Comparison of Visual Field Defects in Normal-Tension Glaucoma (NTG) and Primary Open Angle Glaucoma (POAG)

Dr. Vijaya Pai H. MS, Dr. Himabindu Veluri MS

**Purpose:** Comparison of visual field defects in patients with Normal tension glaucoma (NTG) and Primary open angle glaucoma (POAG) may reveal a difference in the pathogenesis of the two conditions.

**Methods:** We compared closely matched visual fields of 37 eyes with NTG and 22 eyes with POAG which were performed using the 30-2 program of Humphrey perimeter. Period of study- January 2003 to March 2006.

**Results:** In the mild defects 46.2 % of the NTG group showed defects close to fixation compared to 33.3 % of the POAG group (P = .687). The NTG group had a PSD of 6.78 dB compared to 5.87 dB in the POAG group (P = .648). 53.9% of eyes in the NTG group had vascular risk factors compared to 33.3% in the POAG group (P = .5).

**Conclusion:** Results suggest that field defects of NTG and POAG are similar and should thus not be used to hypothesize different pathogenic mechanisms.

The association between increased intraocular pressure and glaucoma is well known. However, the exact role of intraocular pressure in the pathogenesis of glaucoma remains obscure. Since the description of a patient with glaucomatous optic nerve damage and visual field loss in the absence of increased intraocular pressure by Von Graefe, the relationship between intraocular pressure, optic nerve damage, and visual field loss has aroused controversy. However, there has been little agreement in published reports as to the similarities and differences of these characteristics in patients with normal-tension glaucoma and patients with high-tension glaucoma. Some investigators have shown that visual field defects in patients with normal-tension glaucoma as compared to patients with high-tension glaucoma tend to be of sudden onset, closer to fixation, deeper and steeper, more localized or less diffuse, more common in the superior hemifield have a greater amount of localized visual field loss in the inferior hemifield. The studies of Caprioli and Spaeth, which suggested that normal-tension glaucomatous visual field defects were closer to fixation and had steeper slopes, were challenged by Phelps, Harry, and Montague who pointed out the inappropriateness of the method used in making these quantitative assessments. Similarly, other investigators have found no differences between the visual field defects in patients with normal tension glaucoma and patients with high-tension glaucoma. The reasons for such controversial reports seem to be caused by
differences in study designs, including different types of perimetry, various definitions of normal-tension glaucoma regarding the highest recorded intraocular pressure, different stages of optic nerve damage and visual field loss, and different methods used in statistical analysis of the data. This study was designed to compare the visual field defects of patients with normal-tension glaucoma and patients with high-tension glaucoma by using strict criteria for defining both types of glaucoma and closely matching both groups with respect to the amount of visual field loss.

**Patients and Methods**

This study was conducted at Kasturba Medical College, Manipal. Patients seen from January 2003 to February 2006 in the Out Patient Department of Ophthalmology were selected. We used 37 eyes of 24 patients with Normal-Tension Glaucoma (NTG) and 22 eyes of 16 patients with Primary Open Angle Glaucoma (POAG) for comparison in this non-randomized comparative trial. Criteria for inclusion in the NTG group included a maximum recorded intraocular pressure (IOP) of <21mm Hg before the initiation of therapy and for the POAG group, a maximum recorded IOP of >21mm Hg by Goldmann applanation tonometry. CCT was measured with Ocuscan [Alcon] and the IOP was adjusted accordingly. All patients had glaucomatous optic nerve damage, open anterior chamber angles on gonioscopy, a diurnal IOP curve done without therapy with a minimum of 6 measurements, a visual acuity of 20/60 or better, a pupil diameter of at least 3 mm, at least two reliable visual field tests (fixation loss <20%, and false positive and false negative errors <33 %) using C 30-2 program of Humphrey perimeter, and glaucomatous visual field loss (according to Anderson’s criteria). Cup/disc ratio was determined by binocular examination of the dilated fundus using slit lamp biomicroscopy with a 90 Dioptre double aspheric lens. When binocular examination was not possible due to a poorly dilated pupil, direct ophthalmoscopy with monocular clues such as disc vessel bending was used to determine the cup/disc ratio.

Patients were excluded if they had history of trauma or any ocular disease known to affect the visual field such as diabetic retinopathy, macular degeneration and vascular occlusions. Also, patients with a visual acuity < 20/60, pupil diameter of <3mm, unreliable visual field tests, optic neuropathy other than glaucoma, local disc malformations or neurologic abnormalities were also excluded. The visual field defects were classified into mild, moderate, severe and end-stage based on Advanced Glaucoma Intervention Study (AGIS) scoring system. Visual field defects of the NTG group were matched with those of the POAG group for the severity of damage, for comparison. All visual field examinations were performed by trained technicians.

Mild defects in the NTG group were compared with mild defects in the POAG group, moderate with moderate, and so on and so forth. A whole group analysis was also done in which all the visual fields defects in the NTG group were compared with all the field defects in the POAG group, irrespective of the severity of the defect.

To determine if there was a difference in the frequency of visual field defects close to fixation between patients with NTG and patients with POAG, the number of patients in each group with scotomas extending to within 6° of central fixation were counted. Patients were counted if any of one of the central 4 threshold values in the pattern standard deviation plot decreased to 10 dB or more below the age-corrected normal values, or if any of the central 4 threshold values along with contiguous values decreased 5 dB or more below age-corrected normal values.

To determine if there was a difference between the two groups with respect to localized visual field loss, pattern standard deviation was compared as the NTG group and the POAG group were matched for the severity of the defect. The number of eyes in each group with a more severe involvement of either the superior or the inferior hemifield was also noted in order to determine which hemifield is more commonly involved in each group and also to determine if there are any differences in the frequency of involvement of a hemifield between the two groups. A hemifield was considered to be more involved if the PSD plot showed at least 3 or more contiguous locations with p = 0.005 in that half of the visual field in that half of the visual field. Chi-square analysis, t-test and Mann-Whitney tests were used for statistical analysis.
Results

The total number of eyes in the NTG group were 37, and in the POAG group, 22. The demographic data for the two groups were analyzed. In the mild defects, as reported by other investigators, the NTG group had a younger mean age and a larger mean cup/disc ratio. However, the differences were not statistically significant [Table 1]. 46.2% of the NTG group showed defects close to fixation compared to 33.3% of the POAG group. We found no statistically significant difference in the number of patients with scotomas falling within 6° of central fixation (p = 0.687). Although the NTG group had a larger PSD than the POAG group, (6.78 ± 3.25 vs. 5.866 ± 1.55), this difference was not statistically significant (p = 0.648). 53.83% of the NTG group had vascular risk factors compared to 33.3% of the POAG group. Once again, the difference was not statistically significant. The superior hemifield was more involved in both groups, although there was no statistically significant difference in the frequency of involvement between the two groups [Table 2]. A similar comparison was carried out between the two groups for each category of the field defect that is, moderate, severe, and end-stage. However, the comparison done between mild defects is given more significance as the defects tend to look similar in both groups, as they progress in severity. It is during the mild stage that any true differences can be established with more certainty.

Discussion

Since the description of an entity called normal-tension glaucoma, in which glaucomatous optic disc changes with visual field defects occur in the presence of a normal intraocular pressure, various hypotheses such as vascular ischemia have been put forward in an attempt to discover if differences exist in the pathogenic mechanisms of NTG as compared to those of POAG. Differences in the pattern of visual field loss in the two groups may lead towards such a difference. Unfortunately, due to various differences in the way previous studies were conducted, there has been little agreement between investigators, as to the similarities or differences in the visual field defects between the two groups. Some investigators found that visual field defects were closer to fixation in patients with NTG than in patients with POAG. However, others have found no significant differences in the two groups with respect to involvement of fixation. In our study, in the mild defects, we found no significant differences in the number of patients with NTG and patients with POAG with scotomas extending to within 6° of central fixation.

Studies have also shown that patients with NTG have more localized defects and those with POAG have more generalized defects. We investigated these findings by comparing the PSD values (localized visual field loss) between the two groups. Although the NTG group had a greater amount of localized visual field loss than the POAG group, this difference was not statistically significant. This finding is similar to that of Zeiter, Shin et al, who found no significant difference in the PSD values between patients with NTG and POAG.

In our study we also found a tendency toward involvement of the superior hemifield in both groups. The finding that patients with early to moderate POAG have visual field defects that involve the superior hemifield more than the inferior hemifield has been documented. In addition, many investigators have studied whether there is any difference in the distribution of visual field defects over the superior and inferior hemifields between patients with NTG and POAG. Although many have found no differences between the two groups, some have found a greater involvement of the superior hemifield in the NTG group as compared to the POAG group. We found no statistically significant difference in the distribution of field loss over the superior and inferior hemifields between the two groups.

Many authors have hypothesized that vascular factors in addition to IOP have an important role in the pathogenesis of normal tension-glaucoma. However, our results showed no significant differences in the vascular risk factors between the two groups.

In conclusion, although this study does not imply that there are no different pathogenic mechanisms between NTG and POAG, it does show that there are no differences in the visual field defects between the two groups and hence visual field defects may not point towards differences in pathogenic mechanisms.
References


