, CD ratio and Automated Perimetry.

**Results:** Among 75 fellow eyes, 13.3 % had IOP > 21 mm Hg and 29.3 % had glaucomatous field defects. The risk of field loss in the opposite eye was 5 times in ischemic CRVO when compared with non ischemic CRVO. This difference was statistically significant (chi square test, p value = 0.07).

**Conclusion:** We found a significant number of previously undetected glaucomas in our study, out of which 63 % had normal tension glaucoma. Glaucoma screening of the normal eye is mandatory in persons with unilateral CRVO or Hemi-CRVO.

**Introduction**

It was Verhoeff in 1913 who postulated a role for glaucoma in the pathogenesis of Central Retinal Vein Occlusion (CRVO). Since then, many investigators have described the association between CRVO and POAG or ocular hypertension. Some authors have also described the association between CRVO and Pseudoexfoliation. The prevalence of POAG in eyes with CRVO ranges from 6 to 69 %. Moore in 1922 noted that when CRVO develops, the IOP drops by an average of 18 % as compared to the fellow normal eye. Since then, many investigators have noted this fact. In many cases, perimetry cannot be performed in the affected eye because of poor vision. Even in cases where perimetry can be performed, field changes due to the vascular occlusion itself may mask glaucomatous changes. So quite often, the fellow eye has to be investigated to establish the presence or absence of POAG.

In this observational case series, we studied the glaucoma profile of the fellow uninvolved eye including vision, IOP, CDR and Automated Perimetry.

**Materials and methods**

75 patients with unilateral CRVO or unilateral Hemi CRVO at initial presentation were included in the study. Standard criteria for diagnosis of CRVO and Hemi CRVO were employed.

**Diagnostic criteria for CRVO and BRVO:**

CRVO consists of 2 distinct clinical entities, namely non ischemic and ischemic. The distinction was based on visual acuity, RAPD, Indirect Ophthalmoscopy and
Fundus Fluorescein Angiography if necessary. Detailed explanations regarding classification and criteria are discussed elsewhere.\textsuperscript{12,13,14}

Hemi CRVO is a variant of CRVO. In these eyes there are 2 trunks for the central retinal vein instead of one, and only one of them gets thrombosed. Hemi CRVO also consists of ischemic and non ischemic types. It is important to differentiate between Hemi CRVO and BRVO.

**Diagnostic criteria for OHT, POAG and NTG:**

Ocular Hypertension: (1) IOP > 21 mm Hg (2) Open anterior chamber angle (3) No ocular or systemic features suggestive of secondary glaucoma (4) normal optic disc (5) Normal visual fields.

POAG: (1) IOP > 21 mm Hg (2) Open anterior chamber angle (3) Visual field defect consistent with glaucoma (4) Corresponding glaucomatous cupping in the optic disc (5) No ocular or systemic features suggestive of secondary glaucoma.

Normal-tension glaucoma: (1) IOP 21 or lower (2) Open anterior chamber angle (3) Visual field defect consistent with glaucoma (4) Glaucomatous cupping of optic disc (5) Nothing to suggest secondary glaucoma (6) No neurological causes which can cause field defects.

**Exclusion Criteria**

Only unilateral cases of CRVO or Hemi-CRVO were included in this study. All patients with rubeosis or angle new vessels were excluded. All cases of Branch vein occlusion and macular venous occlusions were excluded. Cases where perimetry could not be done in the unaffected eye due to other causes were also excluded from the study.

**Examination Protocol**

All patients presenting with unilateral CRVO were examined in detail using a pre-designed protocol. History of use of anti-glaucoma medications was elicited. Salient features of the examination protocol included visual acuity using Snellen’s chart, IOP of affected and normal eye using Goldman Applanation Tonometer, detailed retina examination using both Indirect Ophthalmoscopy and Slit-lamp Biomicroscopy, and FFA as and when indicated. The presence or absence of Relative Afferent Pupillary Defect (RAPD) was looked for in all cases. When there was suspicion of narrow angles or presence of rubeosis, a careful gonioscopy using the three-mirror Goniolens was performed. Since we did not have access to ERG, this was not performed in any of the cases in this study.

We felt that many patients were quite upset during their first consultation because of the sudden onset of defective vision. Hence Automated Perimetry was performed at a later date, preferably within a week. In cases where the IOP was normal and the perimetry showed glaucomatous field defects, a diurnal variation was performed to decide whether they should be classified as POAG or NTG.

**Classification of field defects**

**Early defects:** have any one of the following
1. The MD is better than – 6 db
2. Fewer than 18 of the 76 points in 30-2 are defective in TD plot at the 5 % level
3. Fewer than 10 points are defective at the 1 % level
4. No point in the central 5 degrees has a sensitivity < 15 db

**Moderate defects:** A moderate defect exceeds one or more of the criteria required to keep it in the early defect category, but does not meet the criterion to be severe.

**Advanced defect:** have any one of the following
1. An MD index worse than -12 dB
2. More than 37 (50 %) of the points depressed at the 5 % level in a 30-2 field
3. More than 20 points depressed at the 1 % level
4. A point in the central 5 degrees with 0 dB sensitivity
5. Points closer than 5 degrees of fixation under 15 dB sensitivity in both the upper and lower hemifields.

These criteria have been advocated by Anderson and Patella.\textsuperscript{23}

**Data Analysis**

Risk factor analysis was done to predict risk factors for development of glaucoma. The chi square was used for statistical analysis.

**Results**

This study was conducted between January and December of 2004. 75 patients satisfied the inclusion
criteria. 52 patients were males and 23 were females. Only 16 patients (21.3 %) were below the age of 50. 63 patients had CRVO and 12 had hemi CRVO. In 37 patients the right eye was affected and in 38 patients the left eye was affected.

20 patients had hypertension alone, 13 had diabetes alone and 18 had both diabetes and hypertension. Only 6 patients among the 75 had a previous history of glaucoma and all of them were on anti-glaucoma medications. Visual acuity in the affected eye was 6/60 or less in 29 patients and better than 6/60 in 46 patients. Out of the 29 patients with vision less than 6/60, 25 had RAPD. Those with both RAPD and visual acuity of less than 6/60 were classified as ischemic CRVO (33.3 %). The rest 50 patients (66.6 %) were classified as non-ischemic CRVO. Among the patients with visual acuity better than 6/60, none had RAPD.

Out of the 75 patients, 26 fitted into the criteria for either POAG, NTG or OHT. 6 patients had POAG (8 %), 16 had NTG (21.3 %) and 4 had OHT (5.3 %). 21 among the 63 CRVO patients (33.3 %) and 5 among the 12 Hemi CRVO patients (41 %) had some form of glaucoma. (see Table 1) There was no significant difference in the glaucoma incidence between the CRVO group and Hemi CRVO group.

Table 1

<table>
<thead>
<tr>
<th>Glaucoma type</th>
<th>Total</th>
<th>CRVO</th>
<th>Hemi CRVO</th>
</tr>
</thead>
<tbody>
<tr>
<td>POAG</td>
<td>6</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>NTG</td>
<td>16</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>OHT</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Proportion</td>
<td>21/63</td>
<td>5/12</td>
<td></td>
</tr>
</tbody>
</table>

As early as in 1924 Moore had stated that extensive cupping of the optic disc was a rather common association with CRVO. 10 Similar results were also published by Dobree in 1957. 20 The same findings were proven with histopathology support by Salzmann 21 and Landolt. But all these reports concerned the cupping in the affected eye and not the fellow normal eye. Bertelson 22 found in his 17 patients with CRVO that large cupping was seen in 8 contralateral eyes. We found a CD ratio of 0.6 or more in 27 patients (36 %) among...
75. The drawback of using CDR is always the problem of subjectivity. This can be rectified to a large extent by using OCT for measurement of the cup. When this study was conducted, we did not have access to Optical Coherence Tomography.

We did not perform Automated Perimetry in the affected eye since we felt that the results may not be reliable. Hayreh et al have done Goldman Kinetic Perimetry in the CRVO-affected eyes and have used this as one of the criteria to differentiate between non-ischemic and ischemic types of CRVO. They feel that Goldman Kinetic Perimetry is better because it gives a much larger area than the central 30 degrees. We did Humphrey Automated Perimetry of the unaffected eye to pick up even early glaucomatous changes.

Many criteria have been mentioned in the literature for differentiating between ischemic and non-ischemic CRVO. Hayreh et al have mentioned four subjective and two objective criteria. The four subjective criteria are visual acuity, Perimetry, RAPD and ERG. The two objective criteria are FFA and Ophthalmoscopy. The combination of RAPD with ERG was supposed to have the maximum sensitivity and the least reliable criterion is Ophthalmoscopy. We did not have access to ERG and we have used a combination of Visual acuity, RAPD, Ophthalmoscopy and in some cases FFA to differentiate between ischemic and non-ischemic CRVO.

There was no significant difference in the incidence of glaucoma between the CRVO and Hemi CRVO groups. This emphasizes the fact that Hemi CRVO is only an anatomical variation of CRVO and not similar to BRVO. This has also been mentioned in detail in other studies. The percentage of subtypes of glaucoma in this study shows that Normal tension glaucoma (NTG) is the predominant type in our study (63%). This was in drastic variation to the study by Hayreh et al in which Ocular Hypertension was the predominant type followed by POAG and then by NTG. Many factors have been implicated in the pathogenesis of CRVO and they include large cup, raised IOP, sluggish blood flow etc. Among these, large cup and sluggish blood flow may be the factors responsible for CRVO in NTG.

There were a few drawbacks in this study, namely: (1) We did not use ERG to differentiate between ischemic and non-ischemic CRVO. (2) We did not use OCT to objectively assess cup size. (3) We did not use Central Corneal Thickness (CCT) before grouping cases into Ocular Hypertension (OHT).

**Conclusion**

We found a significant number of new glaucoma patients in our study, which includes a surprisingly high number of normal tension glaucomas. The risk of developing glaucomatous damage in the fellow normal eyes is 5 times more in ischemic CRVO when compared with non-ischemic CRVO. We feel that Glaucoma Screening of the fellow eye is mandatory in all cases of unilateral CRVO or Hemi CRVO. If glaucoma or OHT is detected in the fellow normal eye, anti-glaucoma medications must be started to prevent progression of field defects when present, and also to prevent the occurrence of venous occlusion in the normal eye. But it should be stressed here that CRVO is a multifactorial disease and other factors also should be kept in mind when the fellow normal eye is being treated.

**References**

10. Moore RF. Retinal venous thrombosis: a clinical study


