Review Article

Glaucoma in Developing Countries

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Abstract

Glaucoma is a leading cause of blindness worldwide. The diagnosis and management of glaucoma is especially difficult in the developing countries. Lack of cost effective screening strategies, low income, low rates of literacy and inadequate infrastructures and human resources for eye care services are the obstacles for delivering glaucoma service. Majority of people with glaucoma in developing countries usually present at an advanced stage at the time of diagnosis; which negatively affects their quality of life. Further research, proper allocation of resources and collaborative effort by blindness prevention programs will hopefully provide new evidences on cost effective ways to screen and manage glaucoma in the future. This article aims to highlight the burden of glaucoma and ways to address the challenges in developing countries.

Key words: Developing countries, Glaucoma.

Introduction

Glaucoma is the leading cause of irreversible blindness worldwide (Bourne et al., 2013). In 2010, there were 4.5 million people bilaterally blind from primary open angle glaucoma (POAG), and 3.9 million people from primary angle closure glaucoma (PACG). The numbers are expected to rise by 2020, when 5.9 million people will be bilaterally blind from POAG and 5.3 million people from PACG (Quigley and Broman, 2006).

The global prevalence of glaucoma in 2013 was 3.5%. By region, the highest prevalence of POAG was seen in Africa (4.2%) and PACG in Asia (1%). The number of people with glaucoma will increase worldwide to 76 million in 2020 and 111 million in 2040, disproportionately affecting Africans and Asians (Tham et al., 2014;

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Quigley and Broman, 2006). Within Africa, the prevalence of glaucoma was highest (6.8%) in West Africa where POAG was responsible for 2.5% of the blindness (Budenz et al., 2013). The overall prevalence of glaucoma in Asia was 3.5% and comprises almost 60% of the world's total glaucoma cases (Quigley and Broman, 2006; Wong et al., 2006; Tham et al., 2014). Although the prevalence of PACG was lower than POAG, PACG was responsible for 91% of bilateral glaucoma blindness (Foster and Johnson, 2001). The drawback of the available epidemiology regarding the glaucoma burden in the developing country is the reliance on visual acuity thresholds for diagnosing glaucoma (Bourne, 2020). This could have led to an artifactual error in estimation of glaucoma prevalence in the developing countries, as visual acuity can be normal even in advanced stages of glaucoma.

Discussion

Glaucoma is a public health problem (Lawlor and Thomas, 2014; Kyari et al., 2013), however, there is lack of awareness and knowledge about the disease in the general population (Thapa et al., 2012; Thapa et al., 2011; Jacob et al., 1998; Dandona et al., 2000b; Dandona et al., 2000a; Sakata et al., 2007; Sathyamangalam et al., 2009). Nearly 90% of glaucoma cases are undiagnosed in developing countries (Dandona et al., 2000b; Ramakrishnan et al., 2003; Thapa et al., 2012; Sakata et al., 2007; Buhrmann et al., 2000; Rotchford and Johnson, 2002; Budenz et al., 2013). The diagnosis of glaucoma is challenging, even in well-equipped centers. Detecting glaucoma is not as straightforward and easy as diagnosing systemic hypertension or diabetes (Leite et al., 2011). Population-based screening is currently not a feasible strategy and we have to rely on case detection in the clinic (Thomas et al., 2003). The ever increasing world population and with increase in the average life expectancy of people, POAG has become a major cause of ocular morbidity in the developing world (Thomas et al., 2005). Poor infrastructure and inadequate human resources are major barriers against the delivery of eye care in developing countries. The ratio of ophthalmologists to the general public is estimated to be 1:500,000 people in Africa and 1:200,000 in Asia (Thylefors, 1998); while this number is 1:100,000 in India (Thomas et al., 2005). The other problem with developing countries is the concentration of ophthalmic centers mainly in the urban areas (Thomas et al., 2003; Standefer, 2010). Thus people residing in the rural areas neither have easy access to eye care service, nor transportation to reach the urban centers. This directly affects their healthcare seeking behavior, resulting in a higher probability of developing blindness from glaucoma. A study from Africa showed that the residents from rural areas had a higher chance of developing blindness from glaucoma when compared to those from urban areas (Ntim-Amponsah, 2002).

A delay in diagnosing glaucoma is another major challenge in the developing countries (Leite et al., 2011). Population based studies from developing countries show that majority of patients have moderate to severe disease at the time of presentation (Adekoya et al., 2015; Thomas, 2012; Dandona et al., 2000b). A study from Ethiopia showed that even in cases of childhood glaucoma, the presentation is usually late and at an advanced stage (Ben-Zion et al., 2011). Distance from the nearest eye center, travel cost and cost of treatment complicate the diagnosis and monitoring of the disease (Leite et al., 2011; Lazcano-Gomez et al., 2016; Adio and Onua, 2012; Adekoya et al., 2015). A widespread gap in knowledge exists among all levels of eye-care workers that include ophthalmologists working in secondary and tertiary eye care institutions. Most ophthalmologists in the Indian subcontinent do not practice the comprehensive eye examination

as recommended by guidelines (Thomas et al., 2003; Thomas and Dogra, 2008). The quality of residency programs varies tremendously within the Indian subcontinent. Studies have shown that the residents were either not taught or did not practice a comprehensive ophthalmic examination (Thomas et al., 2001; Thomas, 1999; Thomas and Dogra, 2008). When gonioscopy, dilated examination of the optic disc and monitoring intraocular pressure were not routinely practiced, glaucoma cases were missed (Thomas et al., 2003).

Glaucoma demands lifelong medical therapy, medications do not improve vision, have side effects, and are expensive (Leite et al., 2011). The high cost of treatment, unavailability of medications and the guarded outcome of surgery have led to poor compliance with glaucoma therapy (Dasgupta et al., 2002). Compliance also depends on the socio-economic status and level of education of the patient (Friedman et al., 2009).

The US Preventive Services Task Force reported that there was insufficient evidence to assess the benefits and harms of screening for POAG in adults (Moyer, 2013). However, for PACG in Asia, a population attributable risk percentage (PAR%) for the prevention of progression to early PACG was 65%. This was based upon the assumption of prevalence and relative risk using the Early Manifest Glaucoma trial (Thomas et al., 2007). Over 80% of those with ACG live in Asia (Quigley and Broman, 2006); it is therefore imperative to address PACG as a disease of significance in Asia. Studies that utilized the glaucoma prevalence estimate from India showed an effective PAR% for primary angle closure suspect (PACS), primary angle closure (PAC) and POAG to be 56.4%, 65% and 16%, respectively, for developing countries (Thomas et al., 2005; Thomas et al., 2007). These PAR% values are high enough to warrant a relatively cost-effective community glaucoma screening program for the 40-69 years of age group when performed in conjunction with trained ophthalmic assistants and glaucoma specialists (John and Parikh, 2017). A recent study from China showed that population screening for glaucoma (both POAG and PACG combined) is likely to be cost-effective in both urban and rural China (Tang et al., 2019). However, most developing countries do not have the required infrastructure to provide services to the diagnosed cases of glaucoma, let alone the extra cases that would be identified through screening (Thomas et al., 2002).

Though recent studies from India (John and Parikh, 2017) and China (Tang et al., 2019) have shown community screening of glaucoma to be cost-effective; opportunistic screening of patients with risk factors for glaucoma by performing a comprehensive eye examination is the universal rule at present. Population based studies need to be performed for other developing countries that help to formulate strategies to deal with the existing problems (Leite et al., 2011; Kyari et al., 2013), identify the target risk groups and barriers to awareness and knowledge about glaucoma (Kyari et al., 2013). The focus should be on detection of moderate to advanced glaucoma cases, those at risk of blindness. Thus, opportunistic case detection rather than large population based glaucoma screening is recommended for developing countries (Thomas et al., 2002). Effective public education and targeted screening of high risk groups are necessary if the number of blind from glaucoma is to be reduced worldwide (Chen, 2004). To improve detection of glaucoma, the current strategies should aim at increasing awareness of the disease among the general population (Leite et al., 2011); and encourage case finding in first-degree relatives (Kyari et al., 2013).

Eye centers around the world have been hosting an annual Glaucoma Awareness Week with the objective of educating glaucoma patients and

their families, promoting public awareness and providing financial support when needed. Screening during the glaucoma awareness week at a tertiary eye center in Nepal, from 2004 to 2007, resulted in the diagnosis of glaucoma among 120 individuals, which was 7.6% of total registrants (Thapa et al., 2008).

Integrating primary care with eye care for glaucoma screening, patient education and early referral too can play a substantial role in glaucoma management (Rotshtein et al., 2015). The WHO recommended a primary healthcare approach to address the issue of accessibility in developing countries in 1984 (du Toit et al., 2013), but integration of glaucoma management into primary care in the developing countries may seem far from reality in most developing countries (du Toit et al., 2013; Leite et al., 2011; Rao, 2015).

A pyramidal approach to eye care delivery has been advocated by the World Health Organisation (WHO) for the South East Asia region (Rao, 2004), which has been further modified as the L V Prasad Eye Institute (LVPEI) pyramidal model of eye care delivery (Rao, 2015). This pyramidal approach has also been successfully implemented at major eye centers of the developing world, such as Aravind Eye Care System in India and Tilganga Institute of Ophthalmology in Nepal. At the primary level, Primary Care Centers have been delivering basic eye screening and referrals with the help of vision technicians. In very remote areas, Nepal has been successfully conducting outreach programs, almost exclusively for cataract detection and surgery. These programs can be used as opportunities for glaucoma screening (Thapa et al., 2008). In a study done during the community based cataract outreach programs in Nepal, the opportunistic screening of glaucoma showed the prevalence of glaucoma to be 3.37% in people ≥50 years of age (Rajbanshi, 2019). The use of phone-based fundus cameras for optic disc photography and telemedicine too will help in glaucoma case detection at the community level. Besides, for delivering better health services at the primary level, the government can lure ophthalmologists to work in the rural areas by providing proper incentives.

Secondary Care Centers are led by ophthalmologists and provide comprehensive eye care services. It has been recommended that strengthening the secondary level of eye care would lead to better accessibility, affordability and minimization of the travel cost to the tertiary care centers (Rao, 2015). At the tertiary level, besides providing quality eye care services, the key to successful management of glaucoma lies in improving the residency programs; residents learning to practice a complete ophthalmic examination; and finally imparting their knowledge to others (Thomas et al., 2003). Implementing a "training the trainers" program for glaucoma (as of the World Bank assisted cataract surgery program) that trains a core, critical mass of trainers is highly recommended (Thomas, 1999; Lawlor and Thomas, 2014). At the secondary and tertiary levels routine examination of optic disc under mydriasis, and glaucoma investigations as necessary, should be practiced on all glaucoma suspects. Reimbursing the expenses through the national/private health insurance scheme will help to improve the sustainability of this practice.

Teleophthalmology is of importance in developing countries as technology can potentially reduce the cost of healthcare and the number of patients with late-stage glaucoma (Delgado et al., 2019). Tele-ophthalmology can have a significant role in screening glaucoma cases (Sharafeldin et al., 2018). The inadequate number of ophthalmologists has led to the utilization of mid level ophthalmic personnel (MLOP) for delivering eye care (du Toit and Brian, 2009), especially in less populated and remote areas (Thapa et al., 2016).

Glaucomatous changes in the optic disc and an abnormal visual field have been suggested as possible ocular parameters for screening glaucoma (Thapa et al., 2012; Vijaya et al., 2008). Low-cost, portable fundus photography and perimetry could have an important role for case detection (Miller et al., 2017; Johnson et al., 2017). Combining the above technologies to screening by utilizing MLOPs, will be an area of further research for screening glaucoma in developing countries.

A worldwide price assessment of glaucoma management has revealed that the costs of medical, laser, and incisional surgical interventions were 2.5% or more of the median annual household income for many patients (Zhao et al., 2018). A cross-sectional study from India showed that the average cost of glaucoma drugs alone ranged from 13% to 123% of the monthly income of the lower income group patients (Nayak et al., 2015). In Nigeria, though the average cost of glaucoma medications was USD 40/month, the indirect costs of tests, transportation and escorts added another USD 105.4/month (Adio and Onua, 2012). This reiterates that glaucoma treatment is unaffordable to most of the people residing in developing countries. Providing cheap health insurance for the lower income group patients too can help early diagnosis of the disease and the continuation of the medical treatment. In the context of India, the average expenditure per month on beta blockers was 4 times less than prostaglandin analogues (Nayak et al., 2015). Thus if timolol is not contraindicated, it is always preferable to begin anti-glaucoma therapy with timolol from a cost-effective standpoint (Lachaine et al., 2008). Besides telemedicine also helps to reduce the expenditure of travel, stay and loss of wages for the patients travelling from rural parts to cities for treatment. Charging money from those who can pay and providing free treatment to the most needy has been practised in many eye centers of Nepal. This practice seems to be a sustainable way to provide eye care to those who can not afford treatment.

All glaucoma clinics must provide enough time for a good doctor-patient interaction and the patients should be counselled by the treating doctors. This has been linked with greater compliance rates (Nayak et al., 2015). If this is not possible due to limited resources, the hospital should arrange specifically trained counselors to provide proper counselling to the patients regarding the disease and the importance of adherence to treatment.

A paradigm shift towards surgery as the first line of treatment in the developing countries to mitigate the problems of accessibility, repeated hospital visits and cost related to drugs has been recommended (Thomas et al., 2003; Leite et al., 2011). Though surgery carries more risks, it may be a better option for developing countries where compliance and follow up is an issue and the acceptance increases on educating the patients about their disease (Thomas et al., 2004; Anand et al., 2007). Trabeculectomy is still the most commonly performed glaucoma filtration surgery worldwide despite the variability in outcome (Racette et al., 2003; Leite et al., 2011; Thomas et al., 2003). In countries with limited resources, the Blumenthal small-incision technique of cataract extraction combined with trabeculectomy is a safe and cost-effective alternative to phacoemulsification and trabeculectomy (Thomas et al., 2004). In recent years, the outcome of glaucoma implants has been encouraging as a primary treatment and with less complications when compared to trabeculectomy (Bouhenni et al., 2018) (Gedde et al., 2010). The availability of a low cost glaucoma implant (Aurolab Aqueous Drainage Implant) has made glaucoma implant surgery a favorable option in developing countries (Pathak Ray and Rao, 2018). Laser trabeculoplasty was always an interesting option as primary treatment for POAG (Juzych

et al., 2004; Buys, 2006), but its efficacy was deemed to be limited by the level of intraocular pressure reduction and by the duration of the effect (Fink et al., 1988; Juzych et al., 2004). However, a recent multicenter trial, Laser in Glaucoma and ocular Hypertension (LiGHT) concluded that the cost-effectiveness, clinical effectiveness, and safety favored selective laser trabeculoplasty as the first line therapy (Gazzard et al., 2019). For those with angle closure glaucoma, cataract surgery is also an option (Gunning and Greve, 1998; Javanbakht et al., 2017; Azuara-Blanco et al., 2016; Moghimi and Lin, 2011; Thomas et al., 2004). Clear-lens extraction had a greater efficacy and was cost effective when compared to laser peripheral iridotomy, and can be considered as a first-line treatment of PACG and primary angle closure with high intraocular pressure (Azuara-Blanco et al., 2016; Napier and Azuara-Blanco, 2018). These evidence have led us to believe that programs directed to eliminate cataract blindness could play an important secondary role in the prevention of PACG.

WHO estimates that at least 2.2 billion people worldwide have vision impairment and among them 1 billion people with vision impairment that can be avoided or is yet to be addressed (World Health Organization, 2019). According to the Global Burden Disease Study, there has been a substantial increase in the number of blind people due to the increase in aging population, thus demanding a large scale up of the eye care services (Bourne et al., 2012). Case detection, management and referral of glaucoma patient is much more challenging than screening for cataracts. Glaucoma patients, especially those residing in areas with limited access to eye care face major challenges for a long term follow up. In the future, there has to be ways to combine screening for glaucoma alongside cataract programs, which will help detect glaucoma cases. Further research will hopefully provide new evidence on cost effective ways to screen, enhance the outcome of surgery and improve compliance to therapy. With the proper allocation of resources, collaborative effort of blindness prevention programs and an integrated approach for comprehensive eye care, there is hope that glaucoma blindness in the developing countries will decline in the future.

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