Am. J. Trop. Med. Hyg., 90(1), 2014, pp. 96–98
doi:10.4269/ajtmh.13-0357

Short Report: Ocular Onchocerciasis in the Yanomami Communities from Brazilian Amazon: Effects on Intraocular Pressure

Guilherme Herzog-Neto, Karen Jaegger, Erika S. do Nascimento, Verônica Marchon-Silva, Dalma M. Banic, and Marilza Maia-Herzog*

Serviço de Oftalmologia da Universidade Federal Fluminense, Niterói, RJ, Brasil; Referência Nacional em Simulídeos, Oncocercose e Mansonelose, Laboratório de Simulídeos e Oncocercose, Instituto Oswaldo Cruz, Fiocruz, RJ, Brazil

Abstract. To determine the influence of onchocercal eye disease on the intraocular pressure of the Yanomami Tribe Aratha-ú of Roraima State, Brazil, considered endemic for onchocerciasis, a total of 86 patients were submitted to an ophthalmologic exam that included external examination, slit lamp examination, intraocular pressure measurement, and a fundus ophthalmoscope examination. A high prevalence of onchocerciasis-related eye lesions was encountered in 68.6% of the patients. Punctate keratitis and microfilariae in the anterior chamber were found in ~28%. The mean of intraocular eye pressure found was 10.47 mm of Hg.

INTRODUCTION

Human onchocerciasis is a disease caused by *Onchocerca volvulus* microfilariae that causes skin pathology and ocular lesions, sometimes culminating in complete blindness (river blindness)[1,2]; this neglected tropical disease affects ~26 million people worldwide in 38 endemic countries of tropical Africa, Arabian Peninsula, and Latin America. An estimated one million people are blinded or have severe visual impairment[3]; previous evidence of an association between onchocerciasis and glaucoma has been mixed[4,5] showing the need to further investigate the association between onchocerciasis and glaucoma. Glaucoma is a progressive optic neuropathy associated with structural changes in the optic nerve, progressive irreversible visual field defects (loss of vision), and usually associated with elevated intraocular pressure (IOP).[6] The objective of this study is to determine the influence of onchocercal eye disease on the IOP of the Yanomami Tribe Aratha-ú of Roraima State (northern Amazon) Brazil, considered endemic for onchocerciasis.[7]

CASE REPORT

The study was conducted at the Aratha-ú Basic Health Outpost Yanomami Tribe situated in Roraima State, 347 Km from the city Boa Vista (03°09′56″S 06°34′65″W) in the drainage area of the Parima river. A total of 86 voluntary patients were submitted to an ophthalmologic exam that included external examination, slit lamp examination, intraocular pressure measurement, and a fundus ophthalmoscope examination. Each individual underwent a direct eye examination that consisted of visual acuity with a Snellen Illiterate E Chart, external palpebral evaluation, and an anterior segment examination, after careful head positioning, with a Haag Streit 900 Slit-lamp (Haag-Streit AG, Koeniz, Switzerland). The fundus was examined by direct ophthalmoscopy (Welch Allyn Inc., Skaneateles Falls, NY) and indirect ophthalmoscopy with a 20 diopter lens after pupil dilatation with a mixture of 0.1% Tropicamide and 10% Phenylephrine eye drops. Intraocular pressure was measured by applanation tonometry with a Haag Streit Applanation Tonometer adapted to the slit-lamp, before the pupil dilation.

All of the field examinations and data collecting procedures were necessarily accompanied by the official health professionals to the referred population and always preceded the administration of ivermectin. At the time of this study the individuals who were examined had only been submitted to two treatment cycles with ivermectin. The study was approved and registered by the Ethical Committee of the Ministry of Health of Brazil (PARECER No. 1186/2000), FUNAI (No. 012/CGEP/01), and verbal and written consent was obtained from all participants verbally instructed by an official fellow tribe member familiar with both the Yanomami and Portuguese languages.

We used a bivariate analysis to compare the prevalence of onchocerciasis and other ocular damage with relation to the IOP. The differences in IOP according to sex and age were also investigated. A *t* test was applied for continuous variables. All analyses were conducted with GraphPad Prism Software version 5 (GraphPad Software, Inc., La Jolla, CA).

Briefly, all individuals are exposed to *Onchocerca volvulus* infections throughout the years. At the time of ophthalmological examination, the population showed a high prevalence of skin microfilaria (60%) and onchocercal subcutaneous nodules (45%). The studied patients did not differ in gender ratio ($P > 0.05$) and the mean age was 32.1 years (range 9–74 years of age). The mean IOP found in 172 eyes was 10.47 mm of Hg (range 7–21 mm of Hg). There was no significant difference in IOP between male and female eyes ($P > 0.05$). However, the IOP was positively correlated with age ($r = 0.3597$, $P = 0.0007$). A high prevalence of onchocercal-related eye lesions was encountered in 68.6% of the population. Punctate keratitis and microfilaria in the anterior chamber were found in 28% of the patients. Chorioretinitis and iridocyclitis were encountered in < 13% (Table 1). No evidence of optic atrophy was found in the examined population and the largest cup/disk ratio found in any individual examination was 0.4. There was no difference between IOP from individuals with (mean 10.46 mm of Hg; range 7–21 mm of Hg) and without (mean 10.48 mm of Hg; range 7–20 mm of Hg) ocular lesions. Among individuals with ocular lesions no significant differences were seen in the IOP mean between the different types of eye lesions: corneal scleral scarring, anterior uveitis, synechia, microfilaria, and/or punctate keratitis ($P > 0.05$, for all).

*Address correspondence to Marilza Maia-Herzog, Laboratório de Simulídeos e Oncocercose, Instituto Oswaldo Cruz, Fiocruz – Av. Brasil, 4365, Pav. Rocha Lima, Sl. 514, Manguinhos, Cep. 21040-900, Rio de Janeiro, RJ, Brasil. E-mail: mherzog@ioc.fiocruz.br

TABLE 1
Intraocular eye pressures of Yanomami studied individuals according to onchocercal eye lesions

Ocular characteristics	Number of eyes (%)	Mean IOP (mm Hg)	Range IOP (mm Hg)	SD*
Intraocular pressure	172	10.47	7–21	2.973
Male ($N = 43$)	86 (50.0)	9.90	7–16	1.875
Female ($N = 43$)	86 (50.0)	11.02	7–21	3.706
Ocular diagnosis				
With ocular lesions ($N = 59$)	118 (68.6)	10.46	7–20	3.191
Microfilariae ($N = 19$)	38 (22.0)	10.84	7–21	4.413
Punctate keratitis ($N = 20$)	40 (23.2)	9.90	7–14	1.651
Microfilariae and punctate keratitis ($N = 12$)	24 (13.9)	9.33	8–12	0.984
Corneal scleral carring, anterior uveitis or synechiae ($N = 11$)	22 (12.7)	11.55	7–20	3.882
Without ocular lesions ($N = 27$)	54 (31.4)	10.48	7–20	2.486

* $P > 0.05$.
IOP = intraocular pressure.

Of the 86 patients, nine eyes had anterior eye synechia, probably caused by damage from onchocercal disease, and one patient also had anterior chamber microfilaria. Four eyes with anterior eye synechia had simultaneous anterior uveitis. Seven eyes had serious corneal and scleral scarring presumably caused by onchocercal eye disease (IOP was 9 mm of Hg in one eye, 10 mm of Hg in four eyes and 16 mm of Hg in two eyes). Five eyes had conjunctival nodules with IOP being 8 mm of Hg in one eye, 10 mm of Hg in two eyes, 11 mm of Hg in one eye, and 13 mm of Hg in one eye. Patients with cataracts but no other anterior eye disease were excluded from comparison as most of these eyes probably had senile cataracts. The highest eye pressure found in the 22 eyes with anterior segment eye damage (conjunctival nodules, corneal scarring, anterior uveitis or synechia) was 20 mm of Hg, presumably caused by onchocerciasis. As the criteria for high IOP, we arbitrarily adopted the 75th percentiles of the healthy eyes IOP. Therefore, IOP greater than 12 mm of Hg was considered high IOP. In this context, there was no significant difference in the prevalence ($P = 0.3864$) of eyes having IOP above 12 mm of Hg in the groups with ocular lesions (18 of 118; 15.25%) or without ocular lesions (4 of 54; 7.4%).

DISCUSSION

Microfilaria and punctate keratitis are considered early reversible lesions caused by onchocerciasis and should become less frequent with repeated treatment protocols.[8] Because the population involved in this study had only been submitted to two rounds of ivermectin, it is possible that the relative lack of influence of onchocercal eye disease on eye pressure elevation could be related to the early eye disease and the small amount of internal and external eye damage from the disease in these eyes. However, it is worth noting that the prevalence of skin microfilaria in this population, before the mass ivermectin-based treatment beginning 18 months previously, was 87%.[9]

According to Pearlman and Hall[10] eye damage from onchocerciasis generally occurs after the death of the microfilaria from natural attrition or chemotherapy, which endears an inflammatory response responsible for various eye problems such as corneal scarring. Sobosly and others[11] also believe that the most serious eye complications of onchocerciasis occur after the death of the microfilaria, which engenders host-mediated inflammatory reactions that contribute to the typical clinical ocular manifestations such as keratitis, uveitis, and optic nerve atrophy. Serious eye damage was found in 15 different eyes in the Yanomami population studied. This number was considered relatively small when compared with the total number of eyes with onchocercal eye disease none of which had secondary glaucoma at the time of the survey. Some of these eyes had overlapping eye damage, which is the reason for a smaller number of eyes when compared with the number of disease processes. This relative lack of inflammatory damage was probably caused by the small amount of treatment (two rounds of ivermectin) given until then, which resulted in a relative lack of inflammatory eye disease and rendered little need for steroid medication, which is notably another factor associated with glaucoma.

However, there appears to be a slight but not significant tendency to IOP elevation in the eyes with more serious onchocercal damage such as anterior chamber microfilaria and anterior chamber scarring. Another difference in the African studies when compared with the native Yanomami is that black populations are a risk factor for the presence of glaucoma,[12] which may not be the case in relation to the Yanomami. The IOP of the Yanomami is also significantly lower than that of the general Brazilian population, which has a reasonable proportion of African descendents[13]; although the IOP of the Yanomami shows no significant variation between sexes, it tends to elevate with age. The lower IOP in the Yanomami population may be partially explained by their lean physical condition and the lack of salt in their diet.[14] Although genetic factors in the prevalence of glaucoma in a certain population are multifactorial and not altogether known it may be possible that a genetic basis is also behind this difference between the lower IOP of the Yanomami with relation to the general Brazilian population.[15]

The association of onchocerciasis and optic nerve damage, either by secondary glaucoma or direct damage to the optic nerve was not seen in this study. The IOP measurements and lack of optic nerve atrophy appear to confirm that glaucoma was not encountered or significant in the Yanomami at the time of the survey. A question to be asked is if future studies in the same population after years of intraocular microfilarial death and possible inflammation and scarring resulting from accumulation of parasitic antigens may affect the future IOP readings? The authors did not find a relationship between onchocerciasis and glaucoma in the population studied, which at the time of the survey had only been submitted to two rounds of ivermectin treatment. The IOP of the Yanomami population is lower than that of the general Brazilian population.

Received June 17, 2013. Accepted for publication August 5, 2013.

Published online December 2, 2013.

Acknowledgments: Fundação Nacional da Saúde/Roraima and Brazilian Government to the equipment employed. To Instituto Oswaldo Cruz/FIOCRUZ, Fundação Nacional da Saúde and ONG URIHI- Saúde Yanomami for logistic support during the survey.

Authors' addresses: Guilherme Herzog-Neto and Karen Jaegger, Serviço de Oftalmologia da Universidade Federal Fluminense, Niterói, RJ, Brazil, E-mails: gherzogneto@gmail.com and karin_jaegger@hotmail.com. Erika S. do Nascimento, Verônica Marchon-Silva, Dalma M. Banic, and Marilza Maia-Herzog, Laboratório de Simulídeos e Oncocercose, Instituto Oswaldo Cruz, Fiocruz, RJ, Brazil, E-mails: erikar@ioc.fiocruz.br, vmarchon@ioc.fiocruz.br, banic@ioc.fiocruz.br, and mherzog@ioc.fiocruz.br.

REFERENCES

1. Evans TG, 1995. Socioeconomic consequences of blinding onchocerciasis in West Africa. *Bull World Health Organ 73:* 495–506.
2. World Health Organization, 1995. *Onchocerciasis Control Programme in West Africa*. Report of the WHO, Geneva.
3. Centers for Disease Control and Prevention, 2013. Progress toward elimination of onchocerciasis in the Americas: 1993–2012. *MMWR Morb Mortal Wkly Rep 62:* 405–408.
4. Egbert PR, Jacobson DW, Fiadoyor S, Dadzie P, Ellingson KD, 2005. Onchocerciasis: a potential risk factor for glaucoma. *Br J Ophthalmol 89:* 796–798.
5. Chester P, Clifton R, Wayne E, 1992. *Parasitología Clínica*. Salvat Editors. Second Edition. México, D.F. Editorial Interamericana.
6. Wolfs RC, Borger PH, Ramrattan RS, Klaver CC, Hulsman CA, Hofman A, Vingerling JR, Hitchings RA, de Jong PT, 2000. Changing views on open-angle glaucoma: definitions and prevalences: The Rotterdam Study. *Invest Ophthalmol Vis Sci 41:* 3309–3321.
7. Herzog Neto G, Jaegger K, Marchon-Silva V, Calvão-Britto RH, Vieira JB, Banic DM, Maia-Herzog M, 2009. Eye lesions due to onchocerciasis: a clinica study in the Aratha-ú, Yanomami tribe, Roraima State, Brazil. *Acta Trop 111:* 33.
8. Winthrop KL, Proano R, Oliva O, Arana B, Mendoza C, Dominguez A, Amann J, Punkosdy G, Blanco C, Sauerbrey M, Richards F, 2006. The reliability of anterior segment lesions as indicators of onchocercal eye disease in Guatemala. *Am J Trop Med Hyg 75:* 1058–1062.
9. Banic DM, Calvão-Brito RHS, Marchon-Silva V, Schuertez JC, Pinheiro LR, Alves MC, Têva A, Maia-Herzog M, 2009. Impact of 3 years ivermectin treatment on onchocerciasis in Yanomami communities in the Brazilian Amazon. *Acta Trop 112:* 125–130.
10. Pearlman E, Hall LR, 1999. Pathogenesis of onchocercal keratitis (river blindness). *Clin Microbiol Rev 3:* 445–453.
11. Soboslay PT, Geiger SM, Weiss N, Banla M, Lauder CG, Dreweck CM, 1997. Regulatory effects of Th1-type and Th2-type cytokines on parasitic specific celular responsiveness in *Onchocerca volvulus* infected humans and exposed endemic controls. *Immunology 90:* 592–599.
12. Potter AW, 1998. Setting up an eye service in rural Africa. *Br J Ophthalmol 82:* 1451.
13. Amaral WO, Teixeira RM, Alencar LM, Cronemberger S, Calixto N, 2006. Espessura central e periférica da córnea: influência na medida da pressão intra-ocular pelo Tonopen. *Arq Bras Oftalmol 69:* 41–45 [online].
14. Shiose Y, 1984. The aging effect on intraocular pressure in an apparently normal population. *Arch Ophthalmol 102:* 883–887.
15. Stone EM, Fingert JH, Alward WL, Nguyen TD, Polansky JR, Sunden SL, Nishimura D, Clark AF, Nystuen A, Nichols BE, Mackey DA, Ritch R, Kalenak JW, Craven ER, Sheffield VC, 1997. Identification of a gene that causes primary open angle glaucoma. *Science 275:* 668–670.