Prevalence of glaucoma in a tele-screening program for diabetic retinopathy in rural area of Argentina

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Abstract

Purpose: Diabetes is a controversial risk factor for the development of glaucoma. However, including the early detection of glaucoma within tele-screening programs for diabetic retinopathy continues to be a matter of discussion. The aim of this study was to evaluate the prevalence of glaucoma in a tele-screening program for early detection of diabetic retinopathy.
Methods: A cross-sectional study was performed evaluating the number of people with glaucoma within a population with diabetes. Patients who participated in a diabetic retinopathy tele-screening program taken place in the province of La Pampa (Argentina), were included. A questionnaire was performed to verify the presence of glaucoma and the general characteristics of the participants. In addition, visual acuity with and without pinhole, intraocular pressure with a rebound tonometer, and eye fundus using retinography were evaluated.
Results: A total of 2,743 patients with diabetes were included. The prevalence of glaucoma was 5.0% (95% CI 4.3%-5.9%). A higher prevalence of diabetic retinopathy was observed in people with glaucoma (33.9% versus 21.0%, p 0.001). In addition, through the tele-screening program, 314 people with ocular hypertension were detected.
Conclusion: The prevalence of glaucoma within the studied population was higher than in other studies where the general population was evaluated. Considering that blindness due to glaucoma and diabetes is preventable, it is important to con-

sider the association between both pathologies to implement tele-screening programs.
Keywords: diabetic retinopathy, glaucoma, telemedicine, blindness, primary health care.

Prevalencia de glaucoma en un programa de tele-screening de retinopatía diabética en un área rural de Argentina

Resumen

Objetivo: La diabetes es un factor de riesgo controvertido para el desarrollo de glaucoma. La inclusión de la detección precoz del glaucoma dentro de los programas de tele-screening de retinopatía diabética sigue siendo un tema de debate. El objetivo de este estudio fue evaluar la prevalencia de glaucoma en un programa de tele-screening para la detección precoz de la retinopatía diabética.
Métodos: Se realizó un estudio de corte transversal evaluando el número de personas con glaucoma dentro de una población con diabetes. Se incluyeron pacientes que participaron en un programa de tele-screening de retinopatía diabética llevado a cabo en la provincia de La Pampa (Argentina). Se realizó un cuestionario para verificar la presencia de glaucoma y las características generales de los participantes. Además, se evaluó la agudeza visual con y sin estenopeico, la presión intraocular con tonómetro de rebote y el fondo de ojo mediante retinografía.
Resultados: Se incluyó un total de 2.743 pacientes con diabetes. La prevalencia de glaucoma fue del 5,0% (IC 95% 4,3%-5,9%). Se observó una mayor prevalencia de retinopatía diabética en personas con glaucoma (33,9% versus 21,0%, *p*=0,001). Además, a través del programa de tele-screening se detectaron 314 personas con hipertensión ocular.
Conclusión: La prevalencia de glaucoma dentro de la población estudiada fue mayor que en otros estudios donde se evaluó a la población general. Considerando que la ceguera por glaucoma y diabetes es prevenible, es importante pensar en la asociación entre ambas patologías para implementar programas de tele-screening.
Palabras clave: retinopatía diabética, glaucoma, telemedicina, ceguera, atención primaria de la salud.

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Resumo

Objetivo: O diabetes é um fator de risco controverso para o desenvolvimento de glaucoma. A inclusão da detecção precoce do glaucoma em programas de tele-screening para retinopatia diabética ainda é motivo de debate. O objetivo deste estudo foi avaliar a prevalência de glaucoma em um programa de tele-screening para detecção precoce de retinopatia diabética.
Métodos: Foi realizado um estudo transversal avaliando o número de pessoas com glaucoma em uma população com diabetes. Foram incluídos pacientes que participaram de um programa de tele-screening de retinopatia diabética realizado na província de La Pampa (Argentina). Foi realizado um questionário para verificar a presença de glaucoma e as características gerais dos participantes. Além disso, foram avaliadas a acuidade visual com e sem pinhole, pressão intraocular com tonômetro de rebote e fundo ocular por retinografia.
Resultados: Foram incluídos 2.743 pacientes com diabetes. A prevalência de glaucoma foi de 5,0% (IC 95% 4,3%-5,9%). Maior prevalência de retinopatia diabética foi observada em pessoas com glaucoma (33,9% versus 21,0%, p=0,001). Além disso, por meio do programa de tele-screening, foram detectadas 314 pessoas com hipertensão ocular.
Conclusão: A prevalência de glaucoma na população estudada foi maior do que em outros estudos onde a população geral foi avaliada. Considerando que a cegueira por glaucoma e diabetes é evitável, é importante pensar na associação entre ambas as patologias para implementar programas de tele-screening.
Palavras-chave: retinopatia diabética, glaucoma, telemedicina, cegueira, atenção primária à saúde.

Introduction

Glaucoma is the second cause of blindness in the world, and the leading cause of irreversible

blindness[1]. There are 79,000,000 people with glaucoma, and it is estimated that these numbers will continue to grow in the coming years[1]. Studies carried out in hispanic populations estimate a prevalence between 2.07% and 4.74%[2-3]. Given that, in Argentina, visual disability due to glaucoma occupies the third place in people over 50 years of age[4].

To prevent blindness due to glaucoma, it is essential to make a timely diagnosis and treatment. Thus campaigns or programs for early detection of glaucoma are organized in different areas[5]. However, these types of programs continue to be a frequent topic of debate because its cost-effectiveness has not yet been proved[6]. Nevertheless, some authors recommend performing this type of programs in populations with higher risk[6].

Risk factors associated with primary open-angle glaucoma (POAG) are increased intraocular pressure, advanced age, african ascendency, and family history of the disease[7-9]. Among the risk factors of moderate association are some ocular conditions, such as high myopia and endocrine-metabolic diseases such as diabetes mellitus[10-11].

Including diabetes as a risk factor has been controversial, since some studies found a positive association between diabetes and POAG, while others did not[12-17]. Due to these controversies and the lack of studies in our population, we performed this study which aims to estimate and evaluate the prevalence of glaucoma in diabetic patients of La Pampa province (Argentina).

Materials and methods

A cross-sectional study was performed, with prospective recruitment. Patients with diabetes mellitus who attended a diabetic retinopathy tele-screening program in the province of La Pampa were included. The program covered 59 rural locations in the province, performing retinographies, controlling intraocular pressure (IOP) and visual acuity in all people with diabetes mellitus[18-19].

Visual acuity data were obtained without correction and with pinhole, with Snellen decimal scale. IOP values were measured with an Icare ic100 rebound tonometer (Icare Finland Oy, Vantaa, Finland), and eye fundus examination was performed with a Digital Retinography System (DRS) (CenterVue SpA, Padova, Italy). The studies were performed by a trained nurse. The images obtained were analyzed by a single ophthalmologist. The presence of glaucoma was evaluated through a questionnaire. It included general characteristics of the participants and information on quality of life, using the Euroqol validated to Spanish.

Patients who presented an incomplete questionnaire, with non-gradable images in the retinography and who refused the informed consent process were excluded.

The data is presented expressing the categorical variables with whole numbers and proportions, with a 95% confidence interval (CI95%); and numerical variables with mean and standard deviation. The association between categorical variables was made using a chi2 and between numerical variables with a T-test. Logistic regression adjusting for age and sex was performed to assess the association between glaucoma and diabetic retinopathy. A $p < 0.05$ was considered statistically significant.

The following study was evaluated and approved by the Patagonian Independent Ethics Committee and was conducted in accordance with the guidelines of the Declaration of Helsinki.

Results

A total of 2,995 people evaluated by the Program were included, of which 24 (0.8%) were excluded for presenting incomplete data and 228 (7.6%) were excluded because they presented non-gradable images, leaving a total of 2,743 people for evaluation.

Of the total number of people evaluated, 5.0% (95% CI 4.3%-5.9%) reported glaucoma, and 11.4% (n314) presented ocular hypertension at the time of evaluation. The mean intraocular pressure was 15.6 millimeters of mercury (mmHg) (SD 4.3) in the right eye and 16.9 mmHg (SD 4.5) in the left eye.

Table 1 summarizes the characteristics presented by the people with or without glaucoma.

The main findings were that people with glaucoma had less visual acuity and higher grades of diabetic retinopathy. Diabetic retinopathy continued to be significant in the multivariate analysis adjusted by age and sex (p 0.008, Odds Ratio 1.9, 95% CI 1.3-2.7).

Table 1. Comparison between people with and without glaucoma.

Characteristics	No glaucoma	Glaucoma	P-value
Age (years), mean ±SD	60.1 ± 12.1	60.2 ± 11.1	0.454
Gender			0.960
female, N (%)	1523 (58.4)	81 (58.2)	
Visual acuity			
uncorrected			
OD, mean ±SD	0.7 ± 0.3	0.6 ± 0.3	**<0.001**
OS, mean ±SD	0.7 ± 0.3	0.5 ± 0.3	**<0.001**
with pinhole			
OD, mean ±SD)	0.8 ± 0.2	0.8 ± 0.2	**0.001**
OS, mean ±SD	0.8 ± 0.2	0.7 ± 0.3	**<0.001**
Intraocular pressure			
OD, mean ±SD	15.6 ± 4.4	15.6 ± 4.0	0.492
OS, mean ±SD	16.0 ± 4.5	16.8 ± 5.2	0.734
DR			**0.001**
no DR, N (%)	2059 (79.0)	92 (66.1)	
mild NPDR, N (%)	284 (10.9)	27 (19.4)	
moderate NPDR, N (%)	180 (6.9)	17 (12.2%)	
severe NPDR, N (%)	73 (2.8)	2 (1.4)	
PDR, N (%)	8 (0.3)	1 (0.7)	
Current health, mean ±SD	79.2 ± 18.9	79.9 ± 18.8	0.662
Health status, N (%)	1665 (65.0%)	87 (63.5%)	0.714

DR: diabetic retinopathy. NPDR: non-proliferative diabetic retinopathy. PDR: proliferative diabetic retinopathy. SD: standard deviation. 95CI%: confidence interval 95%.

Discussion

The prevalence of glaucoma in this study was 5.0%. This is higher than other papers which studied people without diabetes. A recent meta-analysis estimated a global prevalence of glaucoma of 3,5% in people between 40 and 80[1]. Different studies have associated diabetes mellitus with glaucoma[20-22]. Diabetes affects vascular tissues as well as neuronal and glial functions and metabolism in the retina, leading to apoptosis of retinal neurons, including ganglion cells. Impaired metabolism of neurons and glia by diabetes may make retinal ganglion cells more susceptible to stress related to open-angle glaucoma. Other factors that may accelerate the onset or aggravate the features of glaucoma include: increased transforming growth factor B; the formation of glycoproteoglycans in the iridocorneal angle; fibronectin deposits and cell depletion in the trabeculum[23-25].

In addition, it was observed that people with glaucoma are twice as likely to have diabetic retinopathy. Scientific studies have already studied this association and there are different pathophysiological mechanisms that relate them[11-17]. These mechanisms include: increased oxidative stress, vascular dysregulation, glial cell dysfunction, axonal transport abnormalities, genetic polymorphisms, among others[23-25].

On the other hand, new cases of ocular hypertension, having or are risk of developing glaucoma, were detected by the Program. From the total number of people evaluated, 11.4% had ocular hypertension. This group of people was referred for a second evaluation and follow-up by an ophthalmologist.

Regarding the use of telemedicine for early detection of glaucoma, it can be said that it is a controversial issue. The United States Preventive Services Task Force concluded in 2013 that there was insufficient scientific evidence to recommend the use of tele-screening in glaucoma[6]. However, some recent studies justify screening in the highest-risk population[6]. Intraocular pressure measurement was included as a screening strategy in La Pampa's Program for many reasons: glaucoma meets the Frame and Carlson criteria; the population has great difficulties in accessing a specialist; the aforementioned association between diabetes mellitus and glaucoma; and the low cost and simplicity of incorporating a tonometer[18-19].

The limitations of this study are related to the fact that: 1) the presence of glaucoma was based on patients' self-reports, which could lead to lack of precision due to a recall bias; 2) the tonometer used for glaucoma screening usually provides pressure values slightly above a Goldman tonometer (the rebound tonometer continues to be recommended for screening programs).

Diabetic patients in La Pampa's rural area have a high prevalence of glaucoma. Due to the association between both pathologies, glaucoma screening in early detection programs for diabetic retinopathy, is highly suggested.

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