Glaucoma in the English-speaking Caribbean

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ABSTRACT

The Barbados Eye Studies have provided the most comprehensive information on the major eye diseases in African origin populations to date. Black Barbadians have among the highest rates of primary open-angle glaucoma (OAG) reported to date in a population-based study (7.0%). Incidence rates of OAG over a nine-year follow-up period were 0.5% per year, and two to five times higher than reported in predominantly Caucasian populations. Risk factors for OAG included older age, male gender, higher intraocular pressure, positive glaucoma family history, in addition to lean body mass and a positive cataract history. Low blood pressure to intraocular pressure relationships were also found to increase OAG risk, suggesting an aetiologic role for low vascular perfusion of the optic nerve. Recent analyses revealed a region on chromosome 2 associated with increased OAG risk, which has potential implications for early diagnosis and treatment. Approximately 50% of Barbadians with OAG were unaware of having the disease in the baseline study and this situation remained unchanged nine years later. Open-angle glaucoma causes painless, irreversible loss of vision and there are clear reasons why screening may be of particular public health importance in high risk African descent populations, given the benefits of early detection and appropriate treatment. There are data that suggest that it would be cost-effective to conduct Open-angle glaucoma screening in Barbados and this has implications for policy and care, with the ultimate aim of reducing glaucoma-related blindness.

Keywords: Barbados Eye Studies, Caribbean populations, glaucoma

El Glaucoma en el Caribe Anglófono

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RESUMEN

Los Estudios Oftalmológicos de Barbados han proporcionado la información más integral sobre las principales enfermedades oculares en las poblaciones de origen africano hasta la fecha. Los barbadenses negros se cuentan entre las poblaciones con tasas más altas de glaucoma de ángulo abierto (GAA) hasta la fecha, según un estudio de base poblacional realizado (7.0%). Las tasas de incidencia de GAA en un período de seguimiento de nueve años, fueron 0.5% por año – de dos a cinco veces mayores que las reportadas predominantemente en poblaciones caucásicas. Los factores de riesgo para el GAA incluyeron los años de edad, el ser varón, el tener presión intraocular alta, y una historia de pruebas positivas de glaucoma en la familia, además pobre masa corporal, y una historia positiva de catarata. Se halló que las relaciones de baja presión sanguínea con respecto a la presión intra-ocular, aumentan el riesgo de GAA, sugiriendo así un papel etiológico a la bajo perfusión vascular del nervio óptico. Recientes análisis revelaron una región en el cromosoma dos, asociada con el aumento de riesgo del GAA, con implicaciones potenciales para un diagnóstico y tratamiento tempranos. Aproximadamente el 50% de los barbadenses con GAA no tenían conciencia de tener la enfermedad en el estudio inicial de partida, y esta situación permanecería invariable nueve años más tarde. El glaucoma de ángulo abierto causa una pérdida sin dolor e irreversible de la visión, y hay razones claras por las que el tamizaje puede revestir particular importancia para la salud pública de poblaciones de ascendencia africana en alto riesgo, dados los beneficios de una detección precoz y un

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tratamiento adecuado. Hay datos que sugieren que sería costo-efectivo llevar a cabo un tamizaje del GAA en Barbados, lo cual tendría implicaciones tanto en relación con las políticas a seguir cuanto para la atención misma, cuyo objetivo final reducir la ceguera relacionada con el glaucoma.

Palabras claves: Estudios oftalmológicos de Barbados, poblaciones caribeñas, glaucoma

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INTRODUCTION

The tremendous negative impact of eye disorders leading to low vision and blindness is rarely remembered when the toll of chronic non-communicable diseases is considered. Blindness due to glaucoma is eminently preventable with early detection and appropriate treatment. As a result of the work of the Barbados Eye Studies, much is now known about the inordinately high rates of glaucoma in the Caribbean region, and as glaucoma prevalence increases with age, this condition represents an important public health concern in ageing Caribbean populations. This report reviews the epidemiology of glaucoma in the Caribbean, highlights its public health relevance and suggests strategies to improve detection and treatment.

BACKGROUND

In 2002, there were approximately 161 million people worldwide who were visually impaired, 37 million of whom were blind (1). Glaucoma accounted for 12.3% of global blindness and was only exceeded by cataract (47.8%). Glaucoma is a group of ocular disorders that constitutes the leading cause of irreversible blindness worldwide. Primary open-angle glaucoma (OAG) is a term used to describe a group of chronic diseases of the eye causing progressive damage to the optic nerve and resulting in painless loss of vision. While current treatments cannot reverse optic nerve damage, early detection and adequate treatment can limit functional visual impairment and may prevent blindness.

Adults of African descent had long been known to be at increased risk of blindness, but there were still limited data on eye diseases available for such populations. The Barbados Eye Studies (BES) were conceptualised by Dr M Cristina Leske to address this important information gap. The main goals of the studies were to determine: a) the frequency of visual impairment, to inform and guide public health planning; b) causes and risk factors for visual impairment, to evaluate possible aetiologies; and, c) to explore ways to prevent or reduce visual loss, leading to appropriate prevention and control strategies (2, 3). The Barbados Eye Studies are now still the main source of data on all major eye diseases in populations of African ancestry namely, cataract, glaucoma, diabetic retinopathy and age-related macular degeneration.

After the successful completion of a pilot study in 1986, the BES, funded by the National Eye Institute, began with a baseline prevalence study conducted on a nationally representative random sample of Barbadian citizens, aged 40–84 years (n = 4709; 95% self-reporting African descent). There was high study participation (84%). The cohort was subsequently followed during the period 1992 to 2003 which allowed the collection of four and nine-year incidence data. Study participation remained high throughout and ranged from 81 to 85% (2–5).

The diagnosis of OAG was based on a strict clinical algorithm in which definite glaucoma required the co-existence of both visual field defects and optic disc damage, after exclusion of other causes at ophthalmologic examination (2). Visual field defects were evaluated by standardized glaucoma hemifield tests according to study protocols. Optic disc damage was assessed by independent review of masked photographic gradings and clinical gradings by the study ophthalmologists. Participants who did not fulfil all of the OAG criteria were classified as having suspect/probable OAG. Of note, intraocular pressure was not considered in the definition of OAG.

Open-angle glaucoma prevalence is highest in populations of African descent (6–8), and based on findings from the BES, it is now known that Black Barbadians have among the highest documented rates of OAG in population-based studies [7.0%] (2, 3, 9–14) as well as high rates of OAG-associated bilateral blindness (15–17). Prevalent glaucoma increased with older age, affecting 1 in 11 persons aged 50 years and older, increasing to one in six persons over the age of 70 years (2). Other OAG risk factors identified in the prevalence study were male gender, high intraocular pressure and a positive family history of OAG. The latter relationship was stronger among men, such that affected men with a positive family history of glaucoma had almost eight times the likelihood of OAG (compared to those without a similar history), while affected women had a twofold increased risk (18). Lean body mass and a positive cataract history were also related to increased OAG risk. While diabetes and hypertension are highly prevalent conditions among Barbadians, neither condition was associated with risk of glaucoma. Importantly, high intraocular pressure as well as low blood pressure to intraocular pressure relationships were positively associated with glaucoma risk, suggestive of adverse effects of low vascular perfusion across the optic nerve.

Based on the nine-year follow-up of the cohort, incidence of definite OAG was 4.4% or 0.5%/year (5). These rates were far higher than incidence rates reported in

Caucasian populations in Sweden [0.24% per year] (19), Australia [0.10% per year] (20) and the Netherlands [0.12% per year] (21). Age at baseline was a key risk factor; there being a four-fold risk of developing OAG among those aged 70 years and older compared to those aged 40 to 49 years. These findings provided confirmation of the suspected inordinately high rates of OAG in Afro-Caribbean and similar populations.

In addition to age, other risk factors for developing OAG by the nine-year follow-up were elevated intraocular pressure (Relative Risk (RR): 1.1 (95% CI: 1.1, 1.2) per mmHg); a positive family history of glaucoma (RR: 2.4 (95% CI: 1.3, 4.6)); lower systolic, diastolic and mean perfusion pressures [all $p < 0.05$] (22). Thinner corneas (Odds Ratio (OR): 1.4 (95% CI: 1.0, 2.0)) and lower systolic blood pressure were also related to increased glaucoma risk.

The strong association between family history and OAG risk in the prevalence study (23, 24), underpinned the Barbados Family Study of Open-Angle Glaucoma, a family study evaluating genetic risks for OAG. This research led to the identification of a region on chromosome 2 which is associated with a significantly increased risk of glaucoma in Barbadians (25). This novel finding has potential implications for new tests and treatments for Barbadian and similar populations.

The frequency of undiagnosed OAG in the BES was high. In the baseline prevalence study, approximately 50% of the participants diagnosed with OAG were unaware of the diagnosis (2). Open-angle glaucoma awareness was therefore reappraised among study subjects who participated at the nine-year follow-up (26). More than half of the participants with incident OAG were also discovered to be unaware of their diagnosis. Factors associated with unawareness included lower intraocular pressure at baseline (OR: 0.86 (95% CI: 0.8, 0.9)), hyperopia or farsightedness (OR: 2.7 (95% CI: 1.1, 6.7)), and of particular interest, patterns of eye care utilization. Persons who were unaware of having OAG prior to re-examination at the nine-year evaluation attended eye care visits less frequently than those who were aware of their diagnosis (33.4% and 64.4% respectively). Persons who were unaware also sought care principally for eyeglasses compared to 'aware' participants who attended mainly for other causes (71.4% and 12.5% respectively), and were four times more likely to consult optometrists or opticians than private ophthalmologists (OR: 4.2 (95% CI: 1.0, 7.7)). The unaware participants were also much less likely to consult a public ophthalmologic clinic (OR: 0.2 (95% CI: 0.04, 0.9)). It is indeed worrying that the expected heightened awareness of eye disease among Barbadians due to the conduct of the BES did not translate to increased awareness or detection of OAG.

Implications of OAG

Blindness

About 12% of all blindness occurring worldwide is due to OAG (1). The primary causes of incident blindness in the BES at nine-year follow-up, based on 56 bilaterally affected eyes, were cataract and glaucoma in nearly three quarters of all cases (17). The most frequent causes were cataract alone (42.9%) and OAG alone (21.4%), with 7.1% being blind from a combination of both causes. Diabetic retinopathy in contrast, accounted for 8.4% of incident or new cases of blindness. Open-angle glaucoma, therefore, contributes far more to the burden of blindness in this Afro-Caribbean population than seen in much of the world, demonstrating the significant impact of this condition in the region. As noted, OAG-related blindness is irreversible. While cataracts remain the principal cause of new cases of blindness among Barbadians, they are easily corrected by surgery.

Quality of life

Many persons are worried about possible adverse outcomes of eye disease. A global study revealed that nearly twice as many people fear going blind than having heart disease or dying prematurely (27). The Barbados Eye Studies also evaluated the impact of glaucoma on quality of life (28). Based on scores reported by participants for activities which required good distance vision, colour and peripheral vision, good social function and mental health were significantly lower in participants with OAG than those without. Persons with OAG also reported more driving difficulty. These data confirm that disabilities related to OAG extend well beyond clinically measurable vision defects.

Is glaucoma screening cost-effective?

While it is known that blindness due to glaucoma is eminently preventable with early detection and treatment, as early stage glaucoma is asymptomatic, disease detection requires screening of the population. A key challenge for healthcare systems is to find cost-effective ways for the early detection of glaucoma.

Information on the social and economic burden and the cost-effectiveness of treatment of glaucoma in the developing world is limited. A recent study utilized computer modelling to simulate the current and future epidemiology, outcomes and treatment of primary open-angle glaucoma in high-incidence populations of the developing world, focussing on Barbados and Ghana (29). The authors reported that Barbados incurs relatively greater social and economic costs from glaucoma than Ghana. There is significant debate about the cost-effectiveness of screening for glaucoma in other countries with low rates of glaucoma. The United States Preventive Services Task Force (USPSTF), in 2005, did not recommend screening for glaucoma. However, the populations to whom these policies apply (based on best evidence) are at low risk for OAG.

In contrast, Barbados has high rates of glaucoma and the authors concluded (using 3 statistical models) that screening for glaucoma in Barbados would be cost-effective. Screening of an entire population for glaucoma has been difficult to justify for populations with a low glaucoma risk, but for Barbados, universal screening of the entire population at ages 45, 55, 65, 75 and 85 years, still proved to be cost-effective.

It should be noted that glaucoma screening includes an ophthalmic examination, which has the added benefit of identifying persons at risk for other potentially blinding eye conditions such as cataract and diabetic retinopathy, and appropriate treatments reduce the social and economic burden of visual impairment in the country.

The social and economic burden of glaucoma is higher in communities with high rates, older populations and higher per capita gross domestic product (GDP). Similarly, lower mortality rates and higher per capita GDP are associated with increases in the relative cost-effectiveness of screening and treatment interventions intended to mitigate the burden of glaucoma.

That being said, feasibility and cost-effectiveness of screening are difficult to extrapolate across Caribbean countries, with vastly different geographic sizes and layout, varying access to free healthcare and varying levels of available ophthalmologic expertise and services.

Strategies to deal with glaucoma in the Caribbean

The major strategy to reduce visual loss from glaucoma is to enhance early detection and treatment. In persons affected by glaucoma, treatment to lower intraocular pressure has been proven to prevent worsening of visual loss. This effect was clearly shown in large scale clinical trials: the Early Manifest Glaucoma Trial [EMGT] (30) and the Collaborative Normal Tension Glaucoma Study [CNTGS] (31). The results of the EMGT in particular (incidentally, M Cristina Leske who led the Barbados Eye Studies was also a principal investigator on this project), underscore the importance of early detection. In addition, the Ocular Hypertension Treatment Study proved that treatment of patients with high eye pressure halved the risk of subsequent glaucoma (32).

Screening is the detection of individuals with a disease, before symptoms occur. The question may then be asked: should screening be made available? The World Health Organisation provides guidelines which include: the condition should be an important health problem; there should be acceptable treatments or interventions as well as screening tests; there should exist facilities for diagnosis and treatment; clear policies should exist for treatment policies; early treatment should be more beneficial than later treatment; case finding should be ongoing; and the process should be economically feasible. The current state of knowledge based on available evidence is consistent with OAG screening being an appropriate strategy in high-risk populations. As glaucoma remains asymptomatic until late stage disease, there is ample opportunity to identify affected persons in the pre-symptomatic phase. Glaucoma screening may be aimed at an entire population, or at high-risk groups.

Early detection in high risk groups

To maximize effectiveness, these efforts should target high-risk groups, in particular relatives of persons with OAG with comprehensive screening for the condition. After diagnosis, appropriate clinical management is essential. Effective treatment with high patient adherence is key to successful outcomes. The EMGT also provides an evidence base for tailoring glaucoma treatment to the individual patient, and supports established standards of clinical care.

Major risk factors for glaucoma include having first degree relatives with glaucoma, raised eye pressure, and older age (> 40 years). Screening of high risk groups should not be done in the tertiary care setting, but rather a primary care model for screening would need to be developed. The feasibility and logistics of screening would have to be unique to each country.

The ideal screening model would involve dispatching a mobile glaucoma unit equipped with digital imaging systems and experienced operators to capture clinical data in the community, which could then be interpreted centrally by experienced clinicians. This would require technological resources unavailable in most countries at present (although the technology does exist) and would therefore require significant start-up costs, but may be more cost-effective in the long run.

Appropriate clinical management

Early detection requires that, downstream, there are adequate systems to handle the new cases of glaucoma that will be detected. This is critical, as patients will require lifelong follow-up. Patients with glaucoma need to be managed by ophthalmologists, ideally with specific glaucoma experience, in line with recognized guidelines for standardized care. Again, this needs not be confined to the tertiary care setting, as long as ophthalmologists can be available in the community setting. Tertiary care settings should be reserved for more complex patients with advanced disease.

Countries would require an investment in the training of ophthalmologists as sub-specialists in the field of glaucoma, particularly to care for the high proportion of complex and advanced glaucoma cases found in a population of African descent.

Treatment of glaucoma is lifelong and requires access to and use of eye drops, laser treatment and surgery, as indicated for each individual patient.

Research

The Barbados Eye Studies have provided us with a wealth of information on eye diseases in Barbados, and underscore the importance and impact of robust research. These studies have informed healthcare policy for African Americans, as

there were no comparable data available in the United States of America (USA). These studies represent an important and unique evidence base to inform eye care in Barbados and the wider Caribbean, to prevent avoidable blindness in the Caribbean, as has been done in the USA. There have also been recent genetic discoveries related to glaucoma which might have future applications for screening and treatment.

CONCLUSION

Glaucoma is the leading cause of irreversible visual impairment and blindness in Barbados and worldwide. The consequences of the disease have a significant social and economic burden on society. Demographic factors such as the region's ageing population, which co-exist with environmental and possibly unique genetic factors, will likely lead to an increased burden of glaucoma over time. It is within our grasp to implement appropriate screening and treatment strategies to prevent or reduce visual impairment due to glaucoma.

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