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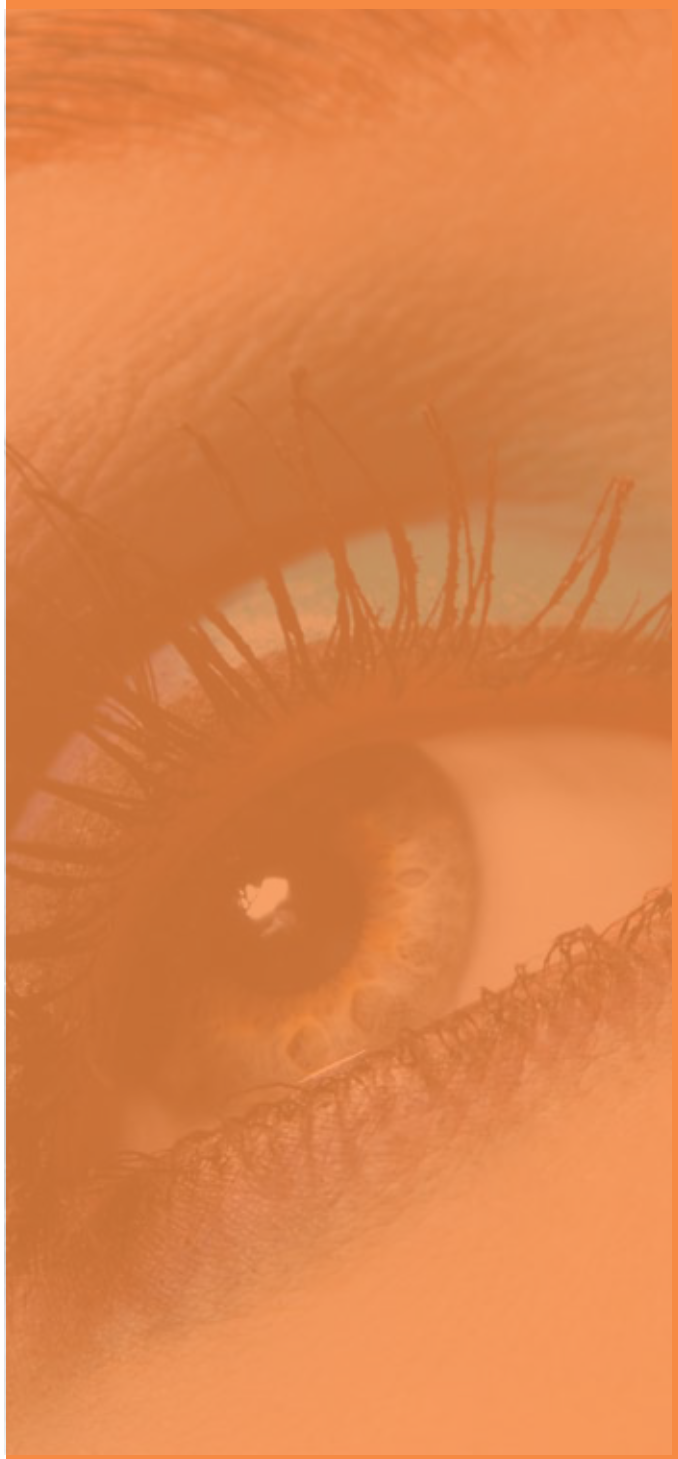

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Eye health in Kenya: 50 years on, what have we to show for it?

Though contemporary recorded history gives a lot of prominence to the rise and development of ophthalmology in western civilization, the birthplace of ophthalmology is arguably in Africa. There is archaeological evidence of an oculist in the Egyptian court as early as 2500BC. Egyptian papyrus records from 1600BC have an entire section devoted to eye disease and couching was already being practiced. Ophthalmology has evolved from these early descriptions of eye conditions, through the elucidation of ocular anatomy and to interventions to improve and even restore eye health.

In Kenya, the first contemporary providers of eye care were opticians that came over from India with the building of the railway in the 1900s. However, co-ordinated eye care as we recognize it today began as an initiative of the Royal Commonwealth Society for the Blind (1950 to date - currently operating as Sight savers) and supplemented by Sight by Wings (started in 1971). The Kenya Society for the Blind (KSB) was the local implementing partner for the Royal Commonwealth Society for the Blind. These organizations would bring in doctors from abroad to provide eye care particularly in the rural areas. Essentially eye health care provision was provided by private healthcare sector players in the *de facto* vacuum left by both the colonial and post-independence governments. This may explain why eye health is to date still viewed by many as an adjunct to health in general and not of primary concern.

When eye care service is mostly provided by the private sector, reach to the general population is limited and it is perceived to be a special service to be accessed only by the select few. Where the poor, remote and socially disadvantaged persons accessed eye care, it was provided by the 'not-for-profit' private sector players, which further propagates the idea that it is not a service to be accessed by all. It is viewed as a gift or favour by those providing the service. It also has played a role in creating the culture whereby the general Kenyan population has low willingness to pay for eye care services as they are deemed to be free services. This has implications on health financing and sustainability of eye care programs.

Even with the government's entry into the provision of eye care services, the field was and still is heavily influenced by private sector for profit and not-for-profit. Most professional eye care services are mostly found in urban areas and in regions where the not-for-profit organisations or social entrepreneurs have had an interest. This may have contributed to the beginning of a skewed distribution of eye care services, both in terms of infrastructure and personnel.

By the time the first Kenyan ophthalmologist, Professor Henry Adala, began his training in 1974, there were three ophthalmologists in the country, who were located in Nairobi and Kisumu. This number grew to 10 by 1980, most being ophthalmologists trained abroad. The start of the Department of Ophthalmology in the University of Nairobi in 1978 contributed to an increase in the number of ophthalmologists and may be seen as the official start of government participation in provision of eye health services. This was further enhanced by the setting up of the Kenya Ophthalmic Program (KOP) by the government in 1980 to coordinate eye health activities in the whole country. In 2002, KOP was upgraded to a full Division of Ophthalmic Services (DOS) of the Ministry of Health (MOH) with several national programmes. DOS is currently known as the Unit of Ophthalmic Services (OSU) which serves as Secretariat for the National Inter-agency Coordinating Committee for Eye Health. The first KOP coordinator was Dr. Walia Dharminder Singh and the founder Head of DOS was Prof. Jefitha Karimurio.

With time it was realised that the rate of training of ophthalmologists could not keep up with the need for eye care services. As part of the effort to provide adequate and accessible eye care, training of mid-level ophthalmic care officers began. Notably, Dr Mark Wood and Dr David Yorston working at Kikuyu Eye Unit were instrumental in starting short courses that trained ophthalmic nurses and ophthalmic assistants in the 1980s. The Kenya Medical Training College also contributed to the increase in human resource for eye health by training of ophthalmic clinical officers and cataract surgeons from 1986 and later ophthalmic nurses, optometrists and even low vision specialists. At present Masinde Muliro University of Science and Technology also trains optometrists.

There has been a steady increase in the numbers of eye healthcare professionals in the years since then which is commendable. However, despite the good progress, the World Health Organization recommended ratios of each cadre to the population have not been realised to date. There is need to rethink the composition of eye healthcare professionals in terms of numbers, cadres distribution and methods of training, if Kenya is ever to attain these VISION 2020 ideals.

As we move into the next half century of independence, we should pause, look at where we have come from and take stock. What have been our triumphs? Can we celebrate these? What oversights have we made? What lessons can we learn from them? What do we want the next 50 years to look like? What steps do we need to take to realise these dreams?

Mutie D[1], Ogundo C[2]

[1]Kenya Medical Training College, Nairobi, Kenya

[2]Mbagathi County and Referral Hospital, Nairobi, Kenya

Corresponding author: Dr D Mutie, Kenya Medical Training College, Nairobi, Kenya. Email: dotmwende@gmail.com

What is a good PhD program in ophthalmology?: Students' perspective

Mwangi N[1, 2], Rono H[1, 3], Arunga S[1, 4], Mdeme F[1, 5]

[1]International Centre for Eye Health, London School of Hygiene and Tropical Medicine, London, United Kingdom
[2]Kenya Medical Training College, Nairobi, Kenya
[3]Kitale County Referral Hospital, Kitale, Kenya
[4]Mbarara University of Science and Technology, Mbarara, Uganda
[5]Kilimanjaro Christian Medical College, Moshi, Tanzania

Corresponding author: Dr Nyawira Mwangi, London School of Hygiene and Tropical Medicine, London, United Kingdom. Email: Nyawira.Mwangi@lshtm.ac.uk

ABSTRACT

Access to doctoral studies is increasing and the impact of PhD programs is generally understood to be positive. However, the lack of clarity about what a PhD entails can be a barrier to student entry into the programs. During the pre-entry period, students need to consider the reasons for choosing to take PhD and the value expected from it. In practice, this involves complex considerations related to personal, institutional, logistical and PhD program characteristics. As such, prospective students would benefit from a reflection on these factors in advance of registering for the PhD. Realising that there is a limited published literature on what makes a PhD 'good', in this paper we explore the factors that contribute to students' perception of a good scholarly engagement. We use an interview format to report on some broad areas of relevant consideration. We conclude that sustained student motivation, effective supervision, adequate facilities and a supportive environment are pertinent for the learning that makes a PhD 'good'.

Key words: PhD, Doctorate, Doctoral students, Eye health, Ophthalmology

INTRODUCTION

The significance of doctoral studies in the emerging knowledge economy is increasingly receiving international recognition[1]. This means that for the Eastern, Central and Southern Africa (ECSA) region to be a serious competitor in the global knowledge economy, access to quality doctor of philosophy (PhD) programs need to increase dramatically to meet current and future demand. This is especially true for the demand for researchers and supervisors for doctoral students. In the area of eye health, graduate medical education (such as residency in ophthalmology) is fairly available in the region, and there is now a modest pool of graduates who may be interested and eligible for PhD studies. The benefits of PhD training are particularly relevant to eye care and to these countries as they are actively building an eye health workforce.

However, uptake of PhD training remains low due to several reasons. Firstly, there is notable paucity of PhD programs that are relevant to the contextual eye health priorities[2]. Secondly, although there are many driving forces to undertaking a PhD, the return on investment for potential students is often unclear, which may deter or delay their enrolment and completion of studies[3]. The resultant low student enrolment and completion rates means that on the long-term, there are fewer academics with PhDs in the ECSA region. Thirdly, there is limited understanding of contextual factors that potential students need to consider before choosing a PhD program. This is important to understand, since PhD studies are expensive and lengthy, and a good fit of a PhD program is more likely to lead to successful completion.

This article highlights key considerations for undertaking a PhD, from a student perspective. We aimed to answer the research question 'What is a good PhD?' with a focus on what a potential student might need to know during the pre-registration phase. Our hope is that these perspectives, which are derived from lessons learnt on the PhD, will provide guidance for future PhD scholars. We have proposed eight broad areas of important consideration and we frame them as questions.

MATERIALS AND METHODS

We report on some reflections of doctoral international students studying at the International Centre for Eye Health, London School of Hygiene and Tropical Medicine (LSHTM). The context of the reflection is an informal student discussion during term time. The participants are a convenience strategic sample of students who were in session at the time of the discussion and who represented different countries.

Prompted by the prospect of completion of studies, we discussed about our recent experience. After the discussion, we realised the need to share

these thoughts with an audience of potential students. Thus, we reviewed the themes (domains) that emerged from our discussion. The first theme related to the pre-registration considerations, such as how to choose a topic, an institution or a supervisor. The second theme related to the value of the PhD, for example in life-skills or in increasing employability. Based on these themes, we developed eight questions to guide us with further reflection (Table 1) and documented our responses.

Table 1: Interview questions

Domain	Questions
Pre-registration choices	1. Why should one study for a PhD and how would one choose a topic? 2. What individual / personal characteristics/factors should you consider before registering for a PhD? 3. What are the principal attributes of a good supervisor? 4. How can you choose the university for your PhD? 5. What makes a particular school in the university good for your PhD studies? 6. Does the location of the university matter?
Value of a PhD	1. What transferable skills should one learn during the PhD? 2. What other comments would you give about the characteristics of a good PhD program?

RESULTS AND DISCUSSION

We present the findings and discussion in an interview format here below.

Simon Arunga

1. **Simon, why did you choose to study for a PhD and how did you choose the research topic?**
   I love research and always wanted a career in research. I did my PhD to develop skills as an academic to be able to do this independently. Being an ophthalmologist and clinical lecturer at Mbarara University of Science and Technology, I also wanted to better my chances of growth and promotion at work.

   The first surgical procedure that I performed as a resident was an evisceration in an eye with severe keratitis. The spill over impact of this was that I developed great interest on the cornea. Thus naturally I had a predilection for research on corneal pathology. Meeting Prof Matthew Burton who has a similar interest reinforced the inclination to corneal research.

   However, after registering for the PhD at the London School of Hygiene and Tropical Medicine, it took me almost whole year to settle down on the specific research question that I was going to pursue for my work on 'microbial keratitis in south-western Uganda'.
2. **What individual / personal characteristics/ factors should you consider before registering for a PhD?**
   One should be highly motivated to go all the way. PhD is a lot of work with no immediate renumeration. There needs to be a strong social/ family support: if one has a partner, the partner buy-in is key. If the PhD is to be done in a different setting from where one is working, there needs to be local support to give the person time away to focus on a PhD such as a study leave, duty coverage etc. Some level of knowledge in research methods and analysis is good but this can also be learned during the PhD Journey.
3. **What are the principal attributes of a good supervisor**?
   They should be motivated to support you and walk the talk. They should be knowledgeable in that area to guide key literature and publication plans, make time to discuss with you, approachable, patient. Having a supervisor who becomes a friend is a great bonus.
4. **How can you choose the university for your PhD?**
   This usually depends on the supervisor, the topic and your home situation. You want to get a university where you can get as much support as you need. I did my PhD at LSHTM because that is where my supervisor is based and I could not find a local supervisor. However, it was flexible in allowing me to do my fieldwork in my home country rather than staying in London for all the three years.
5. **What makes a particular school in the university good for your PhD studies?**
   Support is key in terms of being able to access all the additional training and resources that you need. Good universities invest heavily in support staff, skills training for their candidates and access to online resources.

6. **Does the location of the university matter?**
   Not really as long as there is flexibility. For example, I would not do a PhD away from my home where I have to stay at that particular institution for 3-4 years.
7. **What transferable skills should one learn during the PhD?**
   As many as one can possibly do. However, you do not want to be running from training to training just for the sake of it. Usually one should sit down with his/her supervisor, do a skills appraisal, and target the relevant skills to learn.
8. **What other comments would you give about the characteristics of a good PhD program?**
   Time is one of the greatest resources during a PhD process. A good PhD program should prepare and train you to manage this effectively.

Furahini Mdeme

1. **Furahini, why did you choose to study for a PhD and how did you choose your topic of study?**
   From an early stage, I knew I wanted to reach the highest academic level possible. My father had always talked to me about studying with dedication and obtaining three degrees, and I was determined to do that.

   I completed my fellowship in paediatric ophthalmology shortly after my residency in ophthalmology. As the sole paediatric ophthalmologist at Kilimanjaro Christian Medical Centre, I serve a large population and operate on a lot of eyes with paediatric cataract. With congenital cataract, the visual outcomes are not very good mainly because patients present to us late. This constant challenge has been a compelling driver towards research that contributes to finding a solution. Thus for me it was not difficult to choose 'congenital cataract in Tanzania' as the focus of my PhD.

   PhD study as an intervention should increase participation in eye health research, which should have a positive contribution to prevention of visual impairment and blindness. I would encourage more people from the African continent to take an interest in PhD studies.
2. **What individual / personal characteristics / factors should you consider before registering for a PhD?**
   It is prudent to consider the availability of the preferred course, the costs involved, the availability of appropriate supervisors, whether it is a full term or part-time basis, whether it is local or foreign-based, the time commitments and the impact on the family.
3. **What are the principal attributes of a good supervisor?**
   A good supervisor is empathetic, interested in supporting the student's development and willing to consider the student's point of view. Should also offer constructive challenges that enables the student to raise standards. The supervisor should have a level of openness to enable sharing relevant personal experience with the student, in an atmosphere of mutual respect, trust and confidentiality.
4. **How can you choose the university for your PhD?**
   The availability of the course, costs, the mode of study, as well as the availability of sponsorship and supervisors are important considerations.
5. **What makes a particular school in the university good for your PhD studies?**
   The school should have a reputation for effective teaching and should have experienced faculty and supervisors. They should also have the required learning materials and the required courses relevant to the PhD should already be in place.
6. **Does the location of the university matter?**
   Yes. Some students would prefer to study close to family while others would prefer to be away, some would have specific preferences for the country or city of study as well.
7. **What transferable skills should one learn during the PhD?**
   How to apply for research/project grants. How to identify appropriate funders for research and projects. Skills in statistics and epidemiology. Any skills that you will need in your research.
8. **What other comments would you give about the characteristics of a good PhD program?**
   A good PhD program has the right inputs in terms of human resource (good supervisors, good statisticians), infrastructure (good recourse library, books, and reliable internet connectivity) plus a well-organised and regular transferable skills program.

Hillary Rono

1. **Rono, why did you choose to study for a PhD and how did you choose your research topic?**
   I have always wanted to do a PhD. Taking the Masters in Public Health for Eye Care at the London School of Hygiene and Tropical Medicine further inspired me and prompted me to apply for PhD positions. I wanted to understand research in public health, and participate in generating, documenting and passing knowledge to the next generation. I was interested to develop ideas to full

programs, critically appraise research and use the evidence to support individuals, institutions and the government.

My initial research interest was on trachoma. This is what I researched on during residency, and I prepared research proposals for a PhD on this. My second research interest was the intersection between ophthalmology and technology. I loved physics in school and I have always had an interest in engineering (in addition to medicine). Ophthalmology gave me opportunity to apply some of the concepts in physics. Then as an ophthalmologist, I realised that there was a unique need for technologies. A unique opportunity to take this up was available and there was stakeholder interest in this research. This is how I moved to work with Peek interventions and research on 'smart-phone based screening for visual impairment in Kenya'.

2. **What individual / personal characteristics / factors should you consider before registering for a PhD?**
   You should be curious and self-motivated, creating time for it, choose an area of study of your interest, aim to solve a real need, be tolerant, have good interpersonal skills and balanced in life, check if the current environment at home / work place is it supportive for study and consider your future career path.
3. **What are the principal attributes of a good supervisor?**
   A good supervisor should be available, supportive and encouraging, interested in your area of research, and has the skill set that you need or is in a team that can expose you to the skills needed (for example, the development team at Peek are good in information technology which I need to progress). The supervisor should also demonstrate a level of flexibility and sensitivity to the local environment where the student works – can allow time off to meet emerging needs. The supervisor should also have published some papers.
4. **How can you choose the university for your PhD?**
   You would consider the reputation of their degrees and the acceptability of the degree in your county. Having international reach and multiple PhD programs also provides enrichment to your own program.
5. **What makes a particular school in the university good for your PhD studies?**
   The school should have the faculty or access to faculty with the important skill sets for research, such as statistics, epidemiology and the technical expertise in your area of study. They should have the infrastructure and equipment necessary, such as a library and computers. There should also be arrangements for access to other areas that provide an enabling environment such as hospitals or libraries.
6. **Does the location of the university matter?**
   The location of the university should be near enough to reduce cost of travel and far enough to reduce interference from your daily work routine. The environment should also be peaceful so that one can move around without fear.
7. **What transferable skills should one learn during the PhD?**
   These include skills for literature search, presentation and public speaking, writing skills and teaching skills (especially if you are in a training institution) and skills for lobbying to funders.
8. **What other comments would you give about the characteristics of a good PhD program?**
   The program I am enrolled in is a good PhD. It allows for a balance between normal routine work and academic work and work environment. I would also emphasize that PhD students need guidance but should not be spoon-fed. Beyond anything else, it is a learning experience.

Nyawira Mwangi

1. **Nyawira, why did you choose to study for a PhD and how did you choose your topic of study?**
   Each potential student who gets shortlisted and invited to typical PhD registration interview is asked this question. My motivation arose from multiple factors. First, I had an inner personal drive to take a PhD. I had also taken some research modules and undertaken research projects before the PhD, which helped me develop research skills. Further, I had interacted with some PhD students and supervisors earlier on during Master's programs. I got a preview (to some extent) of what PhD study should enable you to do. I anticipated that it was going to be both challenging and fun.

   I now wanted to pursue a sustained path of research on a specific topic, so as to generate new knowledge, acquire new skills and make a specific scholarly contribution. I also considered the wider personal, professional and even political implications. For example, I was keen that the PhD should enhance my academic and research outputs.

   The significance of recent scientific advances in public health, ophthalmology and health systems intersects in the context of Diabetic Retinopathy (DR). It provides a paradigmatic model of how these disciplines can mutually reinforce the prevention of visual impairment from DR. This area has not yet received sufficient research attention. It is from this lens that we are exploring 'diabetic retinopathy in Kenya'. So far, I have enjoyed it.

2. **What individual / personal characteristics / factors should you consider before registering for a PhD?**
   Consider why you are taking the PhD, the opportunity cost of the PhD (what else you could be doing or involved in instead of the PhD) and the return on investment that you expect to get from the PhD (what you expect to gain for every unit time or finance invested). The PhD should have value to you, beyond pecuniary terms.
3. **What are the principal attributes of a good supervisor?**
   A good supervisor is experienced in the area of study, is able to see both the big picture and the small picture, and promotes scholarship, personal development, and professionalism. Feedback to the student is especially helpful. The supervisor understands the strengths of the students, and tailors the amount of push or independence that is optimal.
4. **How can you choose the university for your PhD?**
   Find out as much as you can about the university that you are considering. Check the website. Check the research that they are involved in and the research output ranking. Talk to your supervisor or mentor, and to current students or alumni of the university. If the university runs any Massive Open Online Course (MOOCS), participation in the MOOC may give you some insights. Generally choose a university that is reputable and is already running other PhD programs.
5. **What makes a particular school in the university good for your PhD studies?**
   You can consider the research focus of the school, as well as the faculty in the school. Most universities publish this information on their website. Talking to current students or alumni of the school is invaluable.
6. **Does the location of the university matter?**
   Your convenience is important- in terms of accommodation, security, travel, cost of living, access to the broader academic community, amenities and distance from family. As there are pros and cons for any location, no single location can satisfy everyone, you have to make concessions.
7. **What transferable skills should one learn during the PhD?**
   These include academic skills, peer review and publishing, statistical skills, information technology skills, grant application, finance management, research skills, implementation skills and creativity. These skills are learnt in the course of PhD-related activities, or in transferable skills courses. The Vitae Researcher Development Framework[4] outlines these skills.
8. **What other comments would you give about the characteristics of a good PhD program?**
   As a student, you need to be ready to become invested in your research project (doing it, writing it and discussing it). You also need to embrace creativity and independence as a learner. The role of an advisory team should not be underestimated. This team is composed of the supervisor(s) and additional members who are invited because they have specific complementary skills to guide the PhD study and research.

CONCLUSIONS

A good PhD is characterised by specific skills development, and this requires a motivated student, quality supervision, adequate facilities and a supportive environment. Doctoral studies provide both a personal and a societal benefit. We advocate for greater enrolment into doctoral studies that have significance for eye health. It is necessary to develop shared meaning about the value of PhD studies. There is also need to eliminate any barriers that stand in the way of increasing the pool of doctorate students, the availability of the courses and the pool of faculty that can support the courses in our institutions. Future research might explore the perspective of supervisors on what makes a good PhD student.

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Primary open angle glaucoma as seen at the University Teaching Hospital, Lusaka, Zambia

Muma MKI[1], Bailey R[2], Michelo C[3]

[1] Department of Epidemiology and Biostatistics, School of Public Health, University of Zambia
[2] London Schools of Hygiene and Tropical Medicine
[3] School of Public Health, University of Zambia

Corresponding author: Dr Mulenga KI Muma, Department of Epidemiology and Biostatistics, School of Public Health, University of Zambia, PO Box 50110, Lusaka, Zambia. Email: mkmuma@yahoo.com

ABSTRACT

Objective: To determine the prevalence of Primary Open-Angle Glaucoma (POAG) among patients attending eye clinic at University Teaching Hospital (UTH).
Design: A cross sectional survey.
Methods: The POAG survey was carried out at the eye clinic of the University Teaching Hospital (UTH), Lusaka from January to December 2013. The clients (n = 1,625) had a full ocular examination and their demographic information (specifically age, sex, residence and ethnicity) was captured. The ocular examination included visual acuity and intraocular pressure (IOP) among others. Multivariate logistic regression, stratified by age group and gender, was used to determine the association between demographic factors and POAG.
Results: Of the 1,714 patients randomly sampled for the study, 89 (5.2%) declined to participate in the study; hence the response rate of 94.8%. The ages ranged from 20 to 98 years, with a median age of 51 years (IQR 45, 59). The prevalence of POAG was 19.0% (95% CI, 14.6%, 23.8%), distributed as 5.7% (95% CI 3.2, 9.1) in males and 13.3% (95% CI 11.7, 21.3) for females. Females were more likely to have POAG than males (72.9% vs. 27.1%; OR 2.78, 95% CI 2.1, 5.8). Surprisingly, age groups younger than 40 years had higher proportion of POAG compared to the older population (61.6% vs. 38.4%, P<0.001). The main determinants of POAG were age, sex and Diabetic Retinopathy (DR). There was a significant negative correlation between POAG and HIV infection ($r^2 = 0.0269$; $p<0.001$).
Conclusion: The prevalence of POAG in this population of 19.0% was higher and certainly not comparable to those in black populations in Barbados, St. Lucia, Nigeria, Ghana and South Africa. The striking finding of this study was that 40.7% of all the identified POAG cases were below the age of 40 years. There was no association between POAG and HIV infection.

Key words: Glaucoma, Prevalence, Primary open-angle glaucoma, Determinants, Intraocular pressure

INTRODUCTION

Preventable blindness has continued to be a significant contributor to disease burden and morbidity in eye health despite the fact that most blindness is avoidable[1]. Glaucoma, which is a group of non-communicable eye diseases leading to optic neuropathies, is one of the causes of preventable blindness. Primary Open Angle Glaucoma (POAG) is the most common form and significantly affects the general population more than other forms of glaucoma[2]. In Zambia, a previous retrospective study looking at the hospital records found that all the glaucoma patients had POAG[3].

Several studies conducted in various continents have demonstrated that POAG varies with age, sex and race[4-10]. According to Friedman *et al*[10], the prevalence POAG in the Caucasian population aged 40 years and older is around 1.69%. In similar environments the black population race were 3 times more likely to have POAG compared with white subjects[10]. This certainly suggests that POAG may be a significant problem in black African populations[10]. Despite this, there is limited research and data on factors that are associated with this public health problem in black African communities[1,2].

Ntim-Amponsah *et al*[8] found the overall prevalence of glaucoma in the Ghana population of 8.4% (8.2% in females, 8.6% in males). This was similar to what Adeyinka *et al*[11] found in Nigeria at 7.3%. These two findings were comparable to the findings in black populations in Barbados and St. Lucia[7]. In South Africa the prevalence was significantly lower at 4.5%[12]. Although these studies were mostly population based, they were cited for this study because of lack of hospital based studies. This hospital study was conducted because of affordable cost as compared to population studies.

A retrospective study performed by Muma *et al*[3] in Lusaka, Zambia, showed POAG prevalence of 4.2% providing a glimpse on the glaucoma situation in the country. A number of determinants were noted ranging from gender to diabetic retinopathy[3]. This study demonstrated that glaucoma was actually a public health problem in Zambia. The findings of this retrospective study, despite the known limitations of a retrospective study, inspired this cross sectional survey

at the same facility. In addition, the upgrade of the facility with modern diagnostic equipment enabled improved diagnostic capability for this study.

The objectives of this study were to determine the prevalence of POAG at University Teaching Hospital (UTH) and evaluate differences in prevalence among different age groups.

MATERIALS AND METHODS

Study area and population: A cross sectional survey of 1,714 participants aged 20 to 98 years old was conducted at the UTH eye clinic in Lusaka, Zambia. The UTH is the national referral hospital with a bed capacity of more than 3,000 and provides both surgical and clinical services, including ophthalmological services. The UTH's eye clinic is estimated to cater for more than 21,000 clients annually for both routine and morbidity driven health care. The clients that attend this clinic come from across the country for both self- and system-referrals, representing all age groups and all ethnic groups. A systematic random sampling using 50% time sampling was employed which meant that of the 220 (on average) eye patients seen in the outpatient eye clinic every month, 110 were to be picked to participate in the study. This translated to a minimum 1320 participants recruited into the study for a period of twelve months. To cater for attrition and assuming a response rate of 80%, the sample size of the study was then 1,714 participants. Those that met the inclusion criteria (1,625) were enrolled for the study. This gave a response rate of 94.8%.

Study design and selection: UTH was selected for the study on the basis of the high number of eye patients seen at the facility. All the patients recruited for the study had a full ocular and their demographic data (specifically age, sex, and residence) was captured. The Intra-Ocular Pressure (IOP) was also measured and entered. A total of 89 clients declined to be part of the study, giving a final sample size of 1,625 adult eye patients aged 20 to 98 years old. The visual acuity was measured using the Snellen's chart or the tumbling E chart depending on the level of literacy of the participant. Poor vision was defined as visual acuity worse than 6/18 in the better eye.

Diagnosis of POAG: Case definitions were based on the European Glaucoma Study Guidelines. The diagnosis of glaucoma was based on glaucomatous optic nerve damage, including abnormal visual fields and/or optic disc cupping with or without elevated IOP (by Goldman applanation tonometre).

Definition of glaucoma suspects: IOP >21mmHg, IOP of difference >4mmHg between the two eyes, or a glaucomatous visual field defect. The optic disc was referred to as suspicious when the cup/disc ratio was greater than 0.5, or there was an unequal cup/disc ratio with a difference of more than 0.1 between the two eyes. Glaucoma cases were subjects on treatment for POAG or newly diagnosed during the survey. The major diagnostic criterion was evidence of structural optic nerve damage. Additional criteria were visual field defect and/or raised IOP.

The indicators of POAG were therefore:

(a) *Optic disc status:* The optic disc was examined using a 78D Volks lens (Volks Optical, Inc., Mentor, OH) at X16 magnification after adequate pupillary dilation. When there was evidence of glaucomatous optic nerve damage, that is, cupping of >0.5 with or without notching supported by visual field changes, it was referred to as glaucomatous. When there was no such evidence of glaucoma, it was referred to as non-glaucomatous.

(b) *IOP:* IOPs were considered normal if it was <22mmHg. Values >21mmHg or a difference of 4mmHg or more between the two eyes were considered abnormal.

(c) *Gonioscopy:* This was performed with a Volk 3-Mirror Gonio Lens. Grade 3 and 4 were considered as open angles.

(d) *Visual fields:* Visual fields were plotted for all participants declared as suspects of glaucoma using Humphrey's Visual Field Analyser at full threshold 24-2. Subjects with visual field defects suggestive of glaucoma were confirmed as glaucoma if there were either glaucomatous optic disc changes or high IOP. The presence of one or more absolute defects in the central 30^0 was acceptable as glaucomatous. Field changes that were considered typically glaucomatous included defects $>5^0$ diameter centrally and of shape and distribution typical of optic nerve damage, paracentral or arcuate scotomas and nasal steps. In advanced cases, central or temporal islands were found. The presence of abnormal repeatable field defect with or without elevated IOP in one or both eyes or visual loss so advanced that visual field testing is impossible was classified as glaucomatous. Fixation loss, false-positive and false-negative responses were also monitored to ensure reliability. Those with no visual field defect that could be attributed to glaucoma were labelled as non-glaucomatous field changes.

This standard of care is considered routine at UTH, and the data was examined to ascertain that these criteria were used in identifying patients with glaucoma. Based on these inclusion and exclusion criteria, only 1,625 were included in the study.

Analysis: Collected data was entered in Microsoft Excel version 2007 and transferred to Stata version 12.0 for further storage and analysis. Prevalence was standardized for age using the national census (2010)

in order to control for changes in the age structure between years. Binomial and multiple logistic regression analyses were used to assess and estimate the association of sex, age and gender with POAG. The distribution of age as a continuous variable conformed to normality as assessed by probability plots.

The variables in the model were age, residence, and stratification was done by sex and age group. Multivariate logistical regression results were adjusted for age as continuous variable.

Ethical statement: The University of Zambia Biomedical Research Ethics Committee approved the study (reference number 013-08-12). Further approval was obtained from Ministry of Health of Zambia through the UTH.

RESULTS

Participation and distribution: Of the 1,714 patients, 89 (5.2%) did not accept to be in the study due to various reasons. Therefore, a total of 1,625 people were screened giving a 94.8% response rate. Of the 1,625 patients recruited for the study, 871 (53.6%) were females and 754 (46.4%) were males (Table 1). The age range of participants was 20 to 98 years with a mean age being 51 years.

At the final evaluation, a total of 309 cases of glaucoma were diagnosed. All the 309 cases of glaucoma were of the primary open-angle type. Included in the POAG were 151 cases (48.9%) of normal tension glaucoma. In all, 77.6% were newly diagnosed, while the rest were known glaucoma patients. A total of 109 (35.3%) had poor vision of 6/60 and less, out of which 60 (19.4%) were new cases. There were 98 (31.7%) with positive family history of glaucoma in first degree relations. None of the normal non-glaucomatous participants had visual field defects that are characteristic of glaucoma. Prevalence of glaucoma by age is summarized in Table 2 and plotted in Figure 1.

The overall prevalence of POAG was 19.0% (95% CI, 14.6%, 23.8%), distributed as 5.7% (95% CI 3.2, 9.1) in males and 13.3% (95% CI 11.7, 21.3) for females. Females were more likely to have POAG than males (72.9% vs. 27.1%; OR 2.78, 95% CI 2.1, 5.8).

There was a statistical difference in gender prevalence of POAG at any age (χ^2 test, P<0.0001). The standardized age-specific prevalence was 23.5% for ages below 40 years old and 21.2% for ages 40 years and above. Prevalence was unusually high in the age group of below 40 years.

Table 1: Determinants of glaucoma at University Teaching Hospital's eye clinic in Lusaka, Zambia (2012 to 2015)

Factor	Description	Proportion (%)	Odds Ratio (95% CI)
Sex	Male	46.4	1
	Female	53.6	4.2 (2.1, 7.2)
Age (years)	<40	40.7	1
	40 – 44	4.5	0.5 (0.3, 0.8)
	45 – 49	6.5	0.7 (0.4, 0.9)
	50 – 54	13.3	0.6 (0.5, 0.9)
	55 – 59	8.1	0.3 (0.2, 0.7)
	60 – 64	1.1	0.1 (0.1, 0.3)
	≥65	25.7	1.2 (1.1, 1.5)
Diabetic retinopathy	No glaucoma	81.3	1
	Glaucoma	18.7	2.1 (1.7, 2.8)
HIV	No Glaucoma	78.9	1
	Glaucoma	21.1	2.21 (0.9, 2.1)
Blindness	No glaucoma	89.5	1
	Glaucoma	10.5	1.5 (1.1, 2.1)
Family History	No glaucoma	77	1
	Glaucoma	12.8	5.2 (3.2, 9.5)

Table 2: Prevalence of POAG among patients according to age groups and gender

Age group (years)		No. of POAG cases	Total population	Prevalence (%)
<40	Male	49	273	17.4
	Female	106	365	29.0
40 - 44	Male	0	11	0
	Female	6	71	8.4
45 - 49	Male	0	73	0
	Female	0	21	0
50 - 54	Male	0	71	0
	Female	30	130	23.1
55 - 59	Male	14	60	23.3
	Female	28	72	38.9
60 - 64	Male	0	18	0
	Female	0	0	0
≥ 65	Male	30	239	12.6
	Female	46	221	20.8
Grand Total		309	1,625	19.0

The number of glaucoma cases by age and gender is summarised in Figure 1. The number of cases increased with age, and women appeared to be more affected than men.

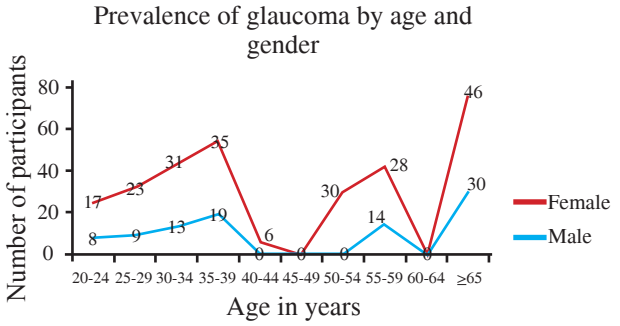

Figure 1: Number of glaucoma cases (n=309) by age and gender seen at UTH

Of the participants who were diagnosed with glaucoma, 77 (23.8%) were blind due to this condition. This was found to be associated with a high co-morbidity with diabetic retinopathy.

DISCUSSION

The study represents one of the few studies that have been conducted to determine the prevalence of POAG and evaluate differences in prevalence among different age groups.

The prevalence of POAG at UTH was remarkably higher (19.0%) than what has been reported in African-derived persons in East Baltimore, Barbados and other African indigenous surveys in West, East and Southern Africa[7,9,11-14]. The higher prevalence in this study compared with other studies could probably be attributed to the very high prevalence of POAG in the participants aged 20 to 39 years old in the study (Table 2) and also due to the fact that this was a hospital based study. Slightly more than 40.7% of all the identified POAG cases were below the age of 40 years (Table 1). To our knowledge, this was the first study that has looked at prevalence of POAG in adult patients aged 20 to 39 years[8]. All the other studies have been reporting on the patients aged 40 years and above. The inclusion of this age group in our study was inspired by a lot of glaucoma patients below the age of 40 years who have been attending the UTH eye clinic. Similarly, Ntim-Amponsah *et al*[8] reported a slightly higher prevalence of POAG at 8.4% in the Akwapim–South district of Ghana because their survey included those aged 30 to 39 years. These two findings could probably explains the prediction by Quigley *et al*[15] that the number of people with open angle glaucoma and angle closure glaucoma in Africa will be over 10 million and the African continent will have the highest ratio of glaucoma to adult population. The finding in this study is a clear demonstration that glaucoma should no longer be considered to be the disease affecting only those aged 40 years and above, but a condition affecting all age groups in significant proportions.

The observed prevalence of POAG in this study population was 19.0%. The result of this cross-sectional survey strongly reaffirms the reports that the prevalence of glaucoma is much higher in people of African descent (black race) than in other racial groups, and that the predominant form of glaucoma is the primary open angle type.

The high prevalence of POAG in the population aged below 40 years of age prompted us to look for other possible causes or associations. Hence we looked at the association of POAG with HIV infection in all age groups though our main interest was those below 40 years of age. We found that there was no association between POAG and HIV infection. This finding from the study suggests that HIV could be protective and this suggests further studies on the relationship between POAG and HIV infection. To our knowledge, it is also the first study that has looked at the association between POAG and HIV infection or at the prevalence of POAG in patients below 40 years of age.

Although our study found a high prevalence of POAG, other studies involving black populations in Barbados, Baltimore, St. Lucia, Nigeria, Ghana, Tanzania and South Africa where prevalence was found to be 7.1%, 4.74%, 8.8%, 7.3%, 8.4%, 3.1% and 4.5% respectively.[7,8,9,11-14].

CONCLUSION

This study confirms speculations among clinicians that onset of glaucoma is earlier and the prevalence of POAG was higher than that reported for Hispanic, American and European (Caucasians) populations and for Africans in East, Southern and West Africa.

In addition, our study shows no association between POAG and HIV. Finally, this study finds that

family history of glaucoma increases the likelihood of someone having glaucoma.

RECOMMENDATIONS

There is still a need for a larger population study involving populations in the different regions of Zambia (representing the different ethnic groups) to provide more complete data on the national prevalence and any tribal differences that may exist in the prevalence of POAG in Zambia. Hopefully, this study will stimulate further research in glaucoma in the Africa sub-region.

We recommend policy consideration to commence glaucoma screening in an integrated manner with other primary care programmes like cervical and prostate cancer screening programmes. If this is done, complimented with the addition of appropriate and continued health awareness messages to younger groups in schools as well as policy makers, this has the potential to diffuse down to the most at-risk communities as well. Such health promotion messages should include informing the communities the consequences of delayed diagnosis and treatment.

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Impairment of vision among commercial motorcyclists (*Bodaboda* riders) in Uganda

Lusobya RC[1], Ssali-Nsibirwa G[2], Kiggundu JB[3], Atukunda I[1], Samia HA[1], Otiti- Sengeri J[1]

[1]Department of Ophthalmology, School of Medicine, Makerere University, College of Health Sciences, Kampala, Uganda
[2]Department of Ophthalmology, Mulago National Referral Hospital, Kampala, Uganda
[3] Department of Epidemiology, Makerere University, College of Health Sciences Kampala, Uganda

Corresponding author: Dr RC Lusobya, Department of Ophthalmology, School of Medicine, Makerere University College of Health Sciences, Kampala, Uganda. Email: lusobyarebecca@gmail.com

ABSTRACT

Background: To determine the prevalence and factors associated with impaired vision among commercial motorcyclists (*bodaboda*) riders in Uganda.
Objective: To determine the prevalence and factors associated with impaired vision among commercial motocyclists (*bodaboda)* riders in Uganda.
Methods: This was a descriptive cross-sectional study done in Kawempe South division in Kampala district. Socio-demographic characteristics, relevant medical and riding history were recorded. All riders underwent a general medical examination and a detailed ocular examination which included vision, anterior and posterior segment assessment. A rider with impaired vision was defined as one whose presenting visual acuity was 6/12 or less in either eye.
Results: Seven hundred and twenty four male riders, aged between 17 to 56 years (mean 30.3 years, Standard deviation=7.2 years) were recruited. Thirty riders (4.1%, 95%CI: 2.7- 5.6) had impaired vision in either eye. Eight riders (1.1%) had visual impairment in both eyes. The ocular disorders associated with impaired vision included: refractive errors 12 (40%), uveitis 6 (20%) and anophthalmic socket 4 (13.3%), ptosis 2 (6.7%), amblyopia 2 (6.7%) corneal scar 2 (6.7%) and cataract 2 (6.7%).
Conclusion: A significant proportion of *bodaboda* riders in Kampala have impaired vision. The causes of impaired vision were ocular disorders that are treatable and reversible if diagnosed early.

Key words: Visual impairment, Commercial motocyclists

INTRODUCTION

Adequate vision is important for safe driving and any significant loss of visual function will diminish a driver's ability to operate a motor vehicle/cycle safely[1]. Globally, 285 million people are estimated to be visually impaired[2] and the majority are found in sub-Saharan Africa. The term *bodaboda* in this study refers to a two wheel commercial motorcycle commonly used as a mode of transport in East Africa.

Several studies have shown an association between visual impairment of motorists and road traffic accidents[1,3-5]. In sub-Saharan Africa, Uganda is among the seven countries contributing 64% of the fatality rate due to Road Traffic Accidents (RTAs) and according to the Uganda annual traffic report 2011, 33% of RTAs involved cars while 24.5% involved *bodabodas* [6-8]. Various studies have also shown that pedestrians, drivers, and persons travelling on *bodabodas* are at risk of death and injury on the roads[9].

Uganda has limited public transport systems and there is an increasing need for *bodabodas* as an alternative transport option[9-12]. The city's estimated number of *bodaboda* riders in 2010 was 300,000 and this is the fastest growing service industry in Kampala city[9].

There is no published data about the magnitude of impaired vision among *bodaboda* riders in Kampala, despite their frequent involvement in road traffic accidents. In this study, we sought to determine the magnitude of impaired vision among these riders in Kampala.

MATERIALS AND METHODS

This was a descriptive cross-sectional study conducted from August to October 2016.The study was conducted in Kawempe south division, one of the largest divisions of Kampala, Uganda's capital city. Figure 1 is a map that shows the geographical location of Kawempe division in Kampala city, Uganda.

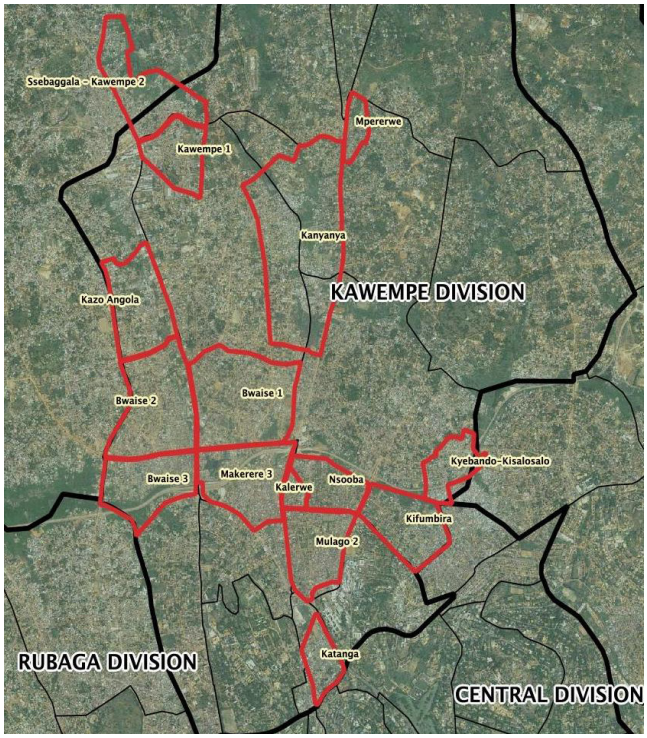

Figure 1: A map showing 5 divisions of Kampala city and Kawempe division

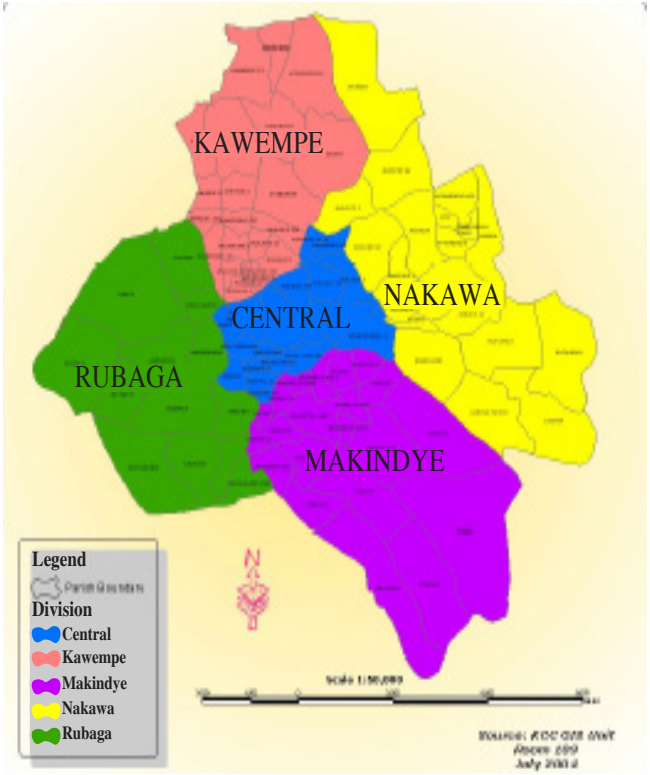

Figure 2: A map showing the 5 divisions of Kampala city.

Kawempe division has a total of 4200 *bodaboda* stages, and a typical *bodaboda* stage has an average of 15 to 30 riders. A minimum of 344 riders were statistically calculated to be enrolled in this study. Since the minimum number of *bodaboda* riders present at each stage was 15, we calculated a total of 23, (344/15), randomly selected *bodaboda* stages as recruitment points for riders for this study.

Participants in the study: Bodaboda riders aged 17 years and above at each stage were chosen randomly at the designated study stages. Riders picked numbers at random without replacement and those who picked odd numbers were included in the study. No number was repeated, to provide an equal chance to all riders. Riders with altered mental states, and/or those with known allergies to drugs used during assessment were excluded from this study.

Data collection: All riders that met the inclusion criteria were recruited and informed consent obtained. A pretested structured questionnaire was used to document socio-demographic characteristics and other variables including riding history, past medical history, past medical history. A full medical exam was done.

Ocular examination: Distance visual acuity was tested using an illuminated Snellen chart at 6 meters. Riders wearing refractive distance correction at the time of screening had their vision tested with the available correction. Objective and subjective refraction was done to determine the refractive status of each rider. Near vision assessment was done using a Jaeger chart. Visual fields were assessed by the confrontational method compared with the examiner in all riders (the examiner underwent perimetry to confirm normal visual field). Mono-ocular riders were regarded as having constricted visual fields. Eye movements were tested in all directions of gaze and pupillary function was assessed. An Ishahara chart was used to assess colour vision and a TNO test chart was used to examine for stereopsis in each rider. A portable slit lamp was used to evaluate the structures in the anterior and posterior segment of the eye. Tonometry was done using a hand-held Perkin's applanation tonometer. Fundoscopy was done using the Keelerdirect ophthalmoscope and indirect dilated fundoscopy was done where indicated (those with vision less than 6/12).

The end point was to determine the ocular disorder associated with impaired vision for each rider. If more than one disorder was present, the disorder most likely to have effect on vision was considered as the most likely associated factor to the impaired vision. All riders with ocular anomaly detected were managed appropriately. In order to minimize errors in the process of data collection, patient examination was done by the principal researcher. Data was processed entered and cleaned using Epi data version 3.1 and analysis done using Stata version 12.

Case definition: In this study, impaired vision was defined as visual acuity of 6/12 or less, or a corresponding visual field loss to less than 20 degrees in the either eye. This is because several studies have shown that a binocular visual acuity of at least 6/9 is safe for driving[13-15].

RESULTS

Impaired vision: In this study, impaired vision was defined as visual acuity of 6/12 or less, or a corresponding visual field loss to less than 20 degrees in the either eye. This is because the World Health Organization (WHO) recommends a visual acuity of at least 6/9 in both eyes for safe driving. A total of seven hundred and twenty four riders were recruited.

All recruited riders were males with a mean age of 30.3 years (standard deviation=7.2 years, range 17 to 56 years). The age distribution and education levels of the riders are summarized in Figures 2 and 3 respectively. The majority, 402 (55%) were healthy with no systemic disease while 84 (12%) had hypertension, 208 (29%) had diabetes and (4%) had both diabetes and hypertension. Table 1 summarizes the relevant riding history among the 724 *bodaboda* riders studied.

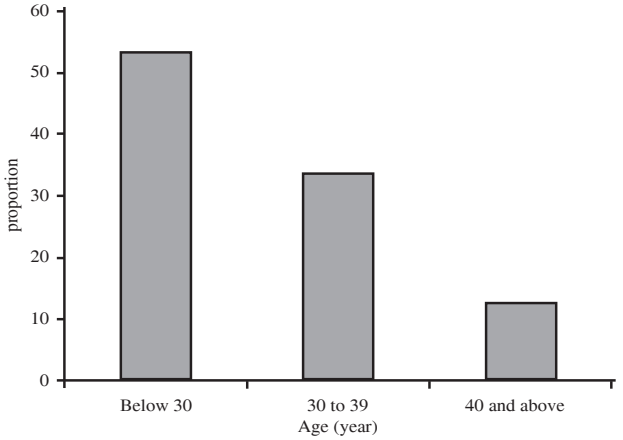

Figure 2: Age distribution of *bodaboda* riders with normal vision compared to those with impaired vision in Kawempe South

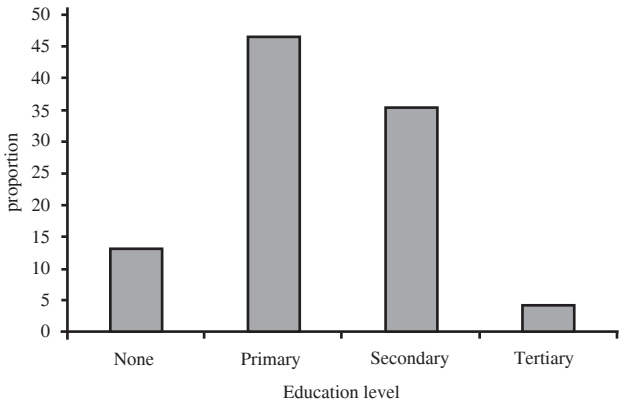

Figure 3: Education level among *bodaboda* riders with normal vision and the visually impaired in (n=724) Kawempe South

Table 1: Riding history of 724 *bodaboda* riders in Kawempe South (n= 724)

Variable	No. of riders (n=724)	(%)
Possess valid license	82	11.3
Formal trainning before riding	138	19.1
Had eye evaluation before riding	54	7.5
Involved in RTA	268	37.1

Prevalence of impaired vision among the bodaboda *riders:* Among the 724 *bodaboda* riders studied, 30 had impaired vision making the prevalence 4.1% (95% CI 2.7-5.6). Tables 2 and 3 summarizes the severity and laterality of impaired vision among the riders respectively.

Table 2: Severity of impaired vision among *bodaboda* riders in Kawempe South (n= 30)

Variable	No. of riders	(%)	95% CI
Visual impairment (categories)			
Mild (6/12-6/18)	16	53.3	1.1-3.3
Moderate (6/24- 6/60)	6	20	0.2-1.5
Severe (5/60 - NPL)	8	26.7	0.3 – 1.9
Total	30	100	

Table 3: Laterality of impaired vision among *bodaboda* riders in Kawempe South

Variable	No.(%)	
Visual impairment	Unilateral	Bilateral
Mild (6/12-6/18)	12(1.7)	4(0.55)
Moderate (6/24- 6/60)	2(0.3)	4(0.55)
Severe (5/60 - NPL)	8(1.1)	0
Total	22(3.1)	8(1.1)

Ocular disorders among bodaboda riders with impaired vision: The ocular disorders associated with impaired vision included: refractive errors 40% (n=12), 10 with myopia and 2 with hypermetropia, uveitis 20% (n=6) and an anophthalmic sockets 13.3% (n=4), ptosis 6.7% (n=2), amblyopia 6.7% (n=2) corneal scar 6.7% (n=2), cataracts 6.7% (n=2).The 4 patients with an anophthalmic socket had evisceration due to a ruptured globe following trauma. Amblyopia was due to uncorrected esotropia. This is summarized in Figure 4.

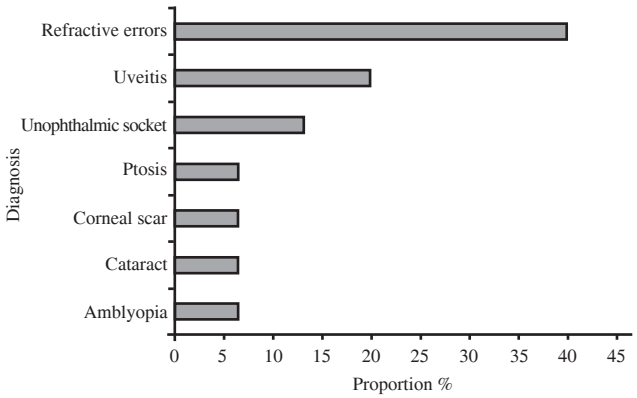

Figure 4: Ocular diseases associated with impaired vision among *bodaboda* riders in Kawempe South from August to October 2016. (N=30)

DISCUSSION

Our study recruited a total of 724 male riders with a mean age of 30.3 years. Like in many other studies[13,14], more than half of the riders 630 (87%) in our study were young adults below the age of 40 years and 53% below the age of 30 years. These findings are similar to other studies done in East Africa that indicate that *bodaboda* riding is a young male-dominated business[15-18].

Three hundred and thirty eight riders (46.69%) had achieved at least a primary level of education, while 258 (35.6%) had achieved a secondary education and 32 (4.4%), tertiary education. Ninety six (13.3%) riders reported not having gone to school (Figure 3). These findings are similar to other studies on riders of commercial motorcycles[16,19]. This is an industry that attracts unemployed youth since it has no regulations or requirements[10,20]. Impaired vision was significantly less frequent among those who had achieved a more advanced level of education ($p<0.001$). The more educated riders are more likely to be aware of their visual impairment and seek medical attention. They presented as corrected refractive errors in this study.

Of the 724 riders in this study, 82 (11.3%) of the riders had a valid riding permit and 138 (19.1%) had formal training for riding. Very few riders had licenses or had an eye exam before starting to ride. Findings from related studies in the region indicate that formal training is hardly available for these riders[19,21,22].There are no formal training schools for these riders in Uganda. This has also been observed in African and Asian countries where majority of the riders don't have licenses and no formal training schools exist[13,23].

This prevalence of impaired vision among the riders in this study was 4.1%. This is similar to other studies such as a study done among Kisumu *bodaboda* riders showed that 2.7% had inadequate visual acuity for riding[15]. The definition of impaired vision in our study varied from other studies however overall a prevalence of 4.1% is an expected finding for vision screening within this age group. The severity and laterality of impaired vision as shown above is similar to previous studies.

Uncorrected refractive errors were the commonest ocular diagnosis among the visually impaired riders affecting 12 (40%). Most of the errors were due to myopia(10) and only 2 had hyperopia. This is an expected finding in any similar vision screening assessment in an adult population of similar age group. Myopia is the commonest refractive error within this age group. Uncorrected refractive error is the most frequent cause of impaired vision among similar riders in previous studies[23-25].

Four (13.3%) riders had an anophthalmic socket following involvement in road traffic accidents, which was a common occurrence among *bodaboda* riders. Visually impaired riders are more likely to have eye trauma[26,27]. A study done in Kisumu in *bodaboda* riders reported that ocular injuries were associated with lowered visual acuity[14].

Other studies have also shown an association between eye trauma and reduced vision[15,28,29]. These riders with an anophthalmic socket are operating with a significantly reduced field of vision which predisposes them to further involvement in road traffic accidents.

Corneal opacity has also been associated with development impaired vision in motorists[34-35]. In this study, two of our riders had corneal scars which were secondary to a healed corneal ulcer and a traumatic corneal tear. Corneal tears are among the commonest ocular injuries affecting motor cycle riders with ocular trauma[36].

Several eye lid disorders can lead to impaired vision, however in this study, 6.7% of the riders with visual impairment was due to ptosis (2 riders). These all occurred secondary to accidents and trauma in these riders.

Other ocular disorders associated with impaired vision in these riders included 6 (20%) with uveitis, 2 (6.7%) with visually significant cataracts and 2 (6.7%) had amblyopia. The prevalence of uveitis and cataracts found is expected in the age group of the riders assessed.

CONCLUSION

We have shown that impaired vision affects a significant proportion of bodaboda riders in Kampala city. These riders are predominantly male and young (less than 40 years of age) with no formal training or license to ride.

The most frequent ocular disorders found to be associated with riders with impaired vision included uncorrected refractive errors, uveitis and ocular trauma related abnormalities that directly affect the quality of vision.

Conditions such as refractive errors and uveitis can be corrected if diagnosed and treated early. Other conditions that result in impaired vision are related to ocular trauma and accidents that are a common occurrence among bodaboda riders.

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Outcomes of paediatric cataract surgery at Lighthouse for Christ Eye Centre - Mombasa, Kenya: A retrospective case series

Shiramba B, Mukiri M, Njambi L, Matende I

Department of Ophthalmology, Faculty of Medicine, University of Nairobi, PO Box 19676-00202, Nairobi, Kenya

Corresponding author: Dr B Shiramba. Email: shiramba2@yahoo.com

ABSTRACT

Background: Paediatric cataract is one of the main and treatable causes of childhood blindness and visual impairment in developing countries, with varied outcome because of lack of properly equipped facilities, late presentation and poor follow-up.

Objective. This study aimed to assess the outcome of non-traumatic cases of paediatric cataract surgically managed at Lighthouse for Christ Eye Centre, Mombasa, Kenya.

Methods: This was a retrospective case series carried out from 1st January 2013 to 31st December 2014. Eyes of children<16 years of age operated for non-traumatic cataract, were included. The clarity of the visual axis and the Visual Acuity (VA) were the primary outcome measures. The types of surgery, the method of aphakic correction and complication rates were also recorded.

Results: Most patients were males (male: female ratio of 2.5:1). Majority of patients were in the 1-5 year age category (48.7%). Most patients were bilaterally affected (70.5%), with developmental cataract being the most common in 67.7% of eyes. Majority of the surgeries done were lensectomy + anterior vitrectomy (AV) + intraocular lens (IOL) implantation. Foldable IOLs were the most commonly implanted, in 82 eyes (75.2%). Twenty-four eyes were left aphakic (18%). The most common type of post-operative refractive correction was spectacles (55.6%). Majority of eyes with post-operative VA recorded, fell in the good outcome category as per World Health Organization (WHO) and Kilimanjaro Centre for Community Ophthalmology (KCCO) guidelines, for each follow-up visit. More than 90% of eyes had a clear visual axis for each follow-up period. At 12 weeks follow-up period, post-operative findings and complications were noted in approximately 40% of eyes, the most common finding was amblyopia (8.8 %).

Conclusion: Lens washout, primary posterior capsulotomy, anterior vitrectomy and primary intra-ocular lens implantation offers an effective method for correction of aphakia related to paediatric cataract surgery. It also maintained a clear visual axis for up to 1 year post-operatively with a significant number (>90%) remaining clear at each follow up visit. A majority of eyes (50%) had good visual outcome.

Recommendations: Strict follow up schedule is advised for consistent visual rehabilitation to further improve the outcome.

Key words: Childhood blindness, Paediatric cataract, Outcome

INTRODUCTION

Paediatric cataract has been found to be the main and treatable causes of childhood blindness and visual impairment worldwide[1]. Globally, the incidence of blindness in children is unknown. However, surveys carried out with the use of key informants and other approaches have enabled identification of blind children and provision of information on the likely magnitude of blindness within the communities[2]. In childhood, the overall incidence of cataracts that are clinically significant is unknown, but has been estimated to be as high as 0.4%[3]. In developing countries, comprising mostly African and Asia, the prevalence was estimated at between 5 to 15/10,000 children[4]. Therefore, childhood cataract is an important cause of avoidable childhood blindness, more so in the middle and low income countries[5].

Surgery is considered the first step in the pathway to visual rehabilitation for childhood cataract and this pathway is often affected by the post-operative outcome, resultant complications and the follow up[6]. Although early surgical intervention is advised to prevent amblyopia, complications have been noted

to increase with early surgery[7]. These postoperative complications are associated with a poorer visual outcome. Therefore, there is need to balance between the timing of surgery to prevent amblyopia and the ability to minimize postoperative complications.

Studies done in Africa[8] and in Asia[9] showed some deficiency in terms of post-operative care and follow up. These studies demonstrated that 20–40% of children who had cataract surgery were not brought back for their routine follow-up visits. The follow up appointments are important in ensuring that these children receive spectacle correction and low vision rehabilitation, amblyopia therapy, monitoring and managing both short term and long term complications therefore better visual and anatomical outcomes.

MATERIALS AND METHODS

A retrospective case series carried out at Lighthouse for Christ Eye Centre, Mombasa. Ethical approval was obtained from the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee and permission to conduct the study was also sought from the administrative head of Lighthouse for Christ Eye Centre. All children less than 16 years of age diagnosed and surgically managed for non-traumatic cataract from 1st January 2013 to 31st December 2014 were included in the study. A pre-designed questionnaire was used to record the information from the medical records.

All information relevant to the study was collected and entered into the pre-designed questionnaire. Post-operative outcome was determined in two ways; a clear visual axis post operatively for all the children and the visual acuity for those whose visual acuity was recorded. This was because of the difficulties experienced in taking visual acuity in children especially the pre-verbal age group. The post-operative findings or complications and the post-operative duration of follow up was also documented. Follow up period was divided into day 1, week 1-3, week 4-11, week 12+, month 6, month 12 and last follow up.

Data was analyzed using STATA/IC v14. The variables were analyzed for normality. Variables that were normally distributed were summarized using mean and standard deviation (SD), whilst median and interquartile range (IRQ) were used for data that was not normally distributed. Odds ratios were constructed with a 95% confidence interval. Statistical significance was set at p-value of < 0.05. The frequencies and proportions of the variables have been presented in tables and graphs where appropriate.

RESULTS

Out of the 78 patients who met the inclusion criteria, there were significantly more males 56 (71.8%) than females with a male: female ratio of 2.5:1. Most patients 38 (48.7%) were in the 1-5 years age category. Mean age of patients was 54.6 months (SD 41.5 months), median age was 48.5 months (IQR 17-84 months). A significant proportion of patients 55 (70.5%) were bilaterally affected. Only 6 (7.7%) patients had documented systemic co-morbidities.

Congenital and developmental cataracts were the commonest and more likely to be bilateral. Twenty patients (25.6%) were classified to have congenital cataract, out of which 23.1% were bilateral and 2.6% unilateral, while 53 (67.9%) were developmental cataract with 47.4% of these being bilateral. Four patients (5.1%) were classified as having steroid induced cataract while one patient (1.3%) was not in any of the categories above.

Table 1: Type of surgical procedure by age (years)

Surgical procedure (N=133)	<1 N (%)	1-5 N (%)	6-10 N (%)	>10 N (%)	Total N (%)
LWO+PPC+AV+IOL	8 (28.6%)	60 (92.3%)	34 (100%)	6 (100%)	108 (81.2%)
LWO+PPC+AV	20 (71.4%)	4 (6.2%)	0	0	24 (18%)
LWO+IOL	0	1 (1.5%)	0	0	1 (0.8%)
	28	65	34	6	133

The surgical procedure was the same for 108 (81.2%) eyes. Majority of eyes of younger patients < 1 year of age were left aphakic, whilst most eyes of patients >1 year of age had and IOL inserted. One (0.8%) eye did not have the standard surgical procedure that involves a primary posterior capsulotomy and anterior vitrectomy. One hundred and fourteen (85.7%) eyes had vitrectorrhexis for the anterior and posterior capsulotomy while the rest (14.3%) had continuous curvilinear capsulorhexis (CCC). The most common type of IOL implanted was foldable in 82 (61.7%) eyes, 27 (20.3%) eyes had polymethyl methacrylate (PMMA) the rest (18%) were left aphakic. Majority of eyes had no complications intra-operatively (88.7%). The most common complication was a decentered IOL in 4 eyes. Others included iris prolapse (2), split IOL (2), twisted haptic (1), VH (1), premature PC tear (1) and wound buttonhole (1).

There was poor follow-up noted with a significant drop-out rate of eyes between week 4-11 and week 12+. Sixty-eight (84%) eyes were examined at week 12+ post-operative period, but only 31 (23%) eyes were seen at 1-year follow-up visit.

Table 2 gives the visual acuity of eyes from the pre-operative to the post-operative period.

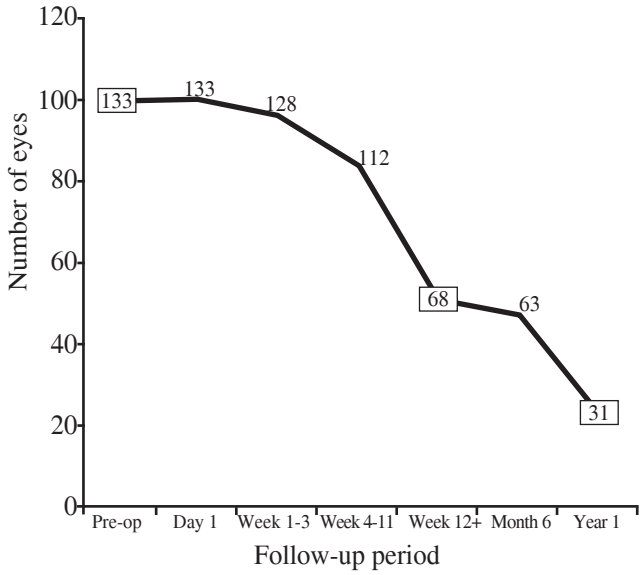

Figure 1: Post-operative follow up drop-out rate

Table 2: Pre- and post-operative visual assessment

Visual acuity (N=133)	Pre-op UCVA	Post-operative period					
		Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
≥6/18	0	8(6%)	16(12.5%)	20(17.9%)	8(11.8%)	16(25.4%)	12(38.7%)
<6/18-6/60	18(13.5%)	9(6.8%)	14(10.9%)	17(15.2%)	1(1.5%)	7(11.1%)	6(19.4%)
<6/60-3/60	4(3%)	2(1.5%)	1(0.8%)	1(0.9%)	6(8.8%)	0	1(3.2%)
<3/60	5(3.8%)	4 (3%)	6(4.7%)	10(8.9%)	2(2.9%)	8(12.7%)	5(16.1%)
Picks objects	1(0.8%)	2(1.5%)	5(3.9%)	2(1.8%)	1(1.5%)	0	2 (6.5%)
FFO	0	5(3.8%)	19(14.8%)	23(20.5%)	16(23.5%)	16(25.4%)	4(12.9%)
FFL	1(0.8%)	6(4.5%)	25(19.5%)	18(16.1%)	7(10.3%)	5(7.9%)	0
Good fixation	57(42.9%)	0	0	0	0	0	0
Poor fixation	5(3.8%)	0	0	0	0	0	0
Not indicated	42(31.6%)	97(72.9%)	42(32.8%)	21(18.8%)	27(39.7%)	11(17.5%)	1(3.2%)

For the majority of eyes, non-conventional methods of recording visual acuity were used both in the pre-operative and post-operative period. VA was not indicated for forty two (31.6%) eyes pre-operatively. Good outcome was defined as visual acuity of ≥ 6/18 with a good proportion of eyes with quantitative vision noted to have improved from pre-operative period to final follow up visit at year 1 (38.7%), although the number of eyes being seen reduced during this time. Poor outcome was defined as visual acuity of < 6/60.

Table 3 shows the post-operative visual outcomes classification as per WHO and KCCO expected visual outcomes for eyes with quantitative vision (Snellen's or equivalent) at weeks 1-3, 4-11 and 12+.

Table 3: Post-operative visual outcome per WHO and KCCO classification

VA outcome	Guidelines		Post-operative VA		
	WHO	KCCO	1-3 Weeks N=33	4-11 Weeks N=44	12+ Weeks N=16
Good	≥6/18	>80%	>70%	16 (48.5%)	18 (40.9%)	8 (50%)
Borderline	<6/18-6/60	<15%		14 (42.4%)	17 (38.6%)	1 (6.3%)
Poor	<6/60	<5%	<5%	3 (9.1%))	9 (20.5%)	7 (43.7%)

Majority of eyes were in the good category of visual outcome across all follow-up periods, although this was still less than WHO recommended values.

Table 4 indicates visual axis clarity status of the eyes available for each post-operative period. More than 90% of eyes had a clear visual axis at every follow-up period.

Table 4: Visual axis clarity

Follow-up duration	Clear visual axis	Not clear visual axis
Day 1 (N=133)	130 (97.7%)	3 (2.3%)
Week 1 (N=128)	124 (96.9%)	4 (3.1%)
Weeks 4-11 (N=112)	105 (93.8%)	7 (6.2%)
Weeks 12+ (N=68)	65 (95.6%)	3 (4.4%)
Month 6 (N=63)	60 (95.2%)	3 (4.8%)
Month 12 (N=31)	29 (93.5%)	2 (6.5%)

Table 5 describes the type of post-operative correction used in the eyes

Table 5: Post-operative refractive correction

Post-op correction	<1 year	1-5 years	6-10 years	>10 years	Total
Spectacles	14 (50%)	42 (64.6%)	14 (40%)	4 (80%)	74 (55.6%)
Contact lens	4 (14.3%)	0	0	0	4 (3%)
None	10 (35.7%)	23 (35.4%)	21 (60%)	1 (20%)	55 (41.4%)
Total	28	65	35	5	133

Majority of eyes had spectacles correction post-operatively (55.6%). Only 4 eyes had contact lenses, which were all aphakic eyes of patients younger than 1 year of age. Table 6 describes the type of post-operative correction used in aphakic eyes.

Table 6: Type of post-operative correction in aphakic eyes

Aphakic eyes (N=24)	Type of correction		
	Spectacles	Contact lens	None
Number of eyes (%)	12 (50%)	4 (16.7%)	8 (33.3%)

Most eyes with aphakia had spectacle correction post-operatively. Ninety-one eyes had refraction done post-operatively. Table 7 describes the post-operative residual spherical refractive error according to the age of the patients whose eyes are being studied.

Table 7: Post-operative residual spherical refractive error according to age

Post-op spherical error	Age (years)			
	<1	1-5	6-10	>10
-0.50	0	1 (2%)	0	0
0 to +0.99	4 (20%)	4 (8.2%)	5 (27.8%)	1 (25%)
+1 to +1.99	0	6 (12.2%)	2 (11.1%)	1 (25%)
+2 to +2.99	0	12 (24.5%)	5 (27.8%)	0
+3 to +3.99	0	12 (24.5%)	1 (5.6%)	2 (50%)
≥ +4.00	16 (80%)	14 (28.6%)	5 (27.8%)	0
Total	20 (100%)	49 (100%)	18 (100%)	4 (100%)

80% of patients <1 year of age had residual spherical refractive error of ≥ +4.00D.

Table 8 describes the post-operative residual cylindrical refractive error according to the age of the patients for eyes that had refraction done.

Table 8: Post-operative residual cylindrical refractive error according to age

Post-op cylindrical error	Age (years)			
	<1	1-5	6-10	>10
-3 to -3.99	1 (5.6%)	3 (7%)	0	0
-2 to -2.99	1 (5.6%)	4 (93%)	1 (3.8%)	0
-1 to -1.99	2 (11.1%)	9 (20.9%)	5 (19.2%)	1 (25%)
0 to -0.99	14 (77.8%)	27 (62.8%)	20 (69%)	3 (75%)
Total	18 (100%)	43 (100%)	26 (100%)	4 (100%)

Majority of eyes in each age group had residual cylindrical error in the range of 0 to -0.99D

Table 9 describes the post-operative complications seen in the eyes. Some eyes had more than one complication.

Table 9: Post-operative complications

Post-op complications (N=133)	Follow-up period					
	Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
Corneal oedema	9 (6.8%)	2 (1.6%)	3 (2.7%)	2 (2.9%)	2 (3.2%)	2 (6.5%)
Pupil abnormality/ capture	5 (3.8%)	9 (7%)	9 (8%)	5 (7.4%)	3 (4.8%)	1 (3.2%)
Shallow AC	2 (1.5%)	5 (3.9%)	4 (3.6%)	2 (2.9%)	2 (3.2%)	0
Decentered IOL	2 (1.5%)	2 (1.6%)	2 (1.8%)	1 (1.5%)	0	1 (3.2%)
Hyphaema	1 (0.8%)	0	0	0	0	0
Fibrinous uveitis/ membrane	1 (0.8%)	7 (5.5%)	6 (5.4%)	0	1 (1.6%)	0
VAO	0	1 (0.8%)	4 (3.6%)	2 (2.9%)	1 (1.6%)	0
Glaucoma	0	0	2 (1.8%)	2 (2.9%)	2 (3.2%)	2 (6.5%)
Others	1 (0.8%)	2 (1.6%)	1 (0.8%)	5 (7.4%)	3 (4.8%)	2 (6.5%)
None	116 (87.2%)	105 (81.4%)	85 (75.9%)	42 (61.8%)	46 (73%)	23 (74.2%)

Others include VH and posterior synechiae

The most common complication on day 1 was corneal oedema. Four eyes developed VAO at week 4-11 period, for which 3 eyes had membranectomy and AV, and 1 eye had membranectomy, AV, pupilloplasty and synechiolysis. Table 10 describes other post-operative findings in study eyes.

Table 10: Other post-operative findings (N=133)

Post-op Complications (N=133)	Follow-up period					
	Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
Amblyopia	NA	1 (0.8%)	5 (4.5%)	6 (8.8%)	4 (6.3%)	4 (12.9%)
Squint	0	0	2 (1.8%)	4 (5.9%)	4 (6.3%)	4 (12.9%)
Chorioretinal atrophy	0	0	2 (1.8%)	2 (2.9%)	2 (3.2%)	2 (6.5%)

Amblyopia was not assessed on day 1 but was most common finding at weeks 12+

Table 11 shows the causes of poor visual outcome at the 4-11 weeks and 12+ weeks post-operative period. Eyes with poor vision (<6/18) were 26 and 8 for post-operative weeks 4-11 and 12+ respectively.

Table 11: Causes of poor visual outcome week 4-11 and week 12+

Attributable cause of poor vision	Number of eyes with VA < 6/18 or equivalent	
	4-11 weeks (N=26)	12+ weeks (N=8)
Uncorrected refractive error	14	3
Patient selection (Nystagmus)	4	1
Amblyopia	4	2
Intraoperative complications	1	0
VAO	1	1
Unknown	2*	1

*Both eyes of the same patient who had other systemic co-morbidities (deafness and dumbness)

DISCUSSION

Management of paediatric cataract still remains a challenge in our set up. This is because apart from the risk of amblyopia that comes with visual deprivation, there is also a rapid change in the refractive status of the eye. This type of surgery also tends to require special surgical skills, which may not always be available in our setting.

In our study, approximately 70% of eyes did not have Visual Acuity (VA) assessed or documented on the first post–operative day. However, this number reduced to 30% during follow up in the 1-3 week period.

The proportion of eyes with good vision (>6/18) improved from pre-operative period to final follow-up visit at one year, although the number of eyes seen during this time reduced.

The post-operative visual outcome of 50% having visual acuity of ≥ 6/18 at 12+ weeks is better compared to other studies in India and Nepal that reported 16.4% and 36.6% respectively of eyes with post-operative vision of ≥ 6/18[10,11].

Even though majority of eyes were in the good visual outcome category across all follow-up periods, this number was still low compared to WHO recommendations. Of the eyes that had a minimum follow up of three months, 56.3% had a best corrected VA of 6/60 or better. This number was lower compared to the study by Yorston *et al*[8]. in Kikuyu Eye Unit, which reported a BCVA of 6/60 or better in 91.2% of eyes.This may be attributed to the short and erratic follow-up of most patients in our study. It has been shown that visual development progresses up to around 10-12 years in those with paediatric cataract which are operated within 1 year[12]. Therefore, the visual acuity may improve with strict and longer follow up especially for those with congenital cataracts. This supposedly low level of visual improvement may be sufficient because it provides ambulatory vision and therefore reduces over dependence of these children when it comes to their daily basic activities and furthermore increasing their chances of survival[13].

Accurate visual acuity assessment in children is challenging and difficult compared to adults. Different methods of visual acuity assessment which are age-appropriate have been developed but they may not be readily available in some eye health facilities. Therefore, visual acuity testing may not always be possible for all patients who present to these child eye health facilities. In Kenya, Yorston *et al*[8] suggested that even though accurate visual assessment was difficult, the decision to operate can be based on observing the child's behavior. The unpredictable co-operation of children, the preverbal nature of some of the patients in this age group, level of education or associated disability may also make it difficult to quantify the visual response. Because of such factors, Trivedi *et al*[13] opted to broadly classify VA into ambulatory and non-ambulatory. Although, use of such a classification may be of use in some setups, it is not applicable in our study because this broad categorization may make it difficult to determine whether expectations or targets have been achieved.

For the majority of eyes in this study, non-conventional methods of recording visual acuity were used. Even though these patients were noted to have good fixation, this was not further clarified as to whether it was Central, Steady and Maintained (CSM). This method of VA recording is useful but not accurately quantitative because it has been found to be compatible with a wide range of VA from 6/9 to 6/36, making it difficult for the clinician to track changes in vision that

could occur over time[9]. VA was not assessed for 42 (31.6%) eyes which may also reflect the difficulty in VA assessment in children. For the 27 eyes which had a pre-operative Snellen VA (or equivalent) recorded, 4 eyes had severe visual impairment. In Tanzania, Bowman *et al*[14] concluded that pre-operative blindness was a strong predictor of post-operative outcome.

Aphakic optical correction can be achieved by spectacles, contact lenses, IOL implantation and epikeratophakia which at present is not commonly used. Although IOL implantation is the most preferred method of aphakic correction, it is intentionally under-corrected depending on the age of the child and the axial length. It therefore results in residual hyperopia which should be managed with spectacles while allowing the child to grow into emmetropia or undergo a myopic shift with increasing age[15]. Twenty four eyes were left aphakic and of these, twelve (50%) received spectacle correction for the aphakia while four (16.7%) eyes had contact lenses prescribed and fitted. Majority of eyes (55.6%) had spectacles correction post-operatively to try and correct the residual refractive error, this included the twelve eyes that had been left aphakic. Contrary to what other studies have suggested, the use of contact lenses was not found to be impractical or unsuitable in our set up[8,15]. Clarity of the visual axis is an important aspect that is necessary for an eye to achieve good vision. Several studies have showed that primary posterior capsulotomy markedly reduce visual axis opacification[15]. In contrast, other studies have reported VAO after paediatric cataract surgery ranging from 40-80%[16]. In our study, only four (3.6%) eyes developed VAO and required secondary intervention whilst more than 90% of eyes had a clear visual axis at every follow-up period. These findings therefore support the fact that posterior capsulotomy coupled with anterior vitrectomy should be performed primarily during paediatric cataract surgery to prevent VAO and any associated stimulus deprivation amblyopia.

Refraction was done for ninety one eyes post-operatively and majority of eyes (70.3%) had a residual cylindrical error of < -1.0D. In their study in Tanzania, Bowman *et al*[14] reported that biometric data was not associated with smaller post-operative refractive errors. However, in our study, eyes which had biometry done had a lower median and mean post-operative spherical errors than eyes for which biometry was missing and the differences were statistically significant ($p=0.00$). This confirms the importance of biometric data in reducing the post-operative refractive errors during pediatric cataract surgery.

Post-operatively, the most common complication on day one was corneal oedema. Two eyes of the same patient were noted to have persistent corneal oedema up to one year post-operatively on follow-up. This same patient was noted to have congenital glaucoma. The corneal oedema persisted despite being on medications. This was attributed to be the uncontrolled intra-ocular pressures due to poor follow-up pattern and poor compliance to medications by this patient. Referral to a glaucoma specialist for Combined Trabeculotomy/ Trabeculectomy (CTT) was unfruitful due to financial constraints.

Amblyopia was not assessed on day one but was the most common finding at week twelve (12+), seen in thirteen eyes (9.8%). This is similar to findings by Yorston *et al*[8] who concluded that amblyopia was the leading cause of poor visual outcome, with two major risk factors for amblyopia being surgery before age of two years and the timing of when surgery on the second eye is scheduled. They reported a higher percentage of eyes with amblyopia in their study at 31.4%. This low number of amblyopia in our study may be due to the difficulty of visual assessment in children although a clear preferential fixation can also be used to help in the diagnosis of amblyopia. The poor follow-up pattern of these patients may also signify that children with amblyopia were not actually diagnosed. This may possibly also suggest that probably the guardians were not satisfied with the post-operative outcome and therefore chose to abandon the scheduled follow-up visits. Patching (occlusion) was the treatment of choice in both our study and that of Yorston *et al*[8]. However, in our study the compliance to amblyotherapy was not objectively and adequately assessed probably also due to poor follow-up.

CONCLUSIONS

In conclusion, lens washout, primary posterior capsulotomy, anterior vitrectomy and primary intra-ocular lens implantation offers an effective method for correction of aphakia related to paediatric cataract surgery. It also maintained a clear visual axis for up to 1 year post-operatively with a significant number (>90%) remaining clear at each follow up visit. A majority of eyes (50%) had good visual outcome.

RECOMMENDATIONS

There is need to ensure that paediatric patients have proper and age specific visual acuity assessment at every visit as well as timely refraction. Educate and counsel care givers about good compliance to follow-up visits for consistent visual rehabilitation to further improve the outcome.

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Retinopathy of prematurity: Prevalence and risk factors among infants in rural Kenya

Sitati SM[1], Ojuma MS[2], de Alba CAG[3]

[1]Sabatia Eye Hospital, Kenya
[2]Jaramogi Oginga Odinga Teaching and Referral Hospital, Kenya
[3]University of California San Francisco, USA

Corresponding author: Dr. SM Sitati, Sabatic Eye Hospital, Kenya. Email: smsixty@gmail.com

ABSTRACT

Background: Retinopathy of Prematurity (ROP) is a potentially blinding eye disorder that is seen in premature infants. Data is scanty on prevalence rates in Africa. This study was done to determine the prevalence and risk factors for ROP in a rural hospital in Kenya.

Design: A prospective cohort study.

Methods: The study was carried out at the Jaramogi Oginga Odinga Teaching and Referral Hospital, Kisumu, Kenya between March 2015 and April 2016 in the neonatal unit and outpatient eye clinic. Infants less than 32 weeks gestation and/or weighing less than 1500 grams at birth, plus those with an unstable clinical course had a dilated fundoscopic examination starting at 28 days of life. Exam findings were recorded using standard IC-ROP classification. Examinations were repeated every 1-2 weeks until mature vasculature in zone III was confirmed. Infants were excluded if they died before the ROP outcome or if they did not show up for the first outpatient exam.

Results: One hundred and thirty one neonates were included in the study, with a male to female ratio of 1:0.95 (64/67). Mean gestational age was 30.64 ± 3.6 weeks and mean birth weight was 1478 ± 414.08 grams. Of these, 91 (69.5%) had been on oxygen, with a mean of 4.6 ± 5.9 days on oxygen. Four babies developed ROP (a prevalence of 3.05%). Three (75%) had zone II, stage 1 ROP and one (25%) had zone II, stage 2 ROP; all regressed without treatment. No infant developed vision-threatening ROP. Peri-natal risks identified in this group included respiratory distress syndrome, prolonged oxygen administration, intra-ventricular haemorrhage and seizures.

Conclusion: ROP prevalence was much lower than that reported in other studies, with all cases of ROP regressing without treatment. The presence of ROP in this setting however, makes a case for screening in hospitals in rural areas.

INTRODUCTION

Retinopathy of Prematurity (ROP) is a potentially blinding eye disorder characterized by abnormal vessel growth in the retina of premature infants. Data is scanty on prevalence rates in Africa. Some African studies have shown high prevalence rates[1] while others have reported low prevalence rates that present a barrier to developing screening programs. While ROP screening is currently ongoing in some urban hospitals in Kenya, many premature infants are not screened as no universal policy has been established in the country. The Jaramogi Oginga Odinga Teaching and Referral Hospital in Kisumu, is a goverment hospital situated in the western part of Kenya. Kisumu county has a population of 968,909 living in an area of 805m². The main economic activities are fishing and farming. Despite a recent revamping of its neonatal unit, an ROP screening program has not been established. The neonatal unit admits 50-100 neonates per month and has a bed capacity of 30. The unit is run by a team of paediatricians and there is no resident neonatologist. This study was carried out to determine the prevalence and risk factors for ROP in a rural hospital in Kenya.

MATERIALS AND METHODS

This was a prospective cohort study carried out at the Jaramogi Oginga Odinga Teaching and Referral Hospital, Kisumu, Kenya. It was conducted between March 2015 and April 2016 in the neonatal unit and outpatient eye clinic. All infants aged less than 32 weeks gestation and/or weighing less than 1500 grams, plus those with an unstable clinical course were identified on admission to and during their stay at the neonatal unit. Examinations were started at 28 days post-natal (PNA) and were carried out every one-two weeks in the neonatal unit or eye clinic. Those discharged prior to achieving 28 days PNA were followed up with a phone call reminder and provision of transportation to the hospital to reduce the risk of drop out. Dilatation

was achieved by installation of a mydratic cocktail drop (cyclopentolate 0.1% + phenylephrine 0.25% OR tropicamide 1% + phenylephrine 0.5%) instilled three times at 5 minute intervals in both eyes. Fundoscopic exam was then carried out 30- 40 minutes after the last drop was instilled. This was done with a Heine© Indirect ophthalmoscope and 28D Volk© lens. Fundus findings were then recorded in a questionnaire that contained a pictorial representation of the fundus. ROP was classified according to the International Classification of ROP revisited (ICROP)[3]. Other findings recorded on the questionnaire included days on oxygen, weights (at birth and at examination), anterior segment findings, neonatal risk factors (respiratory distress syndrome, anaemia/transfusions, IVH, neonatal sepsis, jaundice/ phototherapy, seizures, other congenital malformations) and maternal risk factors (multiple gestation, premature rupture of membranes, infection/sepsis, eclampsia, preterm labour and others). Exams were performed at two-week intervals if there was immature retina or stage 1 ROP in zone 2 without plus disease, at one-week intervals if there was immature retina in zone 1 or ROP without plus disease in zone 2 and continued until 50 weeks PMA or until vascularization in zone 3 was achieved. The majority (85%) of the eye examinations were carried out by a paediatric ophthalmologist, while the rest (15%) were done by a general ophthalmologist trained to carry out ROP evaluations.

RESULTS

There were 836 infants admitted in the neonatal unit during the study period. Of these, 303 were classified as premature (less than <37 weeks of gestation). Two hundred and fourteen fulfilled the criteria for inclusion in the study. Out of these, 131(61.2%) were examined. Those not examined (83/214; 38.8%) included deaths before the first exam (27/214; 12.6%), those discharged who did not come for any review (54/214; 25.2%) and those transferred out to other centers (2/214; 0.9%).

The male to female ratio was almost equal, with 64/131 (48.9%) males and 67/131 (51.1%) females. The mean gestational age was 30.64 weeks, calculated from the mother's last menstrual period, with a range of 22-39 weeks. Median age was 31 weeks and modular age 32 weeks. Birth weight of participants ranged from 600 - 3500 grams, with a mean age of 1478 grams. Figure 1 shows the distribution of gestational age and birth weight among infants respectively. The mean maternal age was 25 years, with a range of 17- 33 years.

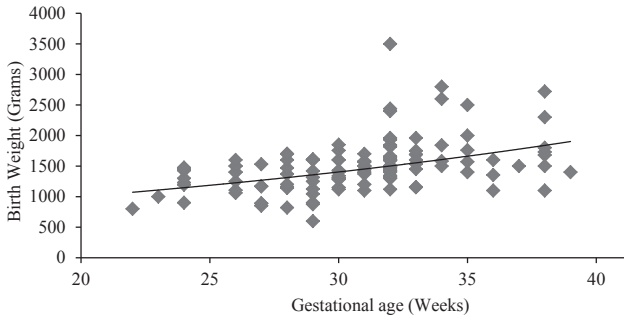

Figure 1: Distribution of birth weight vs gestational age (n=131)

Table 1: Distribution of perinatal risks among 131 included infants

Perinatal risk	No. (%)*
Anaemia	1 (0.6)
IVH	1 (0.6)
Jaundice	18 (10.3)
RDS	112 (64.0)
Seizures	1 (0.6)
Sepsis	15 (8.6)
Transfusion	0 (0.0)
Phototherapy	19 (10.9)
Malformation	0 (0.0)
Other (HIV-exposed, n=7, aspiration pneumonia, n=1)	8 (4.6)

**Percentage values have been rounded up and may not add up to 100*

Out of the 131 neonates, 91 (69.5%) had oxygen administered during their hospital stay. The average days on oxygen was 4.6 ± 5.9 days with a range of 1-43 days. Table 2 shows gender distribution versus days of oxygen use. Of note is that there was no system of oxygen monitoring in this neonatal unit and all infants received 100% oxygen by nasal cannula.

Table 2: Oxygen use in days vs gender, (N=131)

Days on O_2	Male	Female	Totals
None	18	22	40 (30.5%)
1- 3	36	25	61 (46.6%)
4- 7	8	11	19 (14.5%)
>7	2	9	11 (8.4%)

Four neonates were found to have ROP (3.05%; 99% CI 0.05 to 0.093%), with a total of 6 eyes being affected (2.29%; 99% CI 0.06 to 0.059%). All of these had either stage 1 or 2 ROP in zone II, and they all regressed without treatment, none developed vision threatening ROP. Table 3 gives a description of ROP found in each patient. The risk factors identified in this group are as shown in Table 4. Due to the small number of ROP patients, statistical analysis was not performed.

Table 3: Rop descriptions, stage and zone. (N=4 patients)

	Right eye			Left eye			Inpatient or outpatient at diagnosis
	Stage	Zone	Plus	Stage	Zone	Plus	
Patient 1	1	II	-	0	II	-	Inpatient
Patient 2	1	II	-	1	II	-	Inpatient
Patient 3	2	II	-	2	II	-	Inpatient
Patient 4	1	II	-	0	II	-	Inpatient

Table 4. Biodata and Risk factors among neonates with ROP. (N= 4 patients)

Patient	Sex	GA (wks)	BWT (grams)	Days ON O_2	Gestational risks	Perinatal risks	PMA and weight at diagnosis	
1	M	24	900	2	HIV exposed	*RDS	28wks	1390g
2	F	29	600	3	-	*RDS, sepsis	33wks	1530g
3	M	34	2800	43	HIV exposed	*IVH, *RDS seizures	46wks	3950g
4	M	26	1250	2	Twin	*RDS	34wks	2600g

*RDS- Respiratory Distress Syndrome *IVH- Intra-Ventricular Haemorrhage

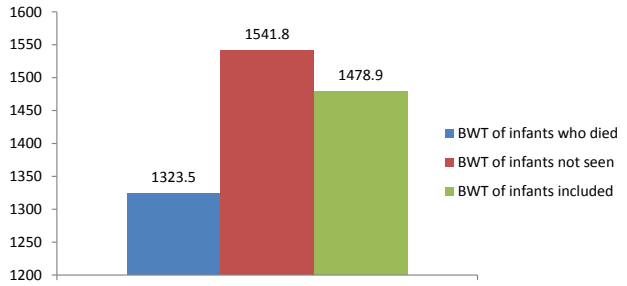

Figure 2: Comparison of average birth weight between infants who died, those never seen and those included.

Finally, a comparison was done between the included infants (n=131) and those who were never seen (n=56) or died before their first exam (n=27). It was found that those who died had a lower average weight than the other two groups, as demonstrated in Figure 2.

DISCUSSION

Retinopathy of prematurity in low and medium income countries has been identified as an upcoming epidemic due to recent improvements in neonatal care[4, 5]. Scanty data on prevalence rates in many developing countries has hampered the development of screening and treatment guidelines. Studies done in schools for the blind in East Africa, in which Kenya was included, showed 0% blindness from ROP[6-8]. The conclusion was that neonates in these countries were not surviving long enough to develop the blinding disease.

The first prevalence study in Kenya, carried out in two urban hospitals, reported an ROP prevalence of 16.7%[9]. Other African studies have reported a prevalence ranging from 18.6%[10] to 47.2%[1]. Our study found a much lower prevalence of ROP (3.05%) than what has been reported. ROP prevalence may vary significantly even within one country depending on the level of neonatal care in each hospital, its location and setting (urban vs rural)[4] and its survival rates at lower gestational age. In this study, the high mortality rates (12.6%) and high dropout rates (25.2%) could have also contributed to the low ROP prevalence found. It is important to stress that in our study, majority of the ROP screening examinations were done in the outpatient setting. Neonates were discharged from the neonatal unit once they achieved a weight of 1700 grams, which was usually before they achieved 4 weeks of life. Most babies therefore received their first eye examinations in the outpatient clinic. Higher risk infants usually remain in the hospital under medical care[11] thus have longer hospital stays. All four infants found to have ROP were diagnosed while undergoing in-patient care

in the NICU. Additionally, this hospital does not have paediatric surgery services, therefore patients that required surgery (2/214; with gastroschisis and cardiac disease) were transferred to other centers for treatment and thus not examined.

A comparison of the average birth weight between those who were included and those who were not (those who died or were never seen), revealed a lower average birth weight among the infants who died. Low birth weight has been identified as a risk factor for development of ROP. This could explain the low prevalence, as those more likely to develop the disease died before examination. On the other hand, those who never showed up for examination had the highest average birth weight. It could be extrapolated that this group of infants fared well at home after discharge and therefore their parents did not see the need to bring them to the clinic for examination.

All the babies in our study were of black African descent. Black race has been suggested as a protective factor for the development of ROP. Studies that have included race as a predictor variable have shown that black race infants have a lower prevalence of ROP blinding disease or ROP requiring treatment when compared to Caucasian infants[12,13]. Good *et al*[14] attempted to explain this racial variation, attributing it to Beta-adrenergic receptor polymorphisms in African-Americans as a protective factor. This theory can be explored for treatment of vision-threatening ROP. In a Nigerian study[1], despite a high ROP prevalence of 47.2%, none of the babies had stage 4 or 5 disease and all ROP cases regressed spontaneously. Wanjala *et al*[9], in a Kenyan study with a prevalence of 16.8%, found no cases of stage 4 or 5 disease after examining 120 infants. While this could explain the low prevalence in this study, other factors including level of neonatal care need to be considered.

Gestational age and low birth weight have been consistently identified as risk factors for development of ROP. Our study was not an exception. Two-thirds of the infants that developed ROP had a gestational age of less than 30 weeks and birth weight of equal to/less than 1250 grams, which is consistent with current guidelines for screening. However, it is important to note that the infant with the worse stage of ROP had a GA of 34 weeks and BW of 2800 grams. This infant, the "forgotten baby", escaped the nurses' attention due to her large birth weight and gestation. She was later discovered by the ophthalmologist and provided the opportunity to emphasize screening of high risk infants who fell outside normal screening criteria. The most important risk for ROP development in this patient was clearly a very prolonged oxygen administration of 43 days.

Gilbert *et al*[4] and Quinn[15] have shown that in low and middle income countries, ROP develops in infants with larger GA and BW and it has been argued that expanded screening criteria should be used. The forgotten baby is a clear example of how infants falling outside normal screening criteria can develop ROP. However, in Kenya, Wanjala *et al*[9], after using an expanded screening criteria of <35 weeks GA and BW ≤1700 grams, found that only one infant 34 weeks GA and 1500 grams BW developed ROP. This infant had been on oxygen for 35 days and was on treatment for neonatal sepsis. He recommended screening at < 32 weeks and 1500 grams, with expanded screening criteria for those with prolonged oxygen administration, blood transfusions and neonatal sepsis.

In this study, the most consistent risk factor among the four babies with ROP was respiratory distress syndrome. Other risk factors identified were HIV exposure, multiple birth, sepsis and intra-ventricular haemorrhage. Comparable studies[1,9] have listed low birth weight, oxygen administration, neonatal sepsis, blood transfusion, apnea and phototherapy as risk factors in univariate analyses. Due to the small numbers of ROP in this cohort we could not perform a meaningful analysis of each contributing risk factor.

While this study may question the necessity of having an ROP screening program in rural Kenya and other similar low income countries, it also confirms the emergence of ROP in this setting including Stage 2 ROP in a larger GA infant due to unregulated oxygen exposure. Improved neonatal care may reduce mortality and increase prevalence of ROP in rural government hospitals. Since ROP is a treatable condition with life-long implications for vision and disability if undetected, it seems prudent to continue with ROP screening of high-risk infants to avoid missing any case of this potentially blinding disease.

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Malignant hypertensive retinopathy in a postnatal patient with pregnancy induced hypertension: Case report

Zungu TL[1,2], Mdala S[1,2],Gandiwa M[1,2], Mhango P[1,2], Kayange PC[1,2]

[1]Department of Ophthalmology, College of Medicine, University of Malawi, Blantyre, Malawi
[2]Lions Sight First Eye Unit, Queen Elizabeth Central Hospital, Blantyre, Malawi

Corresponding author: Dr Thokozani Zungu. Email: thokzungu@gmail.com

ABSTRACT

Pregnancy Induced Hypertension (PIH) is one of the leading causes of maternal and perinatal mortality, especially in developing countries. Hypertensive retinopathy is a common condition in patients with PIH. Patients mostly present with mild hypertensive retinopathy changes such as arteriolar narrowing and arteriovenous nicking. Malignant hypertensive retinopathy is a rare finding in PIH patients.

We present a case of a 32 year old postnatal woman with PIH who developed malignant hypertensive retinopathy in both eyes during post-partum period.

Key words: Pregnancy Induced Hypertension, Pre-eclampsia, Hypertensive retinopathy, Malignant hypertensive retinopathy

INTRODUCTION

Pregnancy Induced Hypertension (PIH) is a significant contributor to maternal and perinatal mortality, especially in developing countries. Pregnancy Induced Hypertension (PIH) is classified into mild PIH, pre-eclampsia, and eclampsia. "Mild PIH is defined as blood pressure of 140/90 mmHg which returns to normal by 12 weeks postpartum. Pre-eclampsia is the presence of hypertension (BP>140/90mmHg) on two occasions with spacing of four hours and significant proteinuria (>300 mg per 24 hrs) and/or oedema. Eclampsia is the occurrence of convulsions or coma unrelated to other cerebral conditions, with signs and symptoms of pre-eclampsia. Our patient had blood pressure of 160/113mmHg which is severe hypertension"[1].

Hypertensive retinopathy occurs in approximately 60% of patients with PIH and patients mostly presents with mild hypertensive retinopathy[2]. Severe forms of PIH such as pre-eclampsia and eclampsia are associated with high prevalence of hypertensive retinopathy.

Malignant hypertensive retinopathy or grade 4 hypertensive retinopathy is the most severe type of hypertensive retinopathy. Malignant hypertensive retinopathy is a rare finding in patients with PIH[3].

We present a case of postnatal woman with PHI who developed bilateral malignant hypertensive retinopathy.

CASE REPORT

A 32 year old woman presented to Lions Sight First Eye Hospital in Blantyre, Malawi in February 2018 two weeks after spontaneous vaginal delivery. She complained of blurred vision in both eyes and headache. The symptoms began a few days after delivery. She also presented with lower limb swelling of approximately 3 month duration. There was no history of convulsions or systemic hypertension during the pregnancy.

Her blood pressure was elevated (163/113 mmHg) when she presented to us at Lions Sight First Eye Hospital. The best corrected visual acuity was 6/18 in both eyes. Anterior segment examination was normal in both eyes. On fundoscopy, there was blurred disc margin, per-papillary hard exudates, multiple cotton wool spots, star-shaped macular hard exudates and reduced retinal transparency around the fovea in both eyes (Figures 1 and 2). In addition, there were two per-papillary flame shaped haemorrhages in the right eye.

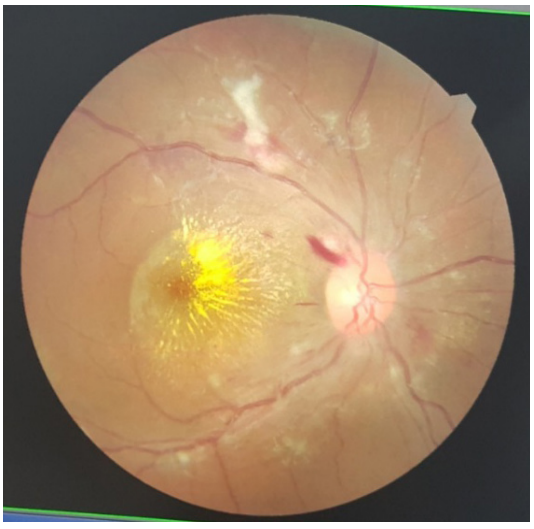

Figure 1: Retinal image of right eye during first visit showing blurred disc margin, two per-papillary flame haemorhages, per-papillary hard exudates, multiple cotton wool spots, macular star and reduced retinal transparency around the fovea

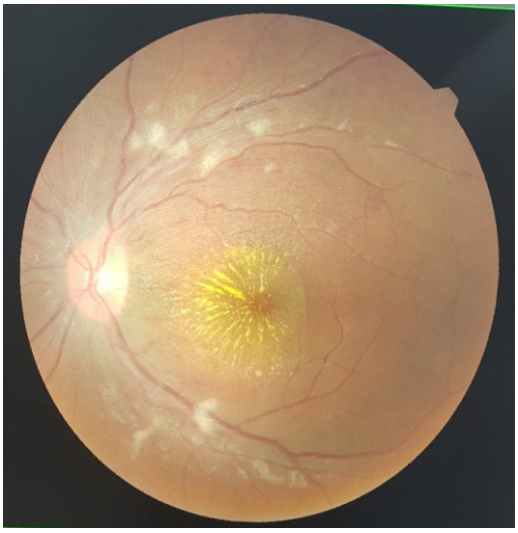

Figure 2: Retinal image of left eye during first visit showing blurred disc margin, per-papillary hard exudates, multiple cotton wool spots, macular star and reduced retinal transparency around the fovea.

Macular OCT scan (Nidek RS330) which was done during the first eye hospital visit showed subretinal fluid correction and highly reflective round lesions in outer retinal retina (Figure 3). The reflective lesion corresponded to hard exudates on the retinal photograph.

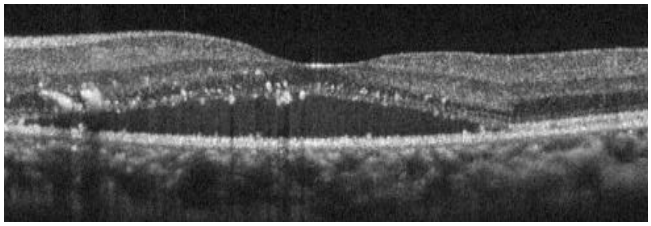

Figure 3: OCT horizontal image of the left eye on first visit showing subretinal fluid collection and hard exudates (multiple round and oval hyper-reflective lesions) in outer retina. OCT scan image of the right eye (not shown) has similar findings.

The diagnosis was malignant hypertensive retinopathy in post-partum woman with PIH. The patient was immediately referred to the internal medicine department for further management of her condition. The blood pressure was still elevated (168/103mm Hg) on second measurement at hypertensive clinic and she was commenced on anti-hypertensive medicine.

The patient reported for follow up review at our clinic at Lions Sight First Eye Hospital four weeks after her first visit. There was a great improvement in symptoms and signs.The visual acuity was 6/6 in both eyes (Figure 4). Fundoscopic signs were resolving in both eyes. There was no longer sub-retinal fluid collection on OCT in both eyes. Small intra-retinal cystic fluid collection and remnant reflective hard exudate were seen on OCT in both eyes (Figure 5).

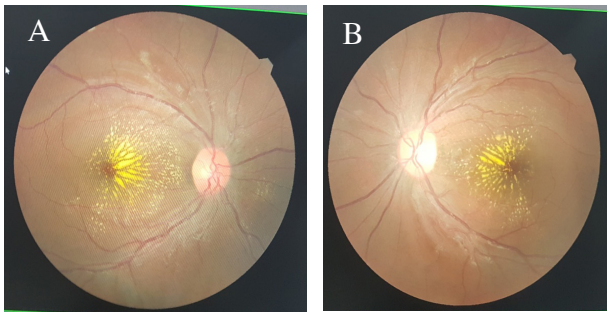

Figure 4: Retinal images of the right eye (A) and left eye (B) on second visit showing marked resolution of signs. There are still hard exudates in both eyes and cotton wool spot in the right eye

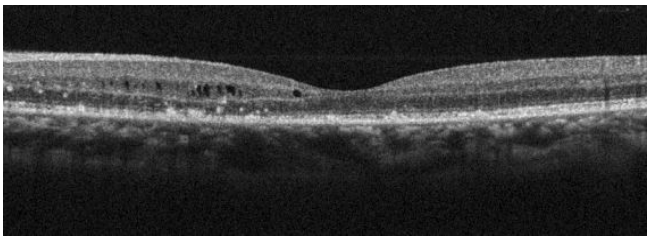

Figure 5: OCT horizontal scan image of the left eye on second visit showing complete resolution of the subretinal fluid collection and reduction of the hard exudates. There is small multiple small multiple intra-retinal cystic fluid collections. OCT scan of the right eye (not shown) has similar findings.

DISCUSSION

Our patient presented with PIH in the post-partum period. She had elevated blood pressure and lower limb oedema. She may have developed pre-eclampsia. However, it is not possible to confirm pre-eclampsia as laboratory test for assessing proteinuria was not done.

The patient in this report presented with blurred vision with reduced best corrected visual acuity of 6/18 in both eyes. The reduced vision could be attributed to bilateral subretinal fluid. Other visual complaints reported in literature include photopsias, visual field defects, diplopia and in severe cases blindness[4]. These symptoms were not reported by our patient.

According to Keith, Wagener and Barker classification, there are four grades of hypertensive retinopathy. Grade 1 is a mild disease, with generalized arteriolar narrowing. Grade 2 shows moderate retinopathy with focal definite arteriolar narrowing with arteriovenous nicking. Grade 3 shows more advanced retinopathy, with retinal haemorrhages, exudates, cotton wool spots. In Grade 4, patients presents with papilloedema in addition to Grade 3 signs[5-8]. Grade 1 hypertensive retinopathy is more common with a prevalence of

14.7% and Grade 4 (malignant retinopathy) is the least common (0.3%) while Grades 2 and 3 have a prevalence of 8.6% and 5.8% respectively[9].

Our patient had Grade 4 (malignant) hypertensive retinopathy with flame shaped haemorrhages, cotton wool spots, exudates on the macula and mild disc swelling. Studies have shown that retinal changes correlate with severity of the hypertension. However, high grades of hypertensive retinopathy such as Grade 3 and 4 are rarely seen in PIH[3].

Hypertensive retinopathy Grades 3 and 4 are markers of acute end organ damage. Factors associated with acute end organ damage are poorly known. One study found that young age was a risk factor for developing Grade II/IV hypertensive retinopathy independent of age[5]. Our patient was relatively young, with 32 years of age.

Our patient developed symptoms one week in the post-partum period. Past literature indicated that pregnancy induced hypertension usually improves after delivery. However, PIH can still occur upto 12 weeks post-partum, and if poorly managed, it can lead to vision threatening ocular complications such as serous retinal detachment[3].

The retinal circulation undergoes a series of pathophysiological changes in response to elevated blood pressure patients with hypertensive retinopathy[10]. Initially, there is a vasoconstrictive stage. During this stage, there is vasospasm and increased tone in retinal arteriolar tone due to autoregulatory mechanisms. This stage is seen clinically as a generalized narrowing of the retinal arterioles. Persistently elevated blood pressure leads to intimal thickening, hyperplasia of the media wall and hyaline degeneration in the subsequent, sclerotic, stage. This stage corresponds to more severe generalized and focal areas of arteriolar narrowing, changes in the arteriolar and venular junctions (arteriovenous nipping) and alterations in the arteriolar light reflex ("copper wiring")[11].

The vasoconstrictive stage is followed by an exudative stage. During exudative stage, there is disruption of the blood–retina barrier, necrosis of the blood vessel smooth muscles and endothelial cells, exudation of blood and lipids, and retinal ischemia. These changes are manifested in the retina as microaneurysms, haemorrhages, hard exudates, and cotton-wool spots. Swelling of the optic disc may occur at this time and usually indicates severely elevated blood pressure[11]. The stages of hypertensive retinopathy described here, however, may not be sequential[10].

Pregnancy induced hypertension has several other ophthalmic complications. Cortical blindness is a reported complication which presents as acute loss of vision in a patient with severe pregnancy induced hypertension which can occur antenatally or postnatally[2]. It is suggested that it likely occurs secondary to cerebral oedema[4]. Vision almost always returns to normal within 4 to 8 hours[12]. Imaging may show cortical occipital lesions. Visual loss is reversible. Other complications reported include hypertensive optic neuropathy (papilloedema), optic atrophy following retinal detachment, choroidal atrophy and retinal pigment epitheliopathy.

Cases of mild hypertensive retinopathy do not require investigation. Ocular investigations such as Optical Coherence Tomography (OCT) and Fundus Fluorescein Angiography (FFA) may be indicated in some cases with advanced retinopathy[6]. Brain imaging such as Magnetic Resonance Imaging (MRI) may be warranted in cases suspected of cortical blindness.

Management mainly involves control of the raised blood pressure. Our patient was managed on antihypertensive drugs only as she developed symptoms post-natally. Literature has shown improvement in vision in a few weeks but however the clearing of exudates takes even years[3]. Papilloedema and surrounding retinal oedema resolve, leaving an optic disc of near normal appearance within a few weeks; depending on severity of disc oedema before employing the treatment[13]. Our patient's vision was restored to normal 6/6/ in both eyes within 4 weeks with resolution of subretinal fluid collection. However, hard exudates take many months and sometimes years to completely resolve[14]. Hypertensive rretinopathy is an end organ damage and therefore the patient requires a multi disciplinary assessment including cardiovascular morbidity[13]. Our patient did not have other hypertension associated morbidities on assessment by internal medicine team.

CONCLUSION

Malignant hypertensive retinopathy is a rare finding in PIH patients. It is a marker of end organ damage. Timely diagnosis and correct management is essential in order to prevent cardiovascular morbidity and mortality.

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Regent Court, Block A, Suite A7, Argwings Kodhek Road, Hurlingham, P.O. Box 4539-00506, Nairobi, Kenya,
Office line: +254 724 111 059, Mobile: +254 732 240 671
www. coecsa.org/info@coecsa.org