

NTG in American Indians/Alaska Natives

A wolf in sheep's clothing.

BY STEVEN L. MANSBERGER, MD, MPH

One does not detect normal-tension glaucoma (NTG) until the patient develops glaucomatous optic neuropathy, and eye care providers do not document the appearance of the optic disc in many patients.¹ For these reasons, patients with NTG often have severe optic disc disease and visual field loss by the time the disease is diagnosed. This article shares the results of a pilot study² that my colleagues and I conducted in order to alert clinicians to the high prevalence of NTG in American Indian/Alaska Natives so that they do not miss the wolf in sheep's clothing.

METHODS

Population

Our study included three tribes from Oregon, Washington, and Idaho. We used the tribal enrollment database to

perform an age-stratified, randomized sampling of individuals aged 40 and older.

Examinations

We performed a baseline examination for glaucoma that included pachymetry, keratometry, presenting and best-corrected vision, IOP measured with the Tono-Pen XL (Medtronic Xomed Ophthalmics, Inc., Minneapolis, MN), anterior chamber assessment by limbal chamber depth,^{3,4} visual field testing using Frequency Doubling Technology perimetry program C-20-5 (Carl Zeiss Meditec Inc., Dublin, CA), confocal scanning laser ophthalmoscopy (CSLO), and nonmydriatic digital imaging of the lens, optic disc, and fundus. Participants also completed a detailed questionnaire, which included demographics and medical history.

The baseline examination contained several criteria

TABLE 1. CASE DEFINITIONS

EYE ABNORMALITY	DEFINITION
Glaucomatous optic neuropathy	Category 1: Cup-to-disc ratio > 0.8 or glaucomatous optic disc features (rim thinning, nerve fiber defect, excavation) and definite glaucomatous visual field loss Category 2: Cup-to-disc ratio > 0.8 or glaucomatous features but unable to complete visual field testing satisfactorily Category 3: Visual field not possible and optic disc unable to be viewed, with either IOP > 22 mm Hg or evidence of glaucoma surgery ⁵
Ocular hypertension (OHT)	IOP >22 mm Hg without glaucomatous optic neuropathy ⁶
Primary angle-closure suspect	Posterior trabecular meshwork cannot be seen in three or more quadrants by gonioscopy ⁵
Primary angle closure	Primary angle-closure suspect with peripheral anterior synechiae, OHT, or signs of acute angle closure without glaucomatous optic neuropathy ⁵
Primary angle-closure glaucoma	Primary angle closure with glaucomatous optic neuropathy ⁵

REFERRAL CRITERIA FOR A FOLLOW-UP EXAMINATION

- History of glaucoma, diabetes, or eye abnormalities
- Capillary blood glucose glucometer reading >110 mg/dL fasting or >140 mg/dL random
- Capillary HbA1c greater than 5.7%⁷
- BCVA of 20/40 or worse
- IOP > 21 mm Hg
- Limbal chamber depth 25% or less than the corneal optical section^{3,4}
- Abnormal, unreliable, or indeterminate result with Frequency Doubling Technology (Table 1)
- Difficulty with CSLO imaging or contour line placement
- Borderline or abnormal report of CSLO using the Moorfields Criteria⁸
- Signs of optic nerve disease, diabetic retinopathy, macular degeneration, or other eye disease with nonmydriatic digital imaging

for a subject's referral for a follow-up examination to allow the highest sensitivity (see *Referral Criteria for a Follow-up Examination*). An ophthalmologist performed the follow-up examination for all subjects with abnormal findings and a subset of participants with normal findings to determine the accuracy of the baseline examination. The normal patients were selected using a random-number generator. The ophthalmologist was masked to the results from the baseline examination to reduce workup bias.

The follow-up examination included BCVA, Goldmann tonometry, biomicroscopy of the anterior segment, gonioscopy, Lens Opacity Classification System III grading of the lens,⁹ standard automated achromatic perimetry (24-2 Swedish Interactive Threshold Algorithm standard, Humphrey Field Analyzer II [Carl Zeiss Meditec Inc.]), a dilated fundus evaluation, and photography of the optic disc and macula.

The examiner used standard criteria to determine the prevalence of eye disorders (Table 1). An abnormal standard achromatic automated perimetry was defined as a pattern standard deviation outside 95% of age-specific norms, a glaucoma hemifield test result outside 99.5% of age-specific norms (outside normal limits on Statpac2 [Carl Zeiss Meditec Inc.]), or a mean deviation

outside the 95% limits without a generalized reduction in sensitivity.

Data Analysis

We used statistical weighting to determine accurately the prevalence of glaucoma and OHT, because not all persons with a normal baseline examination were selected for the follow-up examination and not all persons with an abnormal baseline examination completed a follow-up examination.

FINDINGS

We recruited a total of 288 participants, whose baseline characteristics are listed in Table 2. Sixty-six percent completed the follow-up examination. We found no difference in participants' age or gender when compared to those whom we were unable to contact ($P>.05$).

In general, American Indian/Alaska Natives had a lower average IOP, larger cup-to-disc ratio, and higher prevalence of glaucoma when compared with the results of previous studies in whites. On average, subjects' IOP measured 12.9 ± 3.0 (range, 8 to 23) mm Hg with Goldmann tonometry. Thus, OHT was uncommon, occurring in only 0.004% (0 to 1.1 [the 95% confidence interval for the results using a Poisson distribution after statistical weighting]) of participants. Open-angle glaucoma occurred in 6.2% (2.6 to 7.8). All eyes with glaucoma (14 persons diagnosed with uni- or bilateral glaucoma) had NTG, defined as an IOP of less than 22 mm Hg. None was category 3, 47% were category 2, and 63% were category 1. The average central corneal thickness was 555 ± 36 μ m. No cases were found of suspected or actual primary angle closure, primary angle-closure glaucoma, or pseudoexfoliation (PXF).

SIGNIFICANCE

One of the study's intriguing findings was that all patients with glaucoma had an IOP of less than 22 mm Hg, otherwise known as NTG, on initial screening and one follow-up examination.¹⁰ Previous studies have shown that NTG may represent up to 69% of all patients with glaucoma.¹⁰ Our results (100%) are even higher, albeit with a small sample size and likely younger age distribution than other studies. Only a recent study containing Japanese participants had a similar proportion (92%) of NTG.¹¹

We also found a low probability (0.004%) of OHT, which is present in approximately 5% of individuals over the age of 40 years.¹² The Los Angeles Latino Eye Study found OHT in 3.6% of Latinos.¹³ Despite an association between central corneal thickness and a risk of develop-

TABLE 2. DEMOGRAPHIC CHARACTERISTICS OF THE PARTICIPANTS

	Number	Percentage
Gender		
Male	106	36.8
Female	182	63.2
Age (Years)		
40 to 49	116	40.3
50 to 59	83	28.8
60 to 69	49	17.0
70+	40	13.9
Percentage American Indian/ Alaska Native Heritage		
1/4 or less	37	12.8
>1/4 to 1/2	49	17.0
>1/2 but less than full	79	27.4
Full	104	36.1
Unknown	19	6.5

ing glaucoma,¹⁴ central corneal thickness among American Indian/Alaska Natives was similar to that of other ethnic groups. The high prevalence of NTG and the low prevalence of OHT necessitate further analysis of ocular characteristics and risk factors for glaucoma in American Indian/Alaska Natives. Other significant eye disease in the studied population was discussed in a previous study² and will be the subject of future reports.

The results of our study show similarities and differences from other vision studies (chart reviews or convenience samples in a local village) of American Indian/Alaska Natives.¹⁵⁻¹⁷ In particular, we did not observe angle-closure glaucoma, which was a common cause of blindness in Alaskan Eskimos.^{15,16} Similarly, we found no cases of PXF, a risk factor for open-angle glaucoma. This outcome was contrary to results in Navajo Indians, a study of whom found that 38% of persons older than 60 years had PXF.¹⁷ Our findings and the others just mentioned suggest heterogeneity in the ocular characteristics of American Indian/Alaska Natives.

Our study suggests the prevalence of NTG may be as low as 2.6% or as high as 7.8% in American Indian/Alaska Natives over the age of 40. Because none of the subjects with glaucoma had a high IOP, particular importance should be placed on screening for glaucoma by examining the optic nerve in this population. Future studies require a larger sample size to increase the accuracy of prevalence estimates in this population. □

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Steven L. Mansberger, MD, MPH, is Assistant Scientist and Director of Ophthalmic Clinical Trials for the Devers Eye Institute in Portland, Oregon. Dr. Mansberger is also Director of Glaucoma Services at the Veterans Hospital, and he holds appointments at Oregon Health Science University as Adjunct Assistant Professor of Ophthalmology and Clinical Assistant Professor of Public Health and Preventive Medicine in Portland. He acknowledged no financial interest in the products or companies mentioned herein. Dr. Mansberger may be reached at (503) 413-8202; smansberger@discoveriesinsight.org.



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