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College of Ophthalmology of Eastern, Central and Southern Africa (COECSA)
It is my pleasure to introduce to you the first edition of the journal of ophthalmology of Eastern, Central and Southern Africa (JOECSA). This new journal replaces the East African Journal of Ophthalmology (EAJO) which has been in print since the year 1976 and has so far produced 16 volumes. This replacement was necessitated by the merger of the Ophthalmological Society of Eastern Africa (OSEA) and Eastern Africa College of Ophthalmologists (EACO) to form COECSA. EAJO was the official journal of OSEA and likewise JOECSA will be the official journal for COECSA. JOECSA will provide a platform for all ophthalmologists in the region to publish their research findings and disseminate information to promote good ophthalmic practices.

The main objective of JOECSA is to improve all aspects of Ophthalmology and Community Eye Health in COECSA member states. To achieve this objective, JOECSA will publish a minimum of three journals in a year containing original scientific articles, review articles, case reports and letters dealing with any factor impacting eye health.

A new and vibrant editorial board has been constituted and a team of international advisors will be nominated and engaged in future editions. This will be a peer reviewed journal accessible online through the link http://coecsa.org/ojs-2.4.2/index.php/JOECSA. Once the JOECSA web page is fully developed it will provide the authors, reviewers and editors an effective platform for online submission and review of manuscripts. The ultimate aim of the editorial team is to have the journal indexed in PubMed and Medline increase the visibility of published articles. Guidelines to authors can be found on www.coecsa.org.

The future of this journal depends on the commitment and support of all COECSA members. It is in this spirit that the JOECSA Editorial Board appeals to all of you to support your journal by submitting articles for publication and assisting to review articles from your peers to make the new journal a success.

Dr Emmanuel M Nyenze
MBChB, MMed (Ophth), F.E.A.C.O
Editor –in-Chief
EDITORIAL

A call to pool our regional resources through conversation, collaboration and collective action

Providing eye care to all who need it wherever they are has continued to be a challenge in our region. Among the challenges cited include on one hand the lack of adequate accessible and appropriate infrastructure and trained personnel to tackle different disease conditions while on the other hand the current cost of those services that are available makes them unobtainable by the poor. As the population we serve grows larger and older in the coming decades these issues will only be exacerbated.

Each country in our region has a diversity of challenges when it comes to delivery of eye care but more importantly each country has unique strengths that others can learn from. One of the ways in which eye health professionals can help to improve the poor state of eye health in Eastern Africa is through regional cooperation and collaboration, leaving out what did not work in the neighbouring country and grasping and building on what works well. Better still we can put together small successes in each country and come up with huge regional success stories.

Let us examine which collective and collaborative actions we can initiate to ensure high quality eye care is available “universally” in our region by addressing critical eye health problems through a regional approach, rather than by individual country action.

Regional Interaction

We often read newspaper headlines such as “Members of Ugandan EAC Ministry in Rwanda for bilateral best practices discussions”; “Kenyan delegation learns from the Tanzanian experience of mainstreaming environment”. Let us learn from our politicians and set up regular communication channels to share innovative, comprehensive approaches to address specific eye health issues. An annual scientific congress is not enough. We need more peer exchanges, capacity building workshops, and study tours so that we can share best practices, model policies, and technical expertise to help strengthen our eye programs. We could even develop joint mechanisms to monitor progress towards the elimination of avoidable blindness in our countries. Let us ease cross border movement for patients. Uhuru Kenyatta the President of Kenya in a recent summit in Kampala called for a common East African Community Tourist Visa. Let us take advantage of this and other initiatives such as the East African Community e-identity cards that ease the logistics of cross border travel. Examples exist outside our region -55% of patients undergoing cataract surgery in Nepal come from India. Why should a person from Kirundo in Northern Burundi not travel to Kigali in Rwanda for his surgery rather than taking the much longer journey to Bujumbura? Let us do this in a professional way by setting out a legal framework providing clarity about the rights of patients who seek eye care in another country.

Regional Training Initiatives

We could initiate a program to stimulate contacts and exchanges between existing universities and other training institutions. This program should go hand in hand with programs which promote student mobility and inter-university contacts and cooperation. It would also cover joint appointments, multi-badged degrees, credit transfer arrangements for students, pooling teaching resources, joint professional development activities, and the consolidation of appropriate support functions.

Organizations like The College of Ophthalmologists of Eastern, Central and Southern African region (COECSA) could develop the open method of coordination in training. This would be voluntary cooperation of the training institutions in the Eastern African member countries. The method uses a series of jointly-agreed tools- objectives, guidelines, indicators, benchmarks and good practices – to improve policies and practice. By using the open method, there would be no official sanctions for those who don’t comply but rather, the method’s effectiveness would rely on peer pressure and naming and shaming, as no country would want to be seen as the worst in a given policy area.

Let us divide training responsibilities. COECSA countries have a critical shortage of healthcare workers. This in turn translates to an even more acute shortage of medical trainers. Rather than having a proliferation of mediocre poorly resourced training institutions in each country why not divide responsibilities so that different countries are supported to excel say in their area of strength such that we could have an optometry training centre of excellence in Tanzania, a superb residency training in Kenya, corneal subspecialty training in Rwanda, ophthalmic nursing centre of excellence in Mbarara, a Vitreo-Retinal Centre in Tanzania and so on.

Joint Research

Institutions in the COECSA region, whether academic or in service delivery, bring to the table specific competencies and resource capabilities.
Joint scientific and technological cooperation agreements, based on clearly understood mutual benefits would serve to increase the exchange of knowledge and know-how. Multicentre research would involve larger number of participants, different geographic locations, inclusion of a wider range of population groups, and allow comparison of results among centres. These advantages would all increase the generalizability of regional data and help fill in the large gaps in knowledge that exist in our region.

Despite the limitations we may have as individual countries in the delivery of eye care we all have the same goals. In unison the resources we have individually can go a longer way and benefit many more. And before we even embark on this as a region we could first learn to communicate, collaborate and act collectively within our own countries.

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This editorial represents the opinions of the author alone, not those of the Journal itself.
COMMENTARY

Pediatric ophthalmology care – A reflection on current status in Uganda

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Introduction

This article is intended to generate debate among stakeholders in the delivery of pediatric ophthalmic care in East Africa. It is also intended to emphasize the need for strategies that are region specific and based on activities to prevent blindness in the community through measles immunization, health education, and control of vitamin A deficiency and the provision of tertiary-level eye care facilities for conditions that require specialist management1. The categories of high, middle and low income countries are so broad that action plans ultimately are informed by the detailed factors in any particular country.

Uganda has a population of about 33 million which is largely a young population (0-14 years: 49.1% 15-24 years: 21.2%)2. According to the 2006 Uganda Demographic and Health Survey3, 38% of children under five in Uganda are stunted, 16% are underweight and 6% are wasted. This presents a tremendous burden on the eye health services for the pediatric population. We however don’t have big population based studies to inform planners on the extent of the problem of childhood blindness and visual impairment. Regarding disabilities, 300,000 (1%) people in Uganda have hearing impairments while 250,000 are blind, the causes of which are largely preventable4. Although comparisons between different countries have many confounding factors extrapolation of the findings in the Andra Pradesh population based studies5 suggests that amblyopia from the effects of congenital cataracts and uncorrected refractive errors comprise the major burden of childhood blindness and visual impairment in Uganda as well. Based on experience from elsewhere there are efforts to combat childhood blindness and visual impairment in the East African Region. One of the main approaches being adopted in the East African region is the building of pediatric ophthalmology teams as recommended by WHO/VISION 2020 strategy. The team among others includes pediatric or child-centered ophthalmologist, optometrist, anesthetist, counselor, low-vision therapist and mid-level personnel6.

Current pediatric ophthalmology services in Uganda

The details of specific disease management protocols are not in the scope of this paper. Noteworthy for the pediatric cataract as an example, we subscribe to not implanting an intra-ocular lense in the first twelve months but do lens washout posterior capsulotomy and anterior vitrectomy with a plan to implant when the child is 15-24 months. A more recent study by Plager et al? support this approach.

There are currently four centers offering tertiary pediatric ophthalmology care including Mulago, Mengo, Ruharo and Benedictine Hospitals. Only one of the four (Mengo) has a complete pediatric team. Services are offered free in the public sector but enabled through partnerships between government and non-governmental development organizations and are subsidized in the private not for profit hospitals. Accessibility cannot at the moment be categorized as universal because the distribution of the institutions with pediatric tertiary services is mostly in the southern half of the country. Some learning points about the team have emerged and constitute the main discussion in this paper as further progress is directly linked to ensuring that the pediatric team functions optimally.

The team

**Pediatric Ophthalmologist:** In the limited experience we have had in the region, the tasks of the pediatric ophthalmologists are not clearly spelt out. The few pediatric ophthalmologists (four) available who are heads of these teams work very differently depending on their placement and where they were trained. The outputs therefore vary accordingly. This is not to call for uniformity but for the planning of programs and training facilities and opportunities a harmonious understanding helps in defining expectations. For example in the public sector the absence of optometrists and low vision therapists means that the pediatric ophthalmologist devotes more time to doing several refractions. It also means that children requiring low vision assessment access that service in the not for profit private hospitals introducing an extra expense to the patient. The burden of orthoptic evaluation too is undertaken by the pediatric ophthalmologist in the public sector as the position of orthoptist does not feature in the public sector. In time as information dissemination improves about pediatric eye services some of these factors may become an impediment to timely access to services for some children. As part of career development the pediatric ophthalmologists in the region need accreditation. Whereas service delivery takes precedence there is a felt need to incorporate research to give a better understanding of our pediatric ophthalmology patients and disease patterns.
**Child centered ophthalmologist**

The child eye centers that offer comprehensive tertiary level care in pediatric ophthalmology are in some instances far apart or distributed in a skewed manner. The role of the child centered ophthalmologist has become greater and more critical. The linkages are still weak among service providers. A carefully thought out plan is essential to ensure that children who need services that are not available at the child centered facilities can be availed either through an outreach approach or a strong referral system.

**Optometrist**

The support required from optometrists in ensuring that children get the right prescription and wear correct glasses at all times cannot be overemphasized. Currently there are only eight qualified optometrists in the country all of whom are in the private sector. The public sector has not yet established positions for this cadre. On a positive note however the process to have it in the public sector is on course and in-country training will soon be available. In their interim training of mid-level cadres in pediatric refractions is being implemented.

**Low vision therapist**

These crucial personnel in putting to maximum use what vision a patient has by using appropriate devices is still not yet recognized in the public sector. There are four low vision therapists in Uganda only two doing full-time low vision work. Two are overwhelmed by number of clients, one is underutilized and one not actively practicing low vision. We can maximize benefit by more enlightenment among the eye practitioners regarding the role of low vision therapists and referral of potential beneficiaries. What should our approach be for the cadres that do not exist in the public sector at this time when we are looking at integration of eye services in the mainstream health care delivery system. It might be prudent to coalesce some of these tasks into one or two cadres then strongly advocate for their inclusion in the public sector which in the East African Region still plays the greater role in health care delivery. We can take advantage of policy statements such as “Addressing the human resource crisis and redefining the institutional framework for training of Health workers, including the mandate of all actors, leadership and coordination mechanisms, with the aim of improving both the quantity and quality of health workers production”.

**Anaesthetist**

The anaesthetists are still few in Uganda especially outside urban establishments and none exclusively dedicated to eye departments. But this presents a unique opportunity for advocacy at local hospital level. The opportunity is for the eye fraternity to advocate and where possible facilitate the anaesthetists to obtain additional training in pediatric anaesthesiology. This not only improves safety of the pediatric surgeries but also enhances the anaesthetists’ commitment to the eye departments.

**Counselor**

Because of the ramifications of HIV/AIDS many nurses in the public sector have undergone basic counseling training. The need for counseling in pediatric ophthalmology is even greater considering information gaps among the community with respect to pediatric cataracts, strabismus, congenital anatomical anomalies and relevant information on nutrition. In the public sector, nurses in the eye departments take on most of this responsibility. Professional counselors where available can be equipped with relevant eye health information to carry on this role.

**Mid-level personnel**

Ophthalmic clinical officers have exhibited a lot of versatility in taking on tasks in refraction and remain key in supporting the pediatric team in service delivery.

**Optical services**

Integration of optical services in the public sector remains a challenge. There are initiatives to establish optical workshops in some regional hospitals as a way of increasing accessibility. We do not have enough experience to comment on how this will impact optical service delivery in future.

**Data**

There are gaps in the data on childhood eye health yet this information is crucial in planning, evaluation and advocacy for eye care. An archive of the studies conducted in the Country on child eye health however small is worth compiling to further advance the cause for more resources to be allocated to eye care. Uganda has one of the highest fertility rates at 6.3 as reported by the World Bank 2008 report; an estimated 1.4 million infants are born every year with few of them registered and even fewer issued with birth certificates. The Uganda Health Demographic Survey reported that only 21 out of 100 children aged 5 years and below had had their birth registered. A common strategy in the region is essential to generate a data bank alongside service delivery which takes advantage of the revamped registration of births.

**The patients and their care givers**

Reflection on the costs involved in the follow up of children for example those with pediatric cataract and those with congenital glaucoma demands careful
thought on the plan for follow up. For example, suppose there is one low vision therapist at a facility, is it enough to only give a date appointment for assessment? Would it not be more appropriate to attempt to allocate time in addition to the date. I would argue that if five patients turned up at 8.00am to see the same officer the 4th or 5th to be seen may not be motivated to come back because of the long waiting time.

How much coordination is there among the different officers within the same facility when it comes to review appointments? For each patient more needs to be done to keep visits to the optimum number and to essential ones only. Another aspect is the need for advance information of costs of different services the patient may incur each visit.

CONCLUSION

We don’t have a long history in delivery of pediatric ophthalmology services as they are understood today. We have the opportunity to develop them based on our local context to ensure that as many children who need these services can access them. We have the challenge of using the limited human resource to benefit more. Additionally we need to have a well-coordinated action plan to strengthen data collection and accelerate training of more personnel at all levels. We should constantly take into account the resources available to the pediatric patient so as to have a most cost effective follow up plan.

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Causes of severe visual impairment and blindness in the schools for the blind in the Northern and North Western Uganda

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Objective: To identify the major causes of severe visual impairment and blindness among children attending the schools for the blind with the view of offering treatment to those with remediable visual impairment and blindness.

Design: Cross sectional study.

Study site: Four schools for the blind in the districts of Gulu, Kitgum and Arua (Uganda).

Methods: Pupils in Gulu Primary (Gulu), St Threza Girls (Kitgum), Ediofe Girls (Arua) and Mvara Boys (Arua) schools had complete ophthalmic examination from their respective schools. All findings were documented on the WHO standard forms for recording causes of SVI/ blindness in children. Consent was obtained from the school authority/ teachers.

Results: A total of 53 children were examined; Males 35 (66%) and females 18 (34%). The onset of visual loss among the children was as follows: at birth 16 (30%), Infancy 5 (10%), onset between 1-15 years 25 (47%) and unknown onset 7 (13%). Visual impairment was observed in 98% and categorized as: blind 39 (75%), severe visual impairment 10 (19%), low vision 3 (6%) and normal vision 1 (2%). Anatomically, the major sites of abnormality leading to visual loss were: whole Globe 27%, cornea 21%, lens 21%, optic nerve 13.4% and retina 9.6%. The etiology of conditions that led to visual loss was found to be as follows: unknown (63%), post natal causes (27%), hereditary (4%), peri-natal factors (4%) and intra-uterine causes (2%). The criteria for admission in the school was as follows: those recommended and referred by health workers were 27 (51%), while 20 (38%) were taken by parents or guardians and 5 (11%) by the District Education Office.

Conclusion: Sixty seven percent of the causes of visual impairment were avoidable.

Key words: Uganda, SVI/Blindness, Schools for the blind.

INTRODUCTION

Visual Impairment (VI) is a major worldwide problem that has become a public health concern. It has a significant impact on the quality of life of the individual, the family, the community and the nation at large. The World Health Organization (WHO) definition of Severe Visual Impairment (SVI) is visual acuity of less than 6/60 but equal or greater than 3/60 (counting finger at 3 meters) in the better eye with best possible correction1. In terms of visual field blindness is visual field no greater than 10° around central fixation1. Functional blindness is when a person retains some minimal degree of vision but is unable to carry out / perform tasks for which eyesight is essential2.

It is estimated that nearly 50 million people are blind according to the World Health Organization (WHO) criterion for blindness. An additional 135 million people are visually impaired and need social, vocational, economic or rehabilitative support services3. More than 90% of all the blind and visually impaired people live in the developing world where common causes of bilateral visual loss include cataract, glaucoma, trachoma, vitamin A deficiency and onchocerciasis3. Information on childhood blindness has been obtained through studies in the schools for the blind. According to the WHO a child is an individual aged 15 years or less. Causes and magnitude of visual impairment in the schools of the blind vary from region to region in the world. In the developed countries SVI and blindness among children in the schools of the blind is mainly due to diseases of the retina, optic nerve, central nervous system and hereditary factors. The major causes in the developing countries are however avoidable, for example corneal scarring due to infection or malnutrition, cataract, trachoma, glaucoma etc. About 80% of causes of blindness in the developing countries are avoidable.

Causes of severe visual impairment / blindness and low vision can be classified according to the anatomical site of the lesion or etiology. Anatomical classification is according to the level at which vision is obstructed in the eye, for example, whole globe cornea, lens, uvea, retina and optic nerve. Etiological classification is according to the developmental time at which the insult occurred, that is, hereditary, intrauterine, perinatal childhood or unclassified4.

Surveys to assess the causes of blindness in the schools for the blind were conducted in most parts of Uganda including mid northern Uganda and West Nile except in the schools in Gulu region. Gulu region has been under prolonged war for the past 20 years. There was therefore need to document the causes of SVI/BL in these schools / region so as to build country wide
data base that will be useful in the interventions to address childhood blindness. Establishing the criterion for admission may help in the formulation of policy regarding admission.

The objective of the study was to identify the major causes of SVI / BL among students attending the schools for the blind with the view of offering treatment to those with remediable visual impairment / blindness. The specific objectives were to determine the anatomical site of abnormality leading to visual impairment, the etiology of visual loss, and the criteria for admission in the schools.

MATERIALS AND METHODS

This was a cross sectional study done in four Ugandan schools for the blind in the districts of Gulu, Kitgum and Arua. All the pupils aged 15 years or less and young adults (15-18 years) who became blind before the age of 15 years were enrolled and examined while all those who did not want to be examined and young adults or adults with SVI / blindness that developed after the age of 15 years were excluded in the study.

The study variables included characteristics such as name of school, age, sex, address, tribe, age of onset of visual loss, visual assessment, additional disability and history of previous eye surgery. Other variables were anatomical site of abnormality leading to visual loss, etiology of visual loss, and information on who referred admission in the school. The WHO standard form for recording SVI / BL in children was used.

Permission to conduct the study was obtained from the district and school administrations while individual consent for minors was obtained from the teachers/school matron and confidentiality was observed.

Complete ophthalmic examination was done by Ophthalmologists and any available medical records of the children were reviewed. All findings were documented on the WHO standard forms for recording causes of SVI/ blindness in children and short closed ended questionnaire. The data collected was analysed using SPSS and the results presented in form of texts, tables, charts and graphs forms.

RESULTS

Demographic characteristics: A total of 53 respondents were examined in the four schools; 35(66%) males and 18(34%) females giving a male to female ratio of 2:1. The youngest subject was aged six years while the oldest was 18 years. Majority (86.8%) of the respondents were aged 5 - 15 years.

<table>
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<th>Age (years)</th>
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<th>Gulu Primary</th>
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<tr>
<td>&gt;5 -10</td>
<td>2(4%)</td>
<td>4(8%)</td>
<td>7(13%)</td>
<td>5(9%)</td>
<td>18 (40)</td>
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<tr>
<td>&gt;10–15</td>
<td>4(8%)</td>
<td>5(9%)</td>
<td>14(26.9%)</td>
<td>5(9%)</td>
<td>28 (52.8)</td>
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<tr>
<td>&gt;15</td>
<td>1(2%)</td>
<td>2(4%)</td>
<td>4(8%)</td>
<td>0(0%)</td>
<td>7 (13.2)</td>
</tr>
<tr>
<td>Total</td>
<td>7(13%)</td>
<td>11(21%)</td>
<td>25(47%)</td>
<td>10(19%)</td>
<td>53 (100)</td>
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Visual loss: In the majority (48.1%) onset of visual loss was during childhood period (1-15 years) followed by at birth (30.8%), unknown onset (13.5%) and at infancy (9.6%). Family history of visual loss was reported by 40 (75.5%) while in six cases (11.3%) it was unknown and absent in 7(13.2%). History of consanguinity was negative in 14 (26.4%) and unknown in 39 (73.6%).

Category of visual impairment: Of the 53 respondents, 52 (98.1%) had visual impairment distributed as follows: Low vision (5.8%), SVI (19.2%) and blind (75%). SVI/BL was observed in 94.2%. The child with a normal vision had left eye phthisis bulbi secondary to trauma but a normal right eye and was studying in Braille. Figure 1 shows the major site of abnormality leading to visual loss among the respondents.

The abnormality of the globe includes the following phthisis bulbi, unsightly blind eyes, staphyloma micophthalmia and other globe congenital abnormalities. Aetiology of visual loss: In the majority (63.5%) of respondents the underlying aetiology of causes of visual impairment was unknown. The main causes of visual impairment in these cases were congenital abnormalities (8), cataracts (6), glaucoma (4), optic atrophy (2) keratoconus (2), uveitis, and retinoblastoma amongst others. The respondent with retinoblastoma was an 11 year old male who had bilateral enucleation at 3 years. The postnatal / childhood causes of visual loss (26.9%) were corneal scars (4), measles (4), trauma (2), intraocular infection/inflammation (2) and others. One respondent had optic atrophy secondary to onchocerciasis. The other causes of visual loss were peri-natal disorders (3.8%), hereditary factors (3.8%) and Intra uterine factors (1.9%).

Table 1: Distribution of respondents by school and age (n=53)

![Figure 1: Major anatomical site of abnormality leading to visual loss](image-url)
The most important perinatal/neonatal factor was ophthalmia neonatorum. The two hereditary diseases identified were retinitis pigmentosa and a case of congenital lens dislocation that had a positive familial history of similar diseases. The only intrauterine disease was suspected congenital toxoplasmosis.

In the seven cases aged above 15 years, the causes of visual impairment were due to cataract (3), advanced glaucoma (2) and optic nerve atrophy (2).

**Avoidable and non avoidable causes of visual loss:**

Avoidable causes of visual impairment were observed in 35 (67.3%) of cases while in 17 (32.7%) the causes were non avoidable. The leading causes of avoidable visual loss/impaired vision were cataracts eight (23%), corneal scars seven (20%), glaucoma five (14.3%) and uveitis four (11.4%). The most important causes of non avoidable visual impairment were congenital abnormality 11 (64.7%), and optic atrophy of unknown cause four (23.5%).

**Criteria of admission:** Thirty one (58.5%) respondents were seen by the health workers before going to the school for admission while the remaining 22 (41.5%) were not. Of the 31 cases seen by health workers, 27 (51%) were recommended and referred to the school for the blind. Twenty (38%) children were taken direct to school by parents or guardians without referral from health units and 5 (11%) by others which included NGO’s and the department of special needs education in the districts.

**Additional disability:** Four (7.5%) of the 53 subjects had additional disability which comprises of mental retardation (3) and hearing loss (1). The remaining 49 (92.5%) did not have any additional disability.

**DISCUSSION**

**Demography characteristics:** In this study the majority (86.8%) of the respondents were aged 5 - 15 years. This is because this was a school based study. In Ethiopia Kello and Gilbert reported that 96.7% of the 360 respondents were aged below 16 years. In both cases the children in the schools for the blind are averagely older than their counter parts in the normal schools since they tend to delay to start school. Discussions with the heads of the blind annex revealed that some children are brought to the schools because the parents find keeping them at home a big burden to the family. There were more males (66%) than females (34%) and the reason for this could not be ascertained.

**Onset of visual loss:** In the majority (48.1%) onset of visual loss was during childhood period (1-15 years) followed by at birth (30.8%), unknown onset (13.5%) and at infancy (9.6%). The leading causes of visual loss in the childhood period are mainly avoidable causes of blindness such as intraocular infections, corneal scars, and glaucoma. Onset of visual loss at birth was mainly due to conditions such as congenital abnormality and congenital cataract while onset in the first year of life was associated with corneal scars, cataracts and infections. All the seven cases aged above 15 years reported onset of visual loss before the age of 15.

**Category of visual impairment:** Of the 53 respondents, 52 (98.1%) had visual impairment and these were distributed as follows: Low vision (5.8%), SVI (19.2%) and blind (75%). SVI/BL was observed in 94.2%. In Ethiopia Kello and Gilbert found 94.5% with BL or SVI while in a multistage study in India SVI/BL was reported in 94.4% of the 1411 cases examined. Similar study on 165 children in Indonesia revealed that 96.3% were blind and 3% were SVI. These findings were similar although this is a smaller sample size compared to the rest of the studies. There is therefore evidence to support that the majority of the children in the schools for the blind are the right category of children with visual impairment suggesting a good selection practices.

**Anatomical site of visual impairment:** The study shows the anatomical causes of visual impairment amongst the respondents were: Globe 26.9%, cornea 21.2%, lens 21.2%, optic nerve 13.5%, retina 9.6%, uvea 5.8% and refractive errors 1.9%. Kello and Gilbert reported cornea/phthisis 62.4%, optic nerve 9.8%, cataract/aphakia 9.2% and uvea 8.8% while in Nigeria Ezegwui et al. found lens 30.4%, cornea 21.7%, globe 17.4%, buphthalmos 10.9%. Rahi e'tal in India reported: corneal/globe 47.7%; retina 19.3% and lens 12.3%. Similar studies in Indonesia by Sitorus et al. found: globe 32.7%, retina 26.0%, cornea (17.6%), lens (13.3%), optic nerve (6.1%), and uvea (4.3%). Tumwesigye examined 271 children in 14 schools in central, eastern and western Uganda and found retinal disorders 22%, optic nerve lesions 16%, glaucoma 5.3% refractive errors 3.3% and others 9.3%.

**Aetiology of visual impairment:** The aetiology of visual impairment was as follows: Unknown aetiology 63.5%; post natal/childhood 26.9%; perinatal factors, hereditary and intrauterine factors accounted for 3.8%, 3.8% and 1.9% respectively. Other studies showed that childhood/postnatal factors accounted for 49.8% and 38.6% in Ethiopia and Nigeria respectively while in Indonesia hereditary diseases and infective causes of blindness were the predominant causes of blindness, accounting for 42.4% and 29.7%, respectively. The results in the developing countries are similar and most of the causes of blindness could be avoidable. The result from Indonesia shows a mixed picture between developing and developed countries.

**Causes of blindness:** The avoidable causes of visual impairment accounted for 67% of all cases and these were due to cataracts 11 (31%), corneal scars 7 (20%), glaucoma 3 (9%). The remaining 33% were non avoidable causes which were due to congenital defects 11 (33%), and optic atrophy of unknown aetiology 3 (9%). Findings in Ethiopia and Nigeria showed that avoidable causes of blindness accounted for 68% and
74.5%, respectively, of all the students examined. These are close to the WHO report in which 80% of all causes of blindness are avoidable.

Though this study has a smaller sample, the findings are consistent with the reported patterns in the above developing countries. West Nile region (Arua) and Northern Uganda (Gulu) lacked established eye care service delivery with fully functional eye departments till the years 2003 and 2005 respectively when eye departments were built and ophthalmologists posted to the respective regions. Prior to these periods the regions were being served by visiting ophthalmologists through outreach services. Besides the Gulu region had been under a two decade war which also affected the delivery eye care services. These may partly explain the high causes of avoidable blindness in the two regions.

Criteria for admissions: Of the 53 respondents 27 (51%) were referred to the school for admission by eye health workers and 20 (38%) by parents / guardians. A small fraction 5 (11%) were referred by the district education offices for rehabilitation (special needs) and other Non Governmental Organizations. Four children were seen by eye health workers but not referred suggesting low level of concern about blind children education among some health workers.

CONCLUSIONS AND RECOMMENDATION

Ninety four point two percent of the respondents had SVI/Blindness. The commonest anatomical sites leading to visual impairment were the globe (14%) cornea, (11%) and lens (11%) while the aetiology of conditions that caused visual impairment was unknown in the majority (63.5%). Sixty seven percent of the causes of SVI / VI were avoidable. The practice of referring children to the schools for the blind by health workers is low (50%). It is therefore important to improve capacity to prevent childhood blindness and promote education of the blind children.

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Prevalence of congenital color vision defects among school children in five schools of Abeshge District, Central Ethiopia

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ABSTRACT

Background: Human color vision is normally trichromatic in the sense that a suitable mixture of red, green and blue lights can match any color that we can see. Color blindness occurs when one or more of the cone types are absent, or present but defective. It is a common X-linked genetic disorder. However, most of color blinds remain undetected due to absence of proper screening.

Objective: To determine the prevalence of congenital color blindness and identify the level of awareness about their color vision defect among school children.

Design: This was a cross sectional study.

Setting: The study was conducted in five schools of Abeshge district Central Ethiopia among school children in February 2009.

Materials and Methods: A total of 1040 male school children of grade 3 to 8 screened for color vision defect using Ishihara’s pseudoisochromatic test 38 plate edition. The sociodemographic data and results of color vision test and ocular examination collected using pretested structured questionnaire.

Data was entered and analyzed using SPSS statistical package version 15.0.

Results: A total of 1040 male school children were screened with a mean age of 12 ± 2.43 years. Among these 44 cases (4.2%) (95% Confidence Interval 2.98 to 5.42) were color blind. Of these 30 cases (2.89%) involved deutan, 6 cases (0.58%) protan, 6 cases (0.58%) unclassified, and 2 cases (0.19%) of totally color blind. All of the color blind subjects were not aware of their status of color vision.

Conclusion: The prevalence of congenital color blindness in this study is similar to the previous two studies among Ethiopians. Cases of total color blindness among Ethiopians reported for the first time. Early school screening for color vision defect is recommended.

Key words: Color blindness, Males, Grade school children, Level of awareness, Ethiopia

INTRODUCTION

Color blindness is the inability to distinguish certain colors. Molecular studies have shown that defects in color vision result from the absence, malfunction, or alteration of one (dichromatism), two (monochromatism) or all (achromatism) of the photopigments. Dichromats base their color vision on only two pigments1. The class of dichromats characterized by the entire absence of green cones is called deuteranopia, while those defects characterized by the absence of red cones are called protanopia and those characterized by the absence of blue cones are called tritanopia. Anomalous trichromacy is a relatively mild form of defective color vision. The terms protanomaly, deuteranomaly and tritanomaly is given when there is defect in red, green and blue pigments, respectively. Protanomaly and protanopia are collectively referred to as protan colour vision defects, and deuteranomaly and deuteranopia are referred to as deutan defects. Protan and deutan colour vision defects are often collectively described as red-green defects. Tritanopia and tritanomaly are often described as the tritan or blue-yellow colour vision defects1-3.

Impaired color vision, in the case of red-green color blindness, is genetically determined by X-linked recessive inheritance and thus occurs in males but is transmitted via the female. The defective genes for protan and deutan defects are situated at different loci on the X chromosome, and are therefore non-allelic4-6. The inheritance of other forms of defective color vision is complex6.

Congenital protan and deutan defects, which are collectively termed red-green color blindness, are common, affecting about 8.0–10.0% of Caucasian male population7. In contrast, congenital tritan defects are rare, affecting less than 1 in 10,000 people8. The prevalence of red-green color blindness has been found to vary between different races, tribes and ethnic groups9. The prevalence of color vision defects among non-Europeans is lower than in persons of European ancestry in whom it is reported to be 6.0% for males and 0.25% for females10. In some European countries even higher prevalence is reported; 7.8% of school boys in Germany11, 7.95% among males in Greek12, and 7.33% in young Turkish13 men were reported to have congenital color vision defect. A study done in Australia showed prevalence of 7.4% in males and
0.7% in females. In the USA, the average incidence of red-green color blindness was found to be about 8.0% among males and 0.4–0.7% among females.

Asian males have a prevalence of color vision defects of 4.9% compared to 0.64% in females. A recent study from India reported a prevalence of 8.73% of males and 1.69% of females among Muslim population. The prevalence in Arab boys of Saudi Arabia is 2.93%. 

Individuals of African, Native American or Mexican ancestry have an even lower prevalence: 3.1% in males and 0.7% in females. The incidence of red-green color blindness is significantly higher in North Africa than in sub-Saharan Africa which displays a very low incidence. However, in North Africa it is on the whole still appreciably lower than the usual European incidence of 7% to 9%. Studies in some of the countries of North Africa reported a prevalence of 6.56% in Algerians, 5.6% in Tunisians, 5.99% in Libyans and 10.5% in Moroccans among studied male population. The overall incidence of red-green color blindness in sub-Saharan population was reported to be 6.263%. 

The study of color blindness in Ethiopian population is scarce with only two published studies. According to these studies, the prevalence of congenital color blindness among Ethiopians was reported to be 4.2% among males and 0.2% among females.

Color is routinely used to code and convey information as well as finding extensive application in the educational system. Currently, no treatment exists for congenital color vision defects. However, studies showed that diagnosis of these defects early in life may help children adjust better to tasks at school and may help adults understand their limitations at work. Undiagnosed Color Vision Defect (CVD) could pose a handicap to the scholarly performance of an affected student. It is therefore important that children of school age, particularly boys, should be tested early.

The objective of this study was to determine the prevalence of congenital color blindness among male school children in Abeshge district and to identify the level of awareness about their color vision defects.

MATERIALS AND METHODS

A descriptive cross-sectional study was conducted in February 2009 in Abeshge District of Gurage zone, central Ethiopia. Multistage sampling method was employed. First, five primary schools in the district were selected randomly by using table of random numbers among 15 primary schools in the district. Next, from each selected school, all of the male school children from grades 3 to 8 who were able to read the numbers were selected. All male children from selected grades, who were healthy participants with normal ocular examination findings, were included in the study. Participants on chronic drug therapy for more than one month or with systemic illness or who have history of ocular or head injury which significantly affected vision were excluded from the study. However, we didn’t encounter participants with these exclusion criteria during the survey and all of the male students from the selected five schools were screened for color vision defect. Snellen’s E chart was used to test the visual acuity at 6 meters distance and color vision was assessed with each subject’s best-corrected acuity. All of the participants had normal near vision.

A sample size of 850 was calculated by taking the prevalence of 4.2% obtained from previous study in Ethiopia, with 95% confidence interval, 2% margin of error, design effect of 2 and with the assumption of 90% response rate using the standard formula for the calculation of sample size.

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where

- $n$ = sample size
- $Z$ = z-score for 95% confidence level (1.96)
- $P$ = estimate of the proportion (0.042)
- $d$ = degree of accuracy (0.02)

A total of 1040 male students with the age ranging from 8 to 20 years were screened for color vision using Ishihara pseudoisochromatic 38 plate edition which was administered to participants by the principal investigator in a room with sufficient indirect natural tropical daylight in the morning hours of the dry season. Examination was conducted in class rooms consisting of multiple wider windows with adequate bright light and with subjects sitting near the window side. Direct sunlight was avoided and no electric light was used as it was not available in that set up. The test was conducted based on the standard recommendation of color vision test. All testing was done under binocular viewing conditions. The plates were held at arms length from the subject and tilted so that the plane of the paper is at right angles to the line of vision and set at eye level of subjects. Before the test each participant was given the following instruction using the local language which was understandable by students: “on each page you may see a number or you may not see anything. Tell me what you see as I turn each page as soon as possible.” The first plate was presented first to check whether they followed instruction correctly or not. All of the participants were active and responded within an average duration of 2 seconds per each test plate. Participants who made more than five typical red-green defective responses between plates 2 and 21 were judged to have failed the test. Such participants were then shown the diagnostic plates (22, 23, 24 and 25) to determine the type and severity of the defect. Those who failed the test were immediately retested and the result recorded. For all individuals who missed 5 or more plates, diluted funduscopic examination was conducted with direct ophthalmoscope to rule out any
ocular pathology. However, no ocular pathology was detected in the eyes of subjects found to have color vision defect.

Demographic data including age, sex, grade, address, history of eye disorder, eye injury, use of medications, awareness about their color vision defect along with findings of ocular examination and results of color vision test were recorded in pre-tested structured questionnaire. The demographic part of the questionnaire was filled by trained integrated eye care worker. Data was entered, analyzed, the frequencies of study variables and cross tabulations were done using SPSS statistical package version 15.0.

Ethical clearance was obtained from research and publication review board of the Department of Ophthalmology, Faculty of Medicine, Addis Ababa University. Informed consent was obtained from parents or guardians of the children. Guidelines of the declaration of Helsinki were adhered during the study. Those study participants with color vision defect were explained about their problem and advised about the selection of their future carrier.

RESULTS

A total of 1040 participants were screened with mean age of 12 ± 2.43 years. The majority of participants were in the age group of 11-15 years (718, 69%). The distribution of participants by schools includes Garaba 267 (25.7%), Fenta 241 (23.1%), Fekado 227 (21.8%), Rimuga 175 (16.8%), and Hole 130 (12.5%).

In the study population, 44 (4.2%) cases of defective color vision were detected [95% Confidence interval 2.98 to 5.42]. Of 44 cases of color blind 30 (2.89%) cases involved deutan, 6 (0.58%) protan, 6 (0.58%) unclassified, and 2 (0.19%) cases of totally color blind. The two participants with total color blindness had normal visual acuity and no retinal pathology was detected with dilated direct ophthalmoscopic examination. The prevalence of red-green color blindness excluding totally color blind subjects was 4.04% (95% CI 2.84 to 5.24). Almost all of the study subjects were not aware of their color vision status and only 2 (0.19%) students reported that they have difficulty of differentiating different colors. Overall only one student reported that he had undergone eye examination at least once in his life time.

DISCUSSION

In the screening process of color vision, the question is simply if there is a color deficiency present or not. Since the prevalence of protan and deutan defects are by far the highest in congenital color deficiencies, most screening color vision tests only identify these red-green deficiencies. Screening of color vision deficiencies is usually done with so called pseudoisochromatic plates of which the Ishihara test probably is the most well-known. In the three studies performed to evaluate the sensitivity of Ishihara pseudoisochromatic test, there was no evidence that Ishihara’s test was less valid than any other screening tests. Based on these studies, Ishihara test has the mean sensitivity of 96% and the mean specificity of 98.5%. The Ishihara’s test showed good retest reliability. In this study we used Ishihara’s test 38 plate edition which is generally considered to be the most efficient for screening red and green congenital defects. And only one ophthalmologist interpreted the results. The gold standard in color vision testing is the anomaloscope which was not used in our study because of unavailability.

Ethiopians have a much higher incidence of color blindness (4.2%) than other sub-Saharan population examined when atypical undiagnosed forms of color blindness are included as reported by Adam. Another study conducted by Zein in 954 boys and 1064 girls attending two schools in North-west Ethiopia in 1988 using the Ishihara 24 plate edition reported a total of 40 color blind (4.2%) among males and 2 (0.2%) among females. In this study there were 31 (3.2%) deutans and 9 (0.9%) protans among males. Both female color blinds were deutans. This study reported prevalence of color blindness among female Ethiopian population for the first time.

According to our study the frequency of congenital color blindness in males including totally color blind subjects was found to be 4.2%, which is the same as the rates reported in the previous two studies. The prevalence rate of congenital red-green defect was 4.04% which is also nearly similar with other studies among Ethiopians. The commonest type of color vision defect was deutan with deutan/protan ratio of 5(30/6) which was higher than that reported by Zein of 3.4. This high ratio may be partially explained, because there were six unclassified cases of red-green defects which might have affected the proportion. On the basis of his limited and incomplete data on the frequency of deutan and protan genes, Adam postulated that, analogous to Yemenite Jews, the frequency of protan genes among Ethiopians would be more common than deutan genes. However, the findings of this study do not confirm this postulate. In contrast to this, the usual deutan/protan ratio of 2.2 to 4.2 was reported in most other populations, including the Europeans, Far and Middle Easterners and Indians.

In this study, two cases of totally color blind individuals were identified for the first time among Ethiopians. Monochromacy, more commonly referred to as “total color blindness”, is caused by the total absence of either 2 or 3 of the pigmented retinal cones, reducing vision to one dimension. This type of color vision defect is reported to occur very rarely and it is severe form associated with reduced vision especially if rod monochromatism. In this study we were not able to diagnose the specific type, however, considering the fact that both subjects had normal vision it is possible
to postulate that they might be classified under cone monochromatism.

Detection of color vision defect early in life of an individual is very important to make informed decision on future career. Early detection of color vision malfunction in children allows parents and teachers to make necessary adjustments to the teaching methods for appropriate learning. However this is not always possible in developing countries like Ethiopia with lack of awareness. Of the approximately 7% of male population with congenitally impaired color vision about 40% of that population appeared to be unaware of the defect prior to leaving secondary school. Ganley and Lian reported that 18% of the university students screened for color vision defect did not know their color vision status and among confirmed cases of color blind 33.3% reported that they are not color blind. However in our study among 44 cases of color vision defect using anomaloscope. Defects amongst 29,985 young Greeks. Chimonidou E. Data concerning colour vision disturbances. Hum Gene. 1978; 69:255.

The majority of school children were not aware of their color vision status and among confirmed cases of color blind 33.3% reported that they are not color blind. However in our study among 44 cases of color vision defect using anomaloscope, Defects amongst 29,985 young Greeks. Chimonidou E. Data concerning colour vision disturbances. Hum Gene. 1978; 69:255.

The prevalence of congenital color blindness among school children in Abeshge district of Gurage zone was 4.2% among males which is similar to the previous two studies among Ethiopians. Cases of total color blindness among Ethiopians reported for the first time. The majority of school children were not aware of their problem. Early screening of school children for color vision defect is highly recommended, so that the affected individuals would be able to adjust their future career. We also recommend further studies to be done to determine the magnitude and severity of color vision defects using anomaloscope.

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REFERENCES


Survival among retinoblastoma patients at the Kenyatta National Hospital, Kenya

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ABSTRACT

Background: Retinoblastoma has a high cure rate if detected and treated early. Though there is paucity of data of the outcome of retinoblastoma management in Africa, literature shows wide disparity in survival between children with retinoblastoma in the developed and the developing countries.

Objective: To estimate the 3 year survival of patients diagnosed with retinoblastoma at Kenyatta National Teaching and Referral Hospital, Kenya.

Methods: This was a retrospective audit of records of patients admitted with retinoblastoma between January 2000 and December 2004. Demographic data, clinical presentation, intra-operative findings and histology report were recorded and parents/guardians were contacted to ascertain the patients’ outcome. The data was analyzed using the Statistical Package for Social Scientists version 12 and survival calculated using the Kaplan-Meier survival probability curve.

Results: The cumulative 3-year survival was 26.6%. The mean survival time for the survivors was 68 months (SD 16.6) and the Kaplan-Meier survival probability at 36-months of follow-up was 0.2. The factors that significantly influenced good outcome were; age at presentation of <12 months, early disease at presentation (leucocoria only) OR=4.13(1.48-11.68) p<0.001, intraocular disease on histology OR=8.5(2.23-34.49) p<0.001 and total delay to management of ≤5 months OR=3.5(1.31-9.68) p=0.005. Proptosis and tumor recurrences were associated with 100% mortality.

Conclusions: The survival of patients with retinoblastoma was found to be very low. The main reasons were the late presentation and recurrent disease. The factors associated with poor outcome were presentation with proptosis, metastatic disease, extraocular disease on histology and delay in diagnosis to management of >5months.

Key words: Retinoblastoma, Outcome of ocular cancers, Survival, Cancer, Kenyatta National Hospital (KNH) East Africa, Africa

INTRODUCTION

The incidence of retinoblastoma in Kenya has been estimated to be 1:17,000 live births1,2. Retinoblastoma patients in developed countries have very good prognosis for survival, with overall survival rates of over 90%3,4. The survival of retinoblastoma patients in Africa is scanty and this was the first study on the outcome of retinoblastoma in Kenya. Presence or absence of extraocular disease is the most important prognostic factor6-9 with other aggravating factors being extra retinal involvement with extension within the choroid, the sclera and the optic nerve10-12. Duration of symptoms before treatment also influences the outcome6,13.

MATERIALS AND METHODS

This was a retrospective study at the Kenyatta National Hospital, Kenya’s largest teaching and referral hospital. It included records of all patients admitted with retinoblastoma at Kenyatta National Hospital between 1st January 2000 and 31st December 2004. Kenyatta National Hospital serves Kenya’s population of over 30 million and parts of western Uganda. The eye clinic receives new patients as well as those referred by ophthalmologists and non-physician eye care workers for investigations and for specialized treatment including chemotherapy. Examination under anesthesia augmented with ocular ultrasound was performed for all patients. Histology of enucleated eyes was done at the University of Nairobi, Department of Human Pathology. Patients with a clinical diagnosis of retinoblastoma with or without histological confirmations were included. All records of patients whose histopathological report ruled out retinoblastoma were excluded. Approval was obtained from the Kenyatta National Hospital’s Ethical Board. The International Code of Diseases was applied in computerized and manual retrieval of all files coded for retinoblastoma. Demographic details, clinical/surgical findings, histology report, parents’ or guardians’ contact and details of the last follow up in clinic were obtained. Parents or guardians were contacted via telephone or letters to determine patients’ outcome and in case dead, the cause of death if known. Data obtained was analysed using the Statistical Package for
Social Scientists (SPSS) Version 12. Survival rate was calculated by simple cumulative survival rate method and using Kaplan-Meier survival probability curve.

**RESULTS**

The records of 160 patients were identified but only 105 patients had been followed up for at least three years and hence qualified for the 3-year survival analysis. The cumulative 3-year survival rate was 28/105=26.6%. Mean survival time of the children who died during the period of follow up was 5.1 months (SD 6.4) with a range of 1-30 months from presentation. Mean survival time for the survivors was 68 months (SD 16.6) from presentation, with a range of 41-96 months. Probability of survival at 36 months was 0.2 as calculated on the Kaplan-Meier survival probability curve (Figure 1).

**Figure 1:** Kaplan-Meier Survival probability curve (n=105)

There were 57 were males (54%) and 48 females (46%) with a male to female ratio of 1.16:1. The mean age at presentation was 37.5 months (SD 27) with a range of 1-144 months. The age at presentation was found to significantly influence survival (p value = 0.0067) (Figure 2).

**Figure 2:** Association between age at presentation and survival (n=105)

Seventy six patients (72%) had unilateral disease while 29(28%) had bilateral disease. No patient had trilateral disease. Laterality was not found to be significantly associated with survival, OR 1.4 (0.5-3.5) p=0.532. The mean age at presentation of the bilateral cases was 24.4 months (SD 18.1) while that of unilateral cases was 39.9 months (SD 26.1) and the difference was statistically significant (p<0.001), however laterality was not found to influence survival.

Only nine patients (8.5%) had positive family history of retinoblastoma, 39 patients (34.3%) had negative family history. Though it was not found to significantly affect survival with OR 0.32 (0.01-3.13) p=0.285, family history was not recorded in 55.2% of patient records. The mean delay between onset of symptoms and management was 12 months (SD 11.5 months) with a range of 13 days to 61 months. Delay significantly influenced survival with a delay of 5 months or less having better survival (p=0.005) (Table 1).

**Table 1:** Association between delay to treatment and 3-year outcome (n =105)

<table>
<thead>
<tr>
<th>Duration in months</th>
<th>Outcome</th>
<th>OR 95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5</td>
<td>Alive n (%)</td>
<td>Dead n (%)</td>
<td></td>
</tr>
<tr>
<td>≤ 5</td>
<td>18 (64.3)</td>
<td>26 (33.8)</td>
<td>3.53 (1.31-9.68)</td>
</tr>
<tr>
<td>&gt;5</td>
<td>10 (37.5)</td>
<td>51 (66.2)</td>
<td></td>
</tr>
</tbody>
</table>

The main presenting complaints were white reflex in the eye 71%, swelling of the eye 37%, poor vision 9.5%, pain and redness 7.6% and deviating eye 5% (Figure 3).

**Figure 3:** Presenting complaints

Three patients were diagnosed during scheduled screening by examination under anesthesia due to positive family history of retinoblastoma and thus had no complaints whatsoever. On clinical examination leucocoria was found in 46% of patients, ocular inflammation 30%, recurrent mass in the socket 27% and proptosis in 20% of cases (Figure 4).
Seventeen (16.2%) patients had tumor cells seen on cerebrospinal fluid microscopy, four patients had CT scan evidence of intracranial metastasis while one had ultrasonographic evidence of abdominal metastasis. Patients who presented with leucocoria only were four times more likely to be alive at 3-year follow up than those who had other ocular findings (Table 2). This is in sharp contrast to 48% of the 105 patients who presented with either proptosis (21, 20%) or tumor regrowth after enucleation (29, 27.6%). This was associated with very poor outcome of 100% mortality rate within 12 months of presentation to the hospital (Table 3). It is important to note that 65% of the patients who died within the 3 year follow up had either proptosis or recurrent masses.

### Table 2: Association between early presentation with (leukocoria only) and 3-year outcome (n=105)

<table>
<thead>
<tr>
<th>Leucocoria only</th>
<th>Outcome</th>
<th>OR 95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alive n (%)</td>
<td>Dead n (%)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>14 (50)</td>
<td>15 (19.5)</td>
<td>4.13(1.48-11.68)</td>
</tr>
<tr>
<td>No</td>
<td>14 (50)</td>
<td>62 (80.5)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Association between late presentation with proptosis and tumour regrowth and 3-year outcome

<table>
<thead>
<tr>
<th>Clinical Presentation</th>
<th>Outcome</th>
<th>OR 95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive, n (%)</td>
<td>Dead, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proptosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>21 (27.3)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>56 (72.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumour regrowth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>29 (37.7)</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>48 (62.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Association between histology and 3-year outcome (n=105)

<table>
<thead>
<tr>
<th>Histology findings</th>
<th>Outcome</th>
<th>OR 95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alive n (%)</td>
<td>Dead n (%)</td>
<td></td>
</tr>
<tr>
<td>Intraocular</td>
<td>15 (53.6)</td>
<td>12 (15.6)</td>
<td>8.5(2.23-34.49)</td>
</tr>
<tr>
<td>Extraocular</td>
<td>5 (17.9)</td>
<td>34 (44.2)</td>
<td></td>
</tr>
<tr>
<td>Inconclusive/Missing reports</td>
<td>8 (28.5)</td>
<td>31 (40.2)</td>
<td></td>
</tr>
</tbody>
</table>

Histopathological findings were divided into two categories of intraocular and extraocular diseases based on the available histology report. For bilateral cases in which both eyes were enucleated, for the purpose of correlating the extent of tumour involvement, the eye with the greater extent of tumour involvement was considered. Majority of the patients had extraocular involvement. Only 6 out of 105 patients were reported as having choroidal invasion (without involvement of the sclera and ciliary body). Of these six patients, five were dead at the end of three years and one was alive. Twenty one patients (20%) had missing histology records and the extent of the tumor was not indicated in the histology report of 14 cases (13.3%) thus were considered inconclusive. In addition, the parents/guardians of four patients (3.8%) declined enucleation.
Table 5: Multivariate analysis (n = 105)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Hazard ratio</th>
<th>95% confidence interval</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (ref=female)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.762</td>
<td>[0.459, 1.265]</td>
<td>0.294</td>
</tr>
<tr>
<td>Laterality (ref=bilaterality)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilaterality</td>
<td>1.354</td>
<td>[0.743, 2.465]</td>
<td>0.322</td>
</tr>
<tr>
<td>Age</td>
<td>1.005</td>
<td>[0.997, 1.014]</td>
<td>0.216</td>
</tr>
<tr>
<td>Total delay</td>
<td>1.007</td>
<td>[0.987, 1.028]</td>
<td>0.499</td>
</tr>
<tr>
<td>Leucocoria only (ref=yes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.057</td>
<td>[1.070, 3.957]</td>
<td>0.031*</td>
</tr>
<tr>
<td>Histology –(ref=Inconclusive to the extent of spread)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No histology</td>
<td>0.898</td>
<td>[0.404, 1.997]</td>
<td>0.792</td>
</tr>
<tr>
<td>Tumor confined to eye globe</td>
<td>0.279</td>
<td>[0.121, 0.645]</td>
<td>0.003*</td>
</tr>
<tr>
<td>Tumor involving optic nerve up to resection margin</td>
<td>0.745</td>
<td>[0.359, 1.543]</td>
<td>0.428</td>
</tr>
<tr>
<td>Extrascleral spread</td>
<td>0.902</td>
<td>[0.398, 2.042]</td>
<td>0.804</td>
</tr>
</tbody>
</table>

On multivariate analysis, only presentation with pure leucocoria and histology findings of tumour confined to the globe were found to be independently associated with survival (Table 5).

DISCUSSION

The three year survival for retinoblastoma patients at Kenyatta National Hospital was found to be very low (26.6%) compared to developed countries and some developing countries in Asia where data indicate high survival rate of even up to 96% at 5 year follow up⁴,⁹,¹¹,¹². Data on survival in Africa is scanty; however a study done in the neighbouring country of Tanzania revealed similarly poor outcomes. The study found a DFS probability of 0.23 (standard error=0.07)⁶. There are several factors that could explain the poor survival of retinoblastoma patients in our set-up. Being a referral centre, Kenyatta National Hospital mostly admits patients who have been treated at other centres and are only referred when the case is complicated. This results in both late presentations due to delays in the referral system and presentation with advanced disease both of which are associated with poor outcome. The primary care providers in Kenya are often non-physicians and ophthalmologists are few in rural areas where the majority of the population lives and this further compounds the situation.

The total delay to management was found to influence the 3-year outcome with a total delay of >5 months significantly associate with a negative outcome quite similar to studies in Asia¹¹. According to a study at KNH in 2000 (unpublished) the main reasons for delay in presentation of retinoblastoma patients were ignorance among medical care personnel at primary health care facilities, ignorance among the general population on the symptoms of retinoblastoma and poverty.

The mean age of presentation of 37.5 months (SD 27) was much higher compared to developing countries. This could be a reflection of the delay in presentation in Kenya survival rate was highest amongst patients who presented at 12 months of age or earlier and reduced dramatically in the older age groups. Increasing age at diagnosis and delay in referral has been shown to increase the risk of extraocular retinoblastoma¹⁰.

Majority of the patients presented with clinical features of advanced retinoblastoma. Studies done in Nigeria and Tanzania similarly reflect this advanced disease presentation¹⁴. The advanced stage of disease was found to be associated with very poor outcome quite similar to results of a study done in Turkey¹³. Majority of the patients had histopathology features of extraocular disease and this was shown to significantly influence the 3-year outcome similar to findings of studies in Asia and Africa⁵,¹¹.

Challenges in the area of histopathology were evident in the fact that 20% of the patients did not have conclusive reporting on the extent of the disease while 13% had no histology report. This may have introduced bias in the correlation between extent of disease and
survival and should be borne in mind when interpreting these results. It is worthy to know that ophthalmologists in our resource-challenged set-up often rely on clinical diagnosis of retinoblastoma as not all patients get histological confirmation and this challenge has been documented in Tanzania as well.

The main challenge encountered in the study was follow up of the patients to determine the outcome. Where no contact was made, consideration was made in data analysis and interpretation. Incomplete data including missing or incomplete referral notes, inadequate history taking by the ophthalmologists, lack of a standardized format in reporting of histology as well as missing reports could have introduced bias in the results. This should be borne in mind when interpreting the results. They also point to the areas of weakness in the public awareness and health care delivery in Kenya and the region indeed as articulated in the study done in Tanzania.

These need the concerted effort by all to improve the outcome of this treatable childhood disease in this region. Indeed following these findings a Kenya National Retinoblastoma Strategy was launched whose main areas of focus are increasing awareness, improving medical management (including quality of histology reporting) and supporting families of retinoblastoma children. All this is aimed at improving the survival of retinoblastoma patients in Kenya.

ACKNOWLEDGEMENT

We would like to acknowledge the contribution of the staff in the medical records department at the Kenyatta National Hospital. Special thanks to the Christoffel Blindenmission (CBM) for providing funding to carry out this study as part of the first author’s Masters in Medicine thesis fulfillment. The authors do not have monetary grants for disclosure.

REFERENCES

GREEN LASER 532nm
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FOLDABLE POSTERIOR CHAMBER INTRAOCULAR LENS

Empowering vision*
ON/OFF HINDI
PEDIA WORTH-4-DOT VERNIER UP DUO Vh DUO Hh AMSLER ANISEKONIASHIHI
BRACKET DR
RED/GREEN EDU IMAGES GREY SCALE DOWN ENTER CON+ CON-
ASTIG MIRR PERIPHERAL
ASTIG FAN FIXATION CROSS CYL
MASKING DOT LOGMAR
SNEFF-11
NUMBER TUMB-E LANG ENGLISH
OK

Supra Phob Hydrophobic IOL

GALAXYFOLD Ultra Smart®
WAVE FRONT ADAPTIVE ASPHERIC OPTICS
BEST FUNCTIONAL VISION

Acryfold®
FOLDABLE POSTERIOR CHAMBER INTRAOCULAR LENS

APPALENS PMMA IOL

APPA BLADE

Appavisc-PFS 2ml/3ml
Hydroxy Propyl Methyl Cellulose 2% Solution

COHEVISC 1.4*
PRESERVATIVE FREE 1ml
Sodium Hyaluronate Ophthalmic Solution

Mio-Chol Carbachol USP 0.01%w/v
Rhex-ID Trypan Blue 0.8 mg for Intracameral Use

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Willingness to donate eyes and associated factors among adults in a rural community in Central Ethiopia

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ABSTRACT

Objective: To assess the willingness on corneal donation among rural adults in Central Ethiopia.

Design: A community based, cross sectional study.

Setting: The study was conducted in Wolkite town, Central Ethiopia.

Methods: Data collection was through a house to house visit with face to face interviews. Systematic random sampling method was used. A total of 492 residents aged 18 years or older living in the randomly sampled housing units were included in the study.

Results: The mean age of respondents was 33 years (range 18-60) and 55.3% were females. From all adults, 57.9% were willing to pledge to donate eyes while only 30.9% were aware of eye donation. On multiple logistic regression, willingness to donate was associated only with previous awareness on eye donation (adjusted OR 0.434, 95 % CI: 0.266 - 0.709). The main reason given for being willing to donate (73.7%) was the feeling that they will be pleased to help the blind. The main reason for unwillingness (59.4%) was the belief that it was important to have an intact body after passing away (dislike to separate the eye from the body).

Conclusion: A good proportion of participants were willing to donate their corneas while the awareness level was low. Previous awareness on eye donation was the major factor associated with willingness to donate.

Key words: Eye donation, Willingness, Cornea transplantation, Eye bank, Ethiopia

INTRODUCTION

Corneal diseases are second only to cataract as major causes of blindness worldwide1. According to a national survey done in 2006, 1.6% of Ethiopians were found to have blindness and 3.7% had low vision. Trachomatous and other corneal opacities ranked as the second leading causes of blindness (19.3%) next to cataract (49.9%) and the third leading cause of low vision2.

Corneal transplantation is the major option for restoration of vision for these large numbers of corneal blind people. The success of corneal transplantation service is, however, dependent on many factors. Establishment of an efficient eye bank and acquiring the qualified professionals is the basic one. Furthermore, procurement of the adequate and quality donor corneas is a challenge, which depends on the availability of suitable donors and requires the presence of voluntary eye donation3.

Currently, there is only one eye bank in the country involved in collection and storage of donor corneas, the Eye Bank of Ethiopia. Corneal transplantation is performed in three university referral hospitals in the country, with the same eye bank expected to provide the available corneas for the institutions. Between 130 and 150 corneas are harvested every year and used in 90–120 transplants. However, the annual harvesting rate of corneas for transplantation is minimal compared with the requirement, and this has hampered the effective utilization of the service. Understanding the reasons why people do or do not donate is critical to devise policies to address this undersupply.

The health practice of an individual is influenced by the cultural milieu in which one lives. Among many factors that can affect this include religion and traditional beliefs and practices. It is therefore important to understand whether these factors would affect their willingness to donate their organs. Ethiopia is geographically, culturally, ethnically diverse country. There are more than 80 ethnic groups and Christianity and Islam are the chief religions.

There is scarcity of information on public attitudes towards eye donation and associated factors in the developing world, particularly in sub Saharan Africa. According to studies done in the developed nations, the decision to be an organ donor may be influenced by multiple factors; relational ties, religious beliefs, cultural influences, family influences, body integrity, previous interactions with the health care system4.

In this study, we aimed to assess the awareness on and willingness of adults in a rural community in Central Ethiopia to donate their corneas and to determine the factors influencing their willingness. To date, there is no published study in our country on this topic done at the community level. The information about distribution and demographic associations of
willingness for eye donation could help in developing strategies to increase the harvesting of corneas for dealing with corneal blindness.

MATERIALS AND METHODS

A community based cross sectional study was conducted in Wolkite town, Gurage zone, central Ethiopia. It is located 155 km West of Addis Ababa, the capital city of Ethiopia (Central Statistical Agency of Ethiopia, 2007). According to the National Census, it has a population of 28,856 divided in two kebeles (the smallest administrative unit in urban or rural areas). There is no significant difference in population characteristics in distribution among the kebeles (economic, ethnic, educational, etc.). One of these was selected for the study by a lottery method.

The total sample size was calculated using one proportion formula. Taking an estimated proportion of 30% of people willing to donate eyes and allowing an error of 4% of detecting the estimated prevalence by chance alone with 95% confidence interval, and adding a non-response rate of 10%, the total sample size calculated was 554. One of the adults aged 18 years or above and living in the sampled household was randomly selected and included in this study.

Data collection was through a house to house visit. A structured questionnaire predesigned in local language was completed after the nature of the study was explained and verbal informed consent of each individual was obtained. The length of the interview was about 20 minutes. Non-participating subjects included refusal to participate and non-contactable after three visits. Pre-test was performed in another area, which was not selected for the study. Data analysis was conducted using Statistical Package for Social Sciences (SPSS) version 15.0. Descriptive, univariate, and multivariate analyses were performed. The characteristics of those who were willing to donate eyes were compared to those who were not willing. Statistical significance was determined at the 0.05 level.

The study was approved by the Department of Ophthalmology and was done with adherence to the guidelines of the Declaration of Helsinki. The officials of the study area were approached and permission given to conduct the study. Informed verbal consent was also obtained from the participants. ‘Awareness’ was defined as ‘having heard of eye donation’ and ‘Willingness’- a subject was willing if he/she was voluntary to pledge to donate eyes.

RESULTS

A total of 492 subjects were included in this study, with a response rate of 88.8%. The age of respondents ranged from 18 - 80 years with a mean of 33 years (±14). The majority 261(53%) were in the age group 18–30 years old while 169 (34.4%) were 30–50 years old, and 62 (12.2%) were aged above 51 years. There were 272 (55.3%) females making the female to male ratio 1.24:1; from all participants 283 (57.5%) were married. The completed education level of the participants was as follows: 30.5% were illiterates, 4.1% were able to read and write only, 23.6% primary school education, 32.9% secondary school education and 8.9% had college education. The majority, 225 (45.7%) were Muslims while 203 (41.3%) were orthodox Christians and 39 (7.9%) were protestant Christians.

From the total respondents, 152 (30.9%) were aware of eye donation and the major sources of information were TV (65.1%) and Radio (39.5%). In addition, 285(57.9%) of the study participants were willing to donate their eyes, while 37 (7.5%) said they needed more information to decide (Table 1). On univariate analysis, willingness to donate was not associated with age (p = 0.71), sex (p = 0.12) or religion (p = 0.447). Respondents who were in the secondary education or completed a tertiary education were more willing to donate their eyes (69%) as compared with the other groups (50.6%), which was statistically significant, (OR = 1.203, 95% CI: 1.056-1.370). Educational level was also significantly associated with awareness on eye donation (OR = 2.14, 95% CI: 0.133-0.185). Those who were aware of eye donation (73.7%) were also more willing compared with those who were not aware (50.9%), which was statistically significant, (OR= 2.703, 95% CI: 1.778-4.109). Since awareness was also associated with the educational status of the participants, awareness was also entered on multiple logistic regression analysis; this showed that only awareness was significantly associated with willingness to donate, after adjusting for age, sex, educational status, ethnicity and religion (adjusted OR 0.434, 95% CI: 0.266 - 0.709). From those who were unwilling to donate eyes, 54 (26.3%) said they will be willing if their family member is to receive the benefit.
Table 1: Age, sex, ethnicity, religion, education and willingness to donate eyes, Central Ethiopia

<table>
<thead>
<tr>
<th>Variables</th>
<th>Willing to donate No. (%)</th>
<th>Unwilling to donate No. (%)</th>
<th>Multivariate adjusted odds ratio* 95.0% C.I.</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>153 (58.6)</td>
<td>108 (41.4)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>30 – 39</td>
<td>67 (60.9)</td>
<td>43 (39.1)</td>
<td>1.153</td>
<td>0.559</td>
</tr>
<tr>
<td>40 – 49</td>
<td>31 (52.5)</td>
<td>28 (47.5)</td>
<td>1.718</td>
<td>0.817</td>
</tr>
<tr>
<td>50+</td>
<td>34 (54.8)</td>
<td>28 (45.2)</td>
<td>1.545</td>
<td>0.569</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>149 (54.8)</td>
<td>123 (45.2)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>136 (61.8)</td>
<td>84 (38.2)</td>
<td>0.852</td>
<td>0.563</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>80 (53.3)</td>
<td>70 (46.7)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Able to read and write only</td>
<td>11 (55.0)</td>
<td>9 (45.0)</td>
<td>1.010</td>
<td>0.413</td>
</tr>
<tr>
<td>Primary</td>
<td>51 (44.0)</td>
<td>65 (56.0)</td>
<td>0.824</td>
<td>0.251</td>
</tr>
<tr>
<td>Secondary</td>
<td>113 (69.8)</td>
<td>65 (30.2)</td>
<td>0.592</td>
<td>0.259</td>
</tr>
<tr>
<td>College/University</td>
<td>30 (68.2)</td>
<td>14 (31.8)</td>
<td>1.396</td>
<td>0.635</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslim</td>
<td>122 (54.2)</td>
<td>103 (45.8)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Orthodox (Christians)</td>
<td>126 (62.1)</td>
<td>77 (37.9)</td>
<td>2.191</td>
<td>0.813</td>
</tr>
<tr>
<td>Protestant (Christians)</td>
<td>24 (61.5)</td>
<td>15 (38.5)</td>
<td>2.080</td>
<td>0.823</td>
</tr>
<tr>
<td>Others</td>
<td>13 (52.0)</td>
<td>12 (48)</td>
<td>2.154</td>
<td>0.657</td>
</tr>
<tr>
<td>Awareness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.434</td>
<td>0.266</td>
<td>0.709</td>
<td>0.001</td>
</tr>
</tbody>
</table>

*Adjusted for all other factors in the table.

Among those who were willing to donate their corneas, the most frequently given reason (73.7%) for this act was ‘I will be pleased to help the blind’, followed by ‘I feel doing good to humans’, (38.2%). (Table 2). The most frequent reason given for not being willing to donate corneas was ‘I want my body to be buried intact (dislike to separate the eye from the body)’ (59.4%), while 35.9% of responders indicated that donation is against their religious belief (Table 3). Participants with Muslim religion were more likely to cite that the act of donation is against their religious beliefs (46.4%) as compared with 25.8% of orthodox and 15.4% of protestant Christians. This was statistically significant (p = 0.024).

Table 2: Reasons for willingness to donate eyes (n =285)

<table>
<thead>
<tr>
<th>Reasons given for willingness to donate eyes</th>
<th>No. who gave this response (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleased to help the blind</td>
<td>210 (73.7)</td>
</tr>
<tr>
<td>Doing good to humanity</td>
<td>109 (38.2)</td>
</tr>
<tr>
<td>Because I don’t need my eyes after death</td>
<td>104 (36.5)</td>
</tr>
<tr>
<td>It counts for my afterlife</td>
<td>33 (11.6)</td>
</tr>
</tbody>
</table>

* An individual can give more than one response

Table 3: Reasons for unwillingness to donate eyes (n=170)

<table>
<thead>
<tr>
<th>Reasons given for unwillingness to donate eyes</th>
<th>No. who gave this response (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want my body to be buried intact</td>
<td>101 (59.4)</td>
</tr>
<tr>
<td>It’s against my religious beliefs</td>
<td>61 (35.9)</td>
</tr>
<tr>
<td>My family might be upset/ Not approve</td>
<td>35 (20.6)</td>
</tr>
<tr>
<td>Unsuitable to donate due to health problem</td>
<td>4 (2.4)</td>
</tr>
<tr>
<td>I have no reason</td>
<td>3 (1.8)</td>
</tr>
</tbody>
</table>

* An individual can give more than one response

From the 152 individuals who were aware of eye donation, 130 (85.5%) had positive attitude in that they believed eye donation could help someone blind to see again. Moreover, 108 (83.1%) of those with such positive attitude were willing to donate eyes as compared to only 18.2% of adults who believed eye donation could not help someone blind to see again. This was also statistically significant, (OR= 22.1, 95% CI: 6.8-71.6). When asked whether or not there is eye bank in Ethiopia, only 82 (16.7%) of all participants responded there is an eye bank in the country.
DISCUSSION

There is scarcity of information on the factors influencing corneal donation in different geographic areas and in populations from varied cultural, social, religious, and economic backgrounds. This is more evident in developing nations, despite the fact that they are the major areas with the burden of corneal blindness. It is therefore important to study the factors influencing willingness of the public for corneal donation for effective eye bank function. Since there is scarcity of published papers, particularly in sub-Saharan Africa, on this topic, we have limited our comparison to studies done in Asia. This is also the first paper in Ethiopia to evaluate the willingness of adults to donate corneas at a community level.

From all respondents in our study, 57.9% were willing to donate their corneas even though only 30% of adults had heard about eye donation. In comparison, a study done in a rural population of Andhra Pradish, Southern India, only 32.9% of adults were willing to donate their corneas while 30.7% had heard about eye donation and 52% of adults in North Western (NW) India were found willing to donate with 70.5% of the total respondents having heard about eye donation. In a study done among Singapore adults, 80.7% were aware of eye donation, while 67% were found to be willing to donate corneas. These studies may not be directly comparable with that of ours as the age; ethnicity and religion distribution of all these studies is different from that of ours. Nonetheless, the proportion of rural adults who are willing to donate their eyes in our study is high when it is weighed against the lower level of awareness.

The influences of various socio-demographic factors (like age, gender, religion, economic status, education level etc) on willingness to donate eyes have been described in the literature. On this study, we found only awareness on corneal donation to be significantly associated with willingness to donate, with 73.7% of those who were aware of eye donation being willing to donate eyes, as compared with 50.9% of those who had unawareness (OR = 2.703, 95% CI: 1.778 - 4.109). As having awareness on eye donation was in turn associated with education level of participants (OR = 2.14, 95% CI: 0.133 - 0.185), we expected those with better educational level to be more willing to donate their eyes. Positive association between level of general education and willingness to donate organs has been described in the literature. However, on multiple logistic regression, having had heard of eye donation remained the single most important factor to be associated with the willingness of individuals to donate. Unawareness of eye donation is considered to be one of the major obstacles in the procurement of corneas. This study confirms raising awareness among the public on eye donation and encouraging them to pledge to donate may be effective strategy for enhancing the willingness of the population towards eye donation, irrespective of education level.

From the participants who were willing to donate, 73.7% cited being pleased to help the blind as a major reason for their act while 38.2% considered their act of donation is doing good to humanity after death. This shows the great sympathy the people have towards the blind and their readiness for this noble purpose. This is also in line with the principle of altruism, an unselfish concern for the welfare of others, which is said to be the basic principle why people in the west support organ donation. The participants in the Singapore study (92.9%) similarly cited donating a part of themselves made them feel that they were doing good. This was in contrast to the study done in North Western India where the most important reason indicated was the possibility of “living on” after death, if they donated (94%), followed by doing some good to humanity after death (24%). On the other hand, the main reason for unwillingness to donate in our study was the belief that it was important to have an intact body after passing away (dislike to separate the eye from the body), 59.4%. This could be for cultural reasons in our society where great respect is given for the dead body and taking a part of it may result in disfigurement of the body, considered doing against the norm.

The concern of disfigurement has been described as a reason for negative sentiments regarding corneal donation. In fact, this is one reason proposed for the lower rates of corneal donations than other solid organs. The concern that the body is physically altered in some way during the procurement of cornea may invoke fears about mutilation and a desire to maintain bodily integrity and bury the body whole. A broader discussion with the public addressing such concerns that they have about this aspect of organ donation is very important. It is essential to deliver the message that the body may not appear disfigured after donation of the cornea. Health education on the use of the donated eye and its value in sight restoration for the blind should also be employed. Similarly, the most common reason cited in the Singapore adults was that they preferred their bodies remain intact after death (73.2%). The belief that donation hurts the family members was the main reason for refusal to donate in the study in NW India (45.5%) followed by religious reasons (24%).

Religion was the second common reason given for the unwillingness (35.9%) in our study. This is a significant number. Participants with Muslim religion were more likely to cite that the act of donation is against their religious beliefs (46.4%) as compared with the others. Cultural and religious beliefs may at times be interchangeable and some people may hold strong culturally specific beliefs which are not linked to any
particular religious stance. Furthermore, on the reasons for willingness to donate, 33 (11.6%) respondents stated that it will count for their afterlife if they donate eyes, implying donation is rather a positive act based on their religion. Addressing the religious leaders to educate people the basic teachings of their religions in relation to donations may help combat such misunderstandings. Religion was the most common one given in the study done in urban India, while having eye problem was cited by the participants in the study in rural India as the main reason for not being willing. From those who were aware of eye donation, 85.5% of responders had a positive attitude towards eye donation, in which they believed that corneal donation could help someone to see again. Having positive attitude was found to be a positive predictor of willingness to donate (OR= 22.1, 95% CI: 6.8-71.6).

In conclusion, our study has shown that the willingness to corneal donation of the society in this rural area of Ethiopia is relatively good while the level of awareness is very low. Willingness to donate was associated only with previous awareness on corneal donation. Having positive attitude was also found to be a positive predictor of willingness to donate. The main reasons mentioned for willingness to donate were the feeling of pleasure in helping the blind and the belief that the act of donation is doing good to humanity, while the dislike to separate the eye from the body after death was the main reason for not being willing to donate. This rural population is a good target for mobilization for pledges especially with more efforts to increase the awareness. The lack of a qualitative arm for a more detailed assessment of perceptions and attitude of the residents on corneal donation is the major limitation of the study.

ACKNOWLEDGEMENTS

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Active trachoma is an infectious disease, stop treating it administratively

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ABSTRACT

Objective: To assess how administrative considerations during prevalence surveys affected initiation of mass antibiotic treatment for active trachoma in East Pokot district in Kenya.

Methods: Survey reports were reviewed. The first was the report for a national blindness survey conducted in 1980s. The second was for a baseline trachoma prevalence survey conducted in Baringo administrative district in 2004. East Pokot was one of the divisions in the district and the survey was not powered to estimate the prevalence for the sub-district level. The third was for a survey conducted in 2011 in a newly created East Pokot administrative district.

Results: The national blindness survey report indicated that in Baringo district active trachoma was mainly found among the East Pokot communities. A total of 1,182 people of all ages were examined in the Baringo; 596 of them in East Pokot. Fifty percent of the children aged <10 years in East Pokot had active trachoma. In the 2004 survey 1,179 children aged 1-9 years were examined. The prevalence of active trachoma in Baringo district was 6.4% (95% CI: 3.9% - 9.9%), range 0% to 33.3% in the surveyed clusters. The endemic clusters were in East Pokot. In 2011 the prevalence of active trachoma in the new East Pokot district was 34.3% (95% CI: 27.7%-40.8%), range 28.1% to 41.7% in the surveyed clusters. Mass treatment commenced seven years after the initial baseline trachoma survey.

Conclusion: Emphasis should be given to epidemiology of active trachoma in determining the initiation of mass antibiotic treatment than administrative considerations.

Key words: Trachoma, Survey, Administrative districts, Epidemiology

INTRODUCTION

Trachoma is an ancient disease and the leading infectious cause of blindness in the world1-3. It is commonly found in poor communities4. The prevalence of trachomatous Follicular Inflammation (TF) in children aged 1-9 years is commonly used as the indicator for active trachoma5.

The World Health Organization (WHO) recommends “AFE” for control of active trachoma, which stands for Antibiotic treatment to treat active infection and Facial cleanliness and Environmental change to reduce transmission6. The thresholds for mass antibiotic treatment are as follows7: if prevalence of TF is <10% mass treatment is not required, 10% to <30% treatment needed for 3 years and ≥30% for 5 years prior to impact assessment surveys to justify continuation.

In hypo-endemic districts (prevalence 5% to <10%), further surveys are supposed to be conducted at the sub-district level to identify and administer targeted antibiotic treat to all the endemic villages6. Antibiotic treatment is stopped when the TF prevalence drops to <5% at community level. Project reports from the Kenya Trachoma Control Programme indicate that targeted treatment is difficult to implement because it is too rigorous and too expensive for district trachoma projects.

The recommended trachoma control intervention unit is the district; which is defined as the normal administrative unit for health-care management8 with a population size of approximately 100,000 people to 250,000 people9. In practice trachoma surveys are conducted by administrative districts, irrespective of the population size. Moreover, the periodic review articles on trachoma prevalence survey method hardly ever report or critically appraise the target population size for the reviewed surveys9-11. In Kenya the population sizes of trachoma-endemic administrative districts vary widely. As a result, some district level prevalence surveys have failed to identify pockets of endemic communities (hot-spots) because the non-endemic population dilutes the prevalence10,11.

The purpose of this study was to assess the 30 years trend of active trachoma in East Pokot as a case study to illustrate how mass antibiotic treatment can be delayed when administrative considerations are given more emphasis than the epidemiology of the disease.

MATERIALS AND METHODS

East Pokot occupies the Eastern and Northern arid areas of Baringo County in Kenya (Figure 1), which was until 2010 known as Baringo district. The prevalence...
of active trachoma in Baringo district was first reported in a national blindness survey conducted between 1979 and 1989 by Whitefield et al. They considered both follicles and papillae as signs of active trachoma. This was before the adoption of the WHO simplified trachoma grading scheme and the SAFE strategy.

In 2004, population based trachoma prevalence surveys was conducted to justify commencement of the SAFE strategy in six of the suspected endemic districts in Kenya (Figure 1): Baringo, West Pokot, Narok, Kajiado, Samburu and Meru North. Baringo administrative district had 264,978 people and East Pokot was a division covering the arid North-Eastern parts of the district. The rest of the Pokot communities lived in the neighbouring West Pokot district (Figure 1). West Pokot district was also surveyed in 2004 and it qualified for mass antibiotic treatment. A two stage cluster random sampling method was used to select the survey samples and the method published. The sampling frame included all the sub-locations in the district. Twenty sub-locations (survey clusters) were selected using the systematic sampling method. The sample size was then distributed proportional to the population size of the selected sub-locations.

In 2010, Baringo district became a County and East Pokot an administrative district with 133,189 people. In August 2011, the Fred Hollows Foundation sponsored a repeat trachoma prevalence survey in East Pokot. The Equation 1 below was used to estimate the minimum sample size, where: b= expected prevalence; c = desired precision of the estimate; d = alpha risk (Z score 1.96) and e= expected design effect. A two stage cluster random selection method was used and the details are published elsewhere.

Figure 1: TF map of Kenya showing the endemic Counties and East Pokot
Equation 1: sample size calculation formula\textsuperscript{17}

Minimum sample size = \( \frac{e^2d^2b(1-b)}{c^2} \)

The parameters used to compute the minimum sample size were: Assumed prevalence of TF in children 1-9 years old = 26%; similar to West Pokot\textsuperscript{16}, absolute precision 5.2%, Confidence level 95% and design effect = 4. The minimum sample size for East Pokot survey was 1,093 children. A two stage cluster random selection method was used. A sampling frame was prepared using the 2009 census report. Thirty clusters, each with 40 children aged 1-9 years were selected using the systematic sampling method. A total of 1,200 children were examined.

Two villages were randomly selected for the survey using simple random sampling method. In a village, the random walk method was used to select the households. The team started at the centre of the village and indentified the direction of the first household by spinning an object. After finishing with one household, they repeated the same process to indentify the next one. Children and adults living in the selected households who satisfied the survey criteria were enumerated and examined until the sample size is achieved. A household was defined as people who regularly eat from the same pot. Visitors were excluded. Revisits were done where necessary. Children in school and adults in the field were traced and examined. The graders were trained and validated (kappa >0.95 for all the trachoma graders).

**RESULTS**

The national blindness survey report indicated that trachoma was localised among the Pokot communities living in the dry north-eastern parts of Baringo administrative district. A total of 1,182 people of all ages were examined in the district, 596 of them in East Pokot. Fifty percent of children aged <10 years in East Pokot had active trachoma while in the other communities the prevalence was <25%. The sample for children selected in East Pokot was small\textsuperscript{13, 14}.

In 2004, the prevalence of active trachoma in Baringo district was 6.4% (95% CI: 3.9% - 9.9%). It ranged between 0% and 33.3% in the surveyed clusters (Table 1). These results indicated that TF was clustered in East Pokot division. However, an application for donation of antibiotic for mass treat was rejected because the five clusters surveyed in the division were too few for accurate estimation of the prevalence.

<table>
<thead>
<tr>
<th>Survey clusters</th>
<th>Total examined*</th>
<th>Children 1-9 years old</th>
<th>Prevalence of TF (%)</th>
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<tbody>
<tr>
<td><strong>East Pokot Division</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Chepkrerat</td>
<td>60</td>
<td>20</td>
<td>33.3</td>
</tr>
<tr>
<td>2 Tilingwo</td>
<td>43</td>
<td>13</td>
<td>30.2</td>
</tr>
<tr>
<td>3 Seretion</td>
<td>36</td>
<td>8</td>
<td>22.2</td>
</tr>
<tr>
<td>4 Korossi</td>
<td>46</td>
<td>9</td>
<td>19.6</td>
</tr>
<tr>
<td>5 Nginyang East</td>
<td>143</td>
<td>17</td>
<td>11.9</td>
</tr>
<tr>
<td><strong>The rest of Baringo District</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Kinyach</td>
<td>35</td>
<td>3</td>
<td>8.6</td>
</tr>
<tr>
<td>7 Logumgum</td>
<td>37</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td>8 Ngambo</td>
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<td>9 Keturwo</td>
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<td>10 Kaptombes</td>
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</tr>
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</tr>
<tr>
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</tr>
<tr>
<td>20 Kisonet</td>
<td>37</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Baringo District</strong></td>
<td>1,179</td>
<td>75</td>
<td>6.4% (95% CI: 3.9% - 9.9%)</td>
</tr>
</tbody>
</table>

*The sample size for a cluster was proportional to the population size of the sub-location it was selected from
Table 2: Distribution of TF by in East Pokot survey clusters (2011 survey report)

<table>
<thead>
<tr>
<th>Cluster Code</th>
<th>Divisions</th>
<th>Children 1-9 years old</th>
<th>No. examined</th>
<th>No. with TF</th>
<th>% with TF (95%CI)</th>
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<tbody>
<tr>
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<td>Kollowa</td>
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</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>40</td>
<td>4</td>
<td>10.0</td>
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<td>4</td>
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<td>6</td>
<td>15.0</td>
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<tr>
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<td></td>
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<td>11</td>
<td>27.5</td>
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<td></td>
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<td>17.5</td>
</tr>
<tr>
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<td></td>
<td>40</td>
<td>10</td>
<td>25.0</td>
</tr>
</tbody>
</table>

In 2011, the prevalence of TF in East Pokot was 34.3% (95%CI: 27.7%-40.8%). It ranged between 5.0% and 77.5% in the surveyed clusters (Table 2). These results indicated that the East Pokot was hyper-endemic and mass antibiotic treatment was needed in the entire district. Application for donation of azithromycin was approved and treatment commenced in 2012.

**DISCUSSION**

This study demonstrated how the prevalence of active trachoma in a highly-endemic marginalised community was masked by the low prevalence in the rest of the administrative district, leading to a long delay in administration of mass antibiotic treatment. However, it was likely that the prevalence estimate from the national blindness survey was not precise because the sample size for children was small. Moreover, the prevalence could have been over-estimated because of the inclusion of both follicles and papillae in the case definition \(^{13,14}\).

The 2004 survey results revealed the distribution of active trachoma in Baringo district but the survey was powered to estimate the prevalence of active trachoma at the administrative district level. Consequently, a repeat survey had to be undertaken to accurately estimate prevalence at the sub-district level. This was finally done in 2011 after the East Pokot division was upgraded to a separate administrative district in Baringo County. The consequence of this strict adherence to survey by administrative districts criteria was that mass antibiotic treatment commenced in East Pokot seven years after the initial baseline trachoma prevalence survey.

It is important to note that the Pokot communities live in both West Pokot County and in Baringo County (East Pokot district) and their lifestyles are similar, irrespective of the County they live in. If the 2011 repeat survey was not conducted, East Pokot district would have been left out of mass antibiotic treatment as treatment continued in West Pokot.

Trachoma is an infectious disease which can be reintroduced by people visiting and then returning from untreated areas \(^{18}\). Left untreated, endemic nomadic communities like East Pokot (hot-spots) can increase the risk of re-infection of the neighbouring treated communities and even cross-border transmission to the neighbouring countries. Therefore, the authors urge National Trachoma Control Programmes to
seriously consider the epidemiology of active trachoma when conducting prevalence surveys and stop undue emphasis on local and international administrative boundaries.

**CONCLUSION**

The findings of this study demonstrate that in control of active trachoma, more emphasis should be given to the epidemiology of active trachoma than administrative considerations.

**ACKNOWLEDGEMENTS**

The authors would like to acknowledge the Fred Hollows Foundation, Sightsavers, International Eye Foundation and Government of Kenya for funding the surveys in this study; Dorcas Chelang’a, John Soine and Richard Ayapar for participating in data collection and the local communities for participating in the survey.

**REFERENCES**

Epidemiological assessment of a large geographical area with clustered trachoma: The Upper Eastern Kenya survey

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ABSTRACT

Objective: To assess the prevalence and distribution of trachoma and dirty faces prior to implementation of the SAFE strategy (Surgery, Antibiotic treatment, Facial cleanliness and Environmental improvement) in the Upper Eastern Kenya region.

Methods: A pre-survey trachoma risk assessment was conducted followed by division of the region into three geographical areas (survey segments). The sample size was 800 children aged 1-9 years old and 600 adults aged ≥40 years per segment.

Results: A total of 2,400 children were examined. The prevalence of TF in the region was 9.2% (95%CI: 8.0%-10.4%) and Marsabit was the only segment with prevalence >10%. The prevalence of a dirty face in the region was 17.5% (95%CI: 16.0%–19.1%) and Masabit was the only segment with prevalence >20%. A child with a dirty face was more likely to have TF than one with a clean face. The Odd’s ratios were: Marsabit 12.1(95%CI: 8.1-18.1), Isiolo 7.5(95%CI: 4.4-12.8) and Moyale 1.9 (95%CI: 0.7-5.6). A total of 1,797 adults were examined and 54 (3.0%, 95%CI: 2.2%-3.8%) had TT. Women had higher prevalence of TT than men. Ten out of 13 persons with CO were from Moyale. The backlog of TT in the region was 2,369 people and TT surgical services were poor. Moyale had the lowest prevalence of TF but the highest prevalence of TT.

Conclusion: The survey methods used allowed differentiated interventions as follows: Marsabit needed full SAFE strategy; Moyale “S” component and Isiolo repeat sub-district surveys. A Knowledge Attitude and Practice (KAP) was needed to explain the distribution of trachoma in the region.

Key words: Large area, Trachoma Prevalence, Risk scores, Surgical rate

INTRODUCTION

Trachoma is a neglected tropical disease and the leading infectious cause of blindness in the world1. In Kenya, the disease is mainly found in the arid areas in Rift Valley and Eastern regions among the marginalized nomadic communities with poor hygiene.

Children are the reservoir of active infection and blindness usually occurs in adults2. Recurrent infections in childhood result in conjunctival inflammation which leads to conjunctival scarring and in-turning of the eye lids (entropion) and eye lashes (trichiasis). The trichiasis eye lashes injure the cornea, leading to corneal scarring and visual loss3. The World Health Organization has classified these clinical signs into a simplified trachoma grading scheme used in surveys as follows4: TF = Trachomatous Follicular Inflammation, TI = intense Trachomatous inflammation, TS = Trachomatous Conjunctival Scarring, TT = Trachomatous Trichiasis and CO = Corneal Opacity due to trachoma.

Prevalence of trachomatous Follicular Inflammation (TF) in children aged 1-9 years is the monitoring indicator for active trachoma while trachomatous trichiasis (TT) in adults ≥15 years is the indicator for the potentially blinding trachoma5. The World Health Organization (WHO) recommends that if the prevalence of TF is <5% at community level mass antibiotic treatment is not needed, 5% - <10% administer targeted mass treatment in the endemic villages and >10% treatment the whole population in the district4. The ultimate intervention goal for facial cleanliness is to ensure that 80% of the children 1-9 years in a community have clean faces6.

The aim of this study was to assess the baseline prevalence and distribution of trachoma and dirty faces in the Upper Eastern Kenya region (Figure 1).

MATERIALS AND METHODS

A population based prevalence survey was conducted in May 2011 in Upper Eastern Kenya, a “hard-to-reach” region with poor health and economic indicators, surface area of 96,297 Km² and population of 434,460 people. The population density was 5 people per Km² and varied from 1 person per square kilometre in the Chalbi desert in Marsabit to 6,549 people per square kilometre in Moyale Township7.
The two methods used in this study were developed in Kenya in 2009 and published elsewhere. In brief, the first method is the Trachoma Survey by Segment (TSS) to improve the efficiency of a trachoma survey to identify the specific trachoma-endemic areas in large administrative districts (>200,000 people). A pre-survey trachoma risk assessment is conducted to inform the division of the large area or district into geographical areas (segments) with 100,000 people each. This population size corresponds to the WHO recommended trachoma intervention unit (trachoma district). A simplified Trachoma Risk Assessment form is used to estimate the risk of finding trachoma in different parts in the study area. This information is collected from key informant interviews and review of project reports. Communities with similar risk scores are aggregated in a segment and after the study the non-endemic segments are excluded from mass treatment (segment knock-out). Five known trachoma risk factors are used as risk assessment parameters: evidence of trachoma (reports), main socioeconomic activity, availability of water sources, average duration of time taken to fetch water and poverty level. The five parameters are awarded equal weighting of 1 point (low) to 4 points (high risk) each. The scores are summed to derive the total scores of 5 - 10 points (low), 11 - 15 (medium) and 16 - 20 (high risk). Children aged 1-9 years old are included in TF survey while adults aged 40 years and older are included in TT survey.
The second is the “TT40” trachoma survey method to improve the efficiency of the TT surveys\textsuperscript{8}, where adults aged 40 years and older are recruited for TT surveys. A “TT40” trachoma survey requires a smaller sample than a standard survey where people aged 15 years and older (TT15 survey) are recruited.

Equation 1 is used to calculate the minimum samples, where: \( a = \) population size; \( b = \) expected prevalence; \( c = \) maximum sampling error tolerable; \( d = \) alpha risk (Z score = 1.96) and \( e = \) expected design effect.

\textbf{Equation 1: Sample size calculation formula\textsuperscript{9}}

\[
\text{Minimum sample size} = e \frac{d^2b(1 - b)}{c^2}
\]

The parameters used to estimate the TF survey sample size for Upper Eastern Kenya were: assumed prevalence of TF in children 1-9 years old = 10% (the predictor variable), design effect = 2, confidence limit = 95% and maximum sampling error = 3%. Therefore, the minimum sample size for TF survey was 768 children per segment. In the actual survey 800 children were sampled in each segment. The design effect for this study was lower than the 4 used in standard surveys because the segmentation of the study area and selection of relatively small survey clusters of 40 children each were expected to reduced the random sampling error\textsuperscript{11}. Previous surveys had high participation rates because of rigorous community mobilization and the same was expected in this study.

The parameters used for TT survey were: assumed prevalence of TT in people ≥40 years old = 10%, design effect = 1.5 (due to small clusters with 30 adults each), confidence limit = 95% (Z score 1.96), maximum sampling error = 3%. Therefore the minimum sample TT survey was 576 adults aged >40 years per segment. In the actual survey 600 adults were sampled in each segment.

Twenty clusters with 40 children aged 1-9 years and 30 adults aged 40 years and older each were selected in a segment. In a cluster, a minimum of two villages was randomly selected. Each of the village was listed on a piece of paper and the pieces folded and mixed. One of the villagers was requested to pick two of the papers and read out the names of the selected villages. In a village, the random walk method was used to select households. The team started at the centre of the village and identified the direction of the first household by spinning an object (e.g. a bottle). After finishing with one household, they repeated the same process to indentify the next one. Children living in the selected households who satisfied the survey criteria were enumerated and examined until the sample size was achieved. Revisits were done where necessary.

The children were examined for active trachoma and dirty faces while adults were examined for TT (potentially blinding trachoma), trichiasis surgical scars and corneal opacities. A dirty face was defined as one with eye and/or nasal discharges\textsuperscript{12}.

A two day training workshop for enumerators was conducted in a trachoma endemic area. Field testing of data tools and standardizing the enumerators was done during the workshop. The WHO simplified trachoma grading scheme was used. Clinical examinations were done at the households by four experienced trachoma graders who were validated in preceding surveys in Turkana and Narok districts.

Data were entered by trained clerks and analysed using the Predictive Analytics Software (PASW version 18.0). Prevalence estimates were calculated for each of the surveyed segments. The data for all the three segments were pooled to create a master data set for the Upper Eastern Kenya region. Additionally, the graders sent daily telephone messages to the survey secretariat indicating the number of people examined and with trachoma. At the end of the study, the prevalence estimates calculated using the data entered by statistical clerks and from the telephone messages were compared. The prevalence calculated using the pooled data set was the mean prevalence for the region.

Endemicity of trachoma was classified according to the 2010 WHO guidelines which indicate the number of years mass treatment should be administered prior to an impact assessment survey as follows: if the prevalence of TF is ≤10% targeted treatment needed (no mass treatment), 10% to ≤30% mass treatment needed for 3 years and >30% mass treatment needed for 5 years both followed by repeat surveys to justify continuation or stoppage of treatment. The backlog of people with TT was estimated by multiplying the target population by prevalence of TT.

Cross-tabulations were done and the Pearson Chi-squared test used to test the association between categorical variables. A p value of <0.05 was considered statistically significant. Odds Ratio (OR) was calculated to assess the risk of a particular outcome if a certain factor was present.

To estimate the total backlog of TT, the backlog calculated in persons aged 40 years and older was multiplied by a correction factor of 1.1 and the TT surgical coverage was calculated using the \textit{Equation 2} below\textsuperscript{8}; where \( a = \) number of subjects with TT scars in both eyes; \( b = \) number of subjects with TT scar in one eye and TT in the other eye; and \( c = \) number of subjects with TT.

\textbf{Equation 2: Estimation the TT surgical coverage for people}

\[
\text{TT surgical coverage (people)} = \frac{a + b}{a + b + c}
\]

TT surgical coverage for eyes was calculated using the \textit{Equation 3}\textsuperscript{8}; where \( x = \) the number of eyes with TT surgical scars and \( y = \) number of eyes with TT.
Equation 3: Estimation the TT surgical coverage for eyes

\[
\text{TT surgical coverage (eyes)} = \frac{x}{x + y}
\]

RESULTS

TF prevalence survey: The trachoma risk scores and TF survey results for the three segments are shown in Figure 1 and Table 1.

Out of the 2,400 children examined, 1,311 boys and 1,089 girls were examined and the male:female ratio was 1.2:1. The prevalence in boys was 9.7% (95% CI: 8.1%-11.3%) and in girls 8.6% (95% CI: 6.9%-10.3%), but the difference was not statistically significant (p value 0.37). The prevalence of a dirty face was higher in boys (18.3%, 95% CI: 16.2%-20.4%) than in girls (16.6%, 95% CI: 14.3%-18.9%) but the difference was not statistically significant (p value 0.27).

The Odd’s ratios for a child with a dirty face having TF were: Marsabit 12.1(95% CI: 8.1-18.1), Isiolo 7.5(95% CI: 4.4-12.8) and Moyale 1.9 (95% CI: 0.7-5.6)

TT Survey: A total of 1,800 adults (600 per segment) aged 40 years and older were examined but three were removed from analysis because they were aged <40 years old. Of those included in the study, 1,109 were women and 691 were men, meaning that women were over-represented (male:female ratio = 1:1.6). The distribution of TF and dirty faces by segment was as shown in Table 2.

Thirty seven persons with TT had it in one eye and 17 had it in both eyes. Only one person had recurrent TT in one eye. Prevalence of TT in women (3.6%, 95% CI: 2.5% - 4.7%) was almost double that in men (2.0, 95% CI: 0.9% - 3.1). Ten of the 13 persons with visually impairing CO were from Moyale.

Backlog of people with TT: The backlog of people with TT in Upper Eastern Kenya was as shown in Table 3.

TT surgical scars: In this study there were three persons with TT surgical scars in both eyes and one person with scar in one eye. One person with surgical scar was from Moyale, one from Isiolo and the rest were from Marsabit.

TT surgical coverage: The TT surgical coverage for people aged 40 years and older in the Upper Eastern Kenya region was 5.3% and it was calculated using the Equation 2. The TT surgical coverage for eyes was 9.0%. It was calculated using the Equation 3.

### Table 1: TF survey results for Upper Eastern Kenya region (2011 survey report)

<table>
<thead>
<tr>
<th>Survey segments</th>
<th>Total risk scores*</th>
<th>Children 1-9 years old</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Examined</td>
<td>with TF</td>
<td>% with TF (95%CI)^</td>
<td>with dirty faces#</td>
</tr>
<tr>
<td>Marsabit</td>
<td>18</td>
<td>800</td>
<td>113</td>
<td>14.1(11.6-16.6)</td>
<td>218</td>
</tr>
<tr>
<td>Isiolo</td>
<td>17</td>
<td>800</td>
<td>71</td>
<td>8.9 (6.9-10.9)</td>
<td>95</td>
</tr>
<tr>
<td>Moyale</td>
<td>17</td>
<td>800</td>
<td>37</td>
<td>4.6 (3.1-6.1)</td>
<td>107</td>
</tr>
<tr>
<td>Upper Eastern</td>
<td>17</td>
<td>2,400</td>
<td>221</td>
<td>9.2(8.0-10.4)</td>
<td>420</td>
</tr>
</tbody>
</table>

### Table 2: TT survey results for Upper Eastern Kenya region (2011 survey report)

<table>
<thead>
<tr>
<th>Survey segments</th>
<th>Adults aged 40 years and older</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Examed</td>
<td>With TT</td>
<td>% with TT (95%CI)^</td>
<td>With CO</td>
<td>% With CO</td>
<td></td>
</tr>
<tr>
<td>Marsabit</td>
<td>598</td>
<td>10</td>
<td>1.7(0.6-2.8)</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Isiolo</td>
<td>599</td>
<td>9</td>
<td>1.5(0.5-2.5)</td>
<td>1</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Moyale</td>
<td>600</td>
<td>35</td>
<td>5.8(3.9-7.7)</td>
<td>10</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Upper Eastern</td>
<td>1,797</td>
<td>54</td>
<td>3.0(2.2-3.8)</td>
<td>13</td>
<td>0.7</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Distribution of the TT backlog by survey segments

<table>
<thead>
<tr>
<th>Survey segment</th>
<th>People aged 40 years and older</th>
<th>People aged 15 years and older*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population^</td>
<td>Prevalence of TT (%)</td>
</tr>
<tr>
<td>Isiolo</td>
<td>24,022</td>
<td>1.8</td>
</tr>
<tr>
<td>Marsabit</td>
<td>18,252</td>
<td>1.7</td>
</tr>
<tr>
<td>Moyale</td>
<td>29,513</td>
<td>5.8</td>
</tr>
<tr>
<td>Upper Eastern</td>
<td>71,787</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*15 years is the standard lower age limit for TT survey hence it represents total backlog ^2009 census
DISCUSSION

This study revealed that in the Upper Eastern Kenya region active trachoma was clustered in Marsabit while potentially blinding trachoma (TT) and visual impairment due to trachomatous CO were prevalent in Moyale. If the region was surveyed as single study area it would have qualified for TT surgical services but not mass antibiotic treatment because the mean prevalence of TF was <10%. The World Health Organisation recommends mass antibiotic treatment in communities with ≥10% prevalence of TF. The TSS method used in this study made it possible to identify the specific endemic areas in the region and administration of differentiated mass antibiotic treatment by segments.

Prior to this study, the Upper Eastern Kenya region did not have a trachoma control project. This implies that active trachoma may have spontaneously disappeared in Moyale for reasons which could not be verified using the results of this study. Similar phenomena have been reported in developed countries and they are attributed to social economic development; especially the developments which promote personal hygiene. Furthermore, the high prevalence of TT was an indication that it was likely that the population in Moyale had severe active trachoma in the past. From the results of this study, it was not clear why Marsabit, which was the segment with the highest prevalence of TF, had lower prevalence of TT than Moyale, the segment with the lowest prevalence of TF.

A dirty face is the most important risk factor for active trachoma because it is believed to be the final common pathway by which environmental risk factors influence the risk of the disease. The results of this study indicated that Marsabit had the highest prevalence of both TF and dirty face. Additionally, the Odds of a child with a dirty face were higher than for a child with a clean face.

Published literature indicate that women are at a higher risk of being blinded by trachoma than men and the prevalence of TT is almost double the prevalence of TT in men.

Like it is reported in many trachoma-endemic countries, the TT surgical coverage in this study was too low, meaning the surgical services in Upper Eastern Kenya were inadequate, especially in Moyale where they were needed most. The Kenya National Trachoma Project reports indicated that the TT surgical coverage in the country was generally low.

The major limitation in this study was that the pre-survey trachoma risk scores for all the areas in the region were approximately equal hence they were not very useful in creation of the survey segments. The reason for this is that most of the communities in the Upper Eastern Kenya are marginalized, poor and live under harsh environmental conditions. These scores demonstrated what is known as “the ceiling effect”.

In conclusion, the survey methods used in this study allowed differentiated implementation of the SAFE strategy in Upper Eastern Kenya as follows: Marsabit needed all the components of the SAFE strategy; Isiolo required repeat sub-district level survey to identify and treat the endemic villages and Moyale needed only the “S” component. A Knowledge Attitude and Practice (KAP) study was required to unveil the reasons behind the distribution of trachoma in the region.

ACKNOWLEDGEMENTS

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REFERENCES


Glaucoma in phakomatosis pigmentovascularis in a 4 year old African girl: A case report

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ABSTRACT

The phakomatosis syndromes are a group of neural crest disorders that bear many features in common. They include Sturge-Weber Syndrome, Naevus of Ota, Phakomatosis Pigmentovascularis and Klippel-Trenaunay Syndrome. They have numerous ocular manifestations in common, some of which are described in this case. Glaucoma is one of these manifestations and has peculiar characteristics when seen in association with phakomatosis syndromes.

Key words: Glaucoma, Phakomatosis, Naevus, Congenital, Pigmentovascularis

CASE REPORT

A rare case of a patient who was diagnosed with phakomatosis pigmentovascularis was encountered at Kenyatta National Hospital, a teaching and referral hospital in Kenya. It is of particular interest as the condition is very rare among Africans and has a high predisposition to the development of glaucoma. Consent to publish this case report including the photographs was given by the mother.

History of presenting illness: LW was a 4 year old female patient who hailed from Limuru town in Central Kenya. She was first seen on 31st March 2010. Her mother reported that the child had patchy discolouration of both eyes and her skin from birth. The ocular discolouration was described as being greyish in colour and patchy. The skin was described as being hyperpigmented on the right side of the face and reddish on the left side of the face. Also reported was dark pigmentation of the abdomen and thighs. There was also reddish discolouration of the palms of the hands. The mother reported that since birth there had only been minor progression of the skin changes. No history of convulsions or other neurological deficits was given. Antenatal and birth history were uneventful. No history of other chronic or major illness was given. No prior admissions for medical or surgical reasons and no history of food or drug allergies were elicited. There was no history of similar manifestations in her siblings.

General and skin examination: The child was in good general condition. The right side of her face had hyperpigmentation of the skin in the area over the forehead, upper and lower eyelids, maxillary area and over the cheek and the mandibular area (Trigeminal, V2 dermatome). The left side of her face had thickened skin that was erythematous (Figure 1) and involved the upper and lower lids, nasal bridge, upper lip and cheek (Trigeminal V1 and V2 dermatomes) abnormal discolouration of the buccal mucosa.

Her abdomen had a diffuse hyperpigmentation without sparing of the midline. Her thighs had a similar patchy, slate gray hyperpigmentation (Figure 2).

Her right hand had erythematous lesions on the palms in the distribution of the radial (C6 dermatome) and median (C7 dermatome) nerves involving the thenar
eminence, thumb, index and middle fingers. Her left hand had the same erythematous appearance but involving the entire palm and all the fingers thus involving C6, C7 and C8 dermatomes (Figure 3).

**Figure 3:** Appearance of palms

Ocular examination: Visual acuity by Lea’s was 3/3 in the right eye (OD) and 3/30 in the left eye (OS). She had free extraocular motility in both eyes. Intraocular pressure (IOP) by tonopen was 12mmHg OD and 24mHg OS. Her OD had patchy, slate grey hyperpigmentation of the sclera. The cornea was clear and the anterior chamber was deep and quiet (Figure 4). The iris was brown in colour and the pupillary reaction was normal. She had a cup-to-disc ratio (CDR) of 0.7, the cup was not deep, and the macula was normal.

**Figure 4:** Appearance of right eye with wire speculum in place

The OS also had patchy slate-grey hyperpigmentation of the sclera. It also appeared buphthalmic. The cornea was clear, the anterior chamber was deep and quiet, the iris normal, the pupil had a sluggish reaction to light and the lens was clear (Figure 5). Fundus examination revealed a CDR of 0.9 with a deep cup and the ISNT (inferior-superior-nasal-temporal) rule was broken. The macula was normal (Figure 6).

**Figure 5:** Appearance of left eye with wire speculum in place

**Central Nervous System (CNS) examination:** Her CNS examination revealed a GCS 15/15, normal power in all limbs, no cranial nerve palsies and no cerebellar ataxia. A Computerised Tomography (CT) scan done showed hemiatrophy of the left side of the brain with frontal lobe atrophy.

**Management:** The child was started on Timolol 0.5% 12 hourly OS and booked for examination under anaesthesia (EUA) and OS trabeculectomy + 5 fluorouracil (5FU, 50mg/ml) which was done on the 2nd August 2010 (Table 1).
Table 1: Examination under anaesthesia findings

<table>
<thead>
<tr>
<th></th>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOP (mmHg)</td>
<td>Perkins 12</td>
<td>Perkins 15</td>
</tr>
<tr>
<td></td>
<td>(Timolol) 14.6</td>
<td>Schiotz 17.3</td>
</tr>
<tr>
<td>Horizontal corneal diameter (mm)</td>
<td>11.5</td>
<td>14</td>
</tr>
<tr>
<td>Axial length (AL)</td>
<td>21.6</td>
<td>25.02</td>
</tr>
<tr>
<td>Central Corneal Thickness (CCT) (µm)</td>
<td>483</td>
<td>475</td>
</tr>
<tr>
<td>Retinoscopy</td>
<td>+1.50DS/-0.5DC*90</td>
<td>-8.00DS</td>
</tr>
<tr>
<td>Fundoscopy</td>
<td>CDR 0.7, ISNT rule obeyed</td>
<td>CDR 0.9; deep cup; ISNT rule disobeyed; normal macula</td>
</tr>
</tbody>
</table>

Post-operative assessment: The patient was discharged on the 5th post-op day. The visual acuity was 3/3 OD by Lea’s chart and counting fingers at 2m OS. The IOPs were 17mmHg OD and 9mmHg OS. The anterior chamber OS was deep. The patient was discharged home on ofloxacin antibiotic and dexamethasone steroid eye drops. She was reviewed one week later and visual acuity OS was still counting fingers at 2m and the IOP was 18mmHg. There was a diffuse bleb, the anterior chamber was deep and there was a normal retinal appearance with a CDR of 0.9. She was started on timolol 0.5% drops twice daily both eyes (OU) and dexamethasone was tapered off and she continued on ofloxacin OS. On subsequent follow-up ofloxacin was stopped. Vision remained at CF2m OS. IOP check revealed an IOP of 16mmHg OU and the patient was switched to betagan eye drops.

On review 6 months later the IOP was noted to have dropped significantly to 3 mmHg OS. She had a grade 2 Relative Afferent Papillary Defect (RAPD) and fundus examination revealed tortuous vessels, CDR of 0.9 and a normal macula. The hypotony was secondary to uveitis. Betagan was stopped in this eye and she was started on a tapering dose of Predforte (prednisolone acetate) for the uveitis. IOP rose to 5mmHg after 1 month and to 8mmHg after another month with a low diffuse bleb present. A choroidal effusion was however not ruled out. On her last review IOP was 8mmHg OD on betagan and 9mmHg in the OS on no ocular hypotensive drugs.

**DISCUSSION**

Phakomatosis Pigmentovascularis (PPV) is a condition that presents with extensive cutaneous vascular malformations and pigmentary nevi. It was first described by Ota in 1947 and is characterized by defects of various organs, especially the eyes and nervous system. Four types have been described. They are subdivided further into cutaneous or systemic disease (Tables 2 and 3). It is found almost exclusively in Asians.

Table 2: Classification of phakomatosis pigmentovascularis (PPV)

<table>
<thead>
<tr>
<th>Type</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia, b*</td>
<td>Nevus flammeus + Nevus pigmentosus et verrucosus</td>
</tr>
<tr>
<td>Ila, b</td>
<td>Nevus flammeus + Dermal Melanocytosis± Naevus anemicus</td>
</tr>
<tr>
<td>IIIa, b</td>
<td>Nevus flammeus + Nevus spilus ± Nevus anemicus</td>
</tr>
<tr>
<td>IVa, b</td>
<td>Nevus flammeus +Dermal Melanocytosis +Nevus spilus ± Nevus anemicus</td>
</tr>
<tr>
<td>Va, b</td>
<td>cutis marmorata telangiectatica congenital + dermal melanocytosis</td>
</tr>
</tbody>
</table>

*a, Cutaneous disease; b, Systemic disease.

A simpler classification was suggested by Joshi et al.

Table 3: Simplified classification for PPV

<table>
<thead>
<tr>
<th>Type</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Capillary malformation and dermal melanocytosis</td>
</tr>
<tr>
<td>II</td>
<td>Capillary malformation and epidermal melanocytosis</td>
</tr>
<tr>
<td>III</td>
<td>Capillary malformation, and, dermal and epidermal melanocytosis</td>
</tr>
</tbody>
</table>

The cutaneous vascular malformation found in PPV is always naevas flammeus and this component is present in all except type V. The pigmentary abnormalities may consist of naevus pigmentosis verrucosus, naevas spilus, naevas anaemicus, or slate-grey pigmentation, which could be mongolian spots, naevus of Ito, or naevus of Ota. Naevus of Ota and aberrant Mongolian spots are the most common. Ocular findings in PPV include bluish mottling or a more diffuse slate-grey colouration of the sclera.

PPV is a disorder of neural crest cell migration and differentiation. Dermal melanocytes are of neural crest origin. The nevus of Ota seen as part of this syndrome shows dendritic melanocytes that are surrounded by fibrous sheaths and there is an increase in number, size and pigmentation of melanocytes.
Ultrasound and immunohistochemical examination results of a nevus flammeus both showed absent perivascular nerves. This developmental anomaly of neural crest-derived vasomotor nerves was postulated to account for altered sympathetic modulation of vascular tone, leading to progressive vascular ectasia found in this disorder. The ratio of female to male patients is approximately 3.2:1. However, the series by Montse et al. showed a female predominance of 11:4 which may be a result of the female concern about cosmetic image. PPV without systematic complications is benign and requires no treatment.

In a study by Teekhasaenee and Ritch they observed that the most frequent central nervous system finding on Computed Tomographic (CT) scanning was frontal or temporal lobe cortical atrophy. A CT scan done on our patient showed hemiatrophy of the left side of the brain with frontal lobe atrophy. The characteristic CNS manifestation of Sturge-Weber Syndrome (SWS) is ipsilateral leptomeningeal haemangiomatosis, which causes atrophy of the cortical parenchyma of the brain, seizures, and frequently mental retardation. It must therefore be entertained as a valid differential in this case due to the presence of the nevus flammeus and CNS findings. However, the more extensive cutaneous vascular malformations and cutaneous pigmentation make it less likely.

Clinically it may present as ocular, dermal or oculodermal (naevus of Ota). Ocular features include multifocal, slate grey pigmentation of the episclera. With cutaneous involvement there is deep bluish or black hyperpigmentation of facial skin most frequently in the distribution of the 1st and 2nd divisions of the trigeminal nerve. Associated findings include iris hyperchromia, iris mammillations, fundus and trabecular hyperpigmentation. Glaucoma is found in 10% of patients and uveal melanoma especially in white people has also been documented. The aetiology of glaucoma could be due to the direct infiltration of the trabecular meshwork by the accumulated melanocytes and may present as a gradual increase in IOP, an acute glaucoma with uveitis, as an Angle Closure Glaucoma (ACG) or as a congenital glaucoma. Glaucoma is found in 10% of patients and uveal melanoma especially in white people has also been documented. The aetiology of glaucoma could be due to the direct infiltration of the trabecular meshwork by the accumulated melanocytes and may present as a gradual increase in IOP, an acute glaucoma with uveitis, as an Angle Closure Glaucoma (ACG) or as a congenital glaucoma. Glaucoma has also been thought to be due to a faulty development of the angle (isolated trabeculodysgenesis) especially considering that the trabecular meshwork cells are of neural crest origin. It has also been thought to be due to increased episcleral venous pressure associated with an arteriovenous communication in an episcleral haemangioma. In a study by Teekhasaenee and Ritch they found that 100% of patients with both Episcleral Venous Malformation (EVM) and ocular melanocytosis developed glaucoma and that EVM was associated with a higher incidence of glaucoma than ocular melanocytosis. Those patients with more extensive pigmentation of the anterior chamber angle were also noted to have a higher incidence of glaucoma. In patients with oculodermal melanosis or phakomatosis pigmentovascularis the target IOP is set at the mid teens or close to the IOP of the fellow uninvolved eye if the condition is unilateral.

Treatment usually begins with either a prostaglandin analogue, alpha 2-agonist or a beta blocker. If the initial IOP is very high or one drug is not sufficient then combining drugs from different classes should be attempted. A carbonic anhydrase inhibitor could also be tried in combination with the above. Most authors do not advocate use of more than three drugs simultaneously. As far as laser is concerned, there are no studies showing effectiveness in this condition specifically and there are no clear guidelines on how and where to apply the laser. The next step for children would be surgery. This would be trabeculectomy or trabeculotomy-trabeculectomy with mitomycin (0.2mg/ml for 2 min; 0.4mg/ml for 3-5min) or 5-fluorouracil 50mg/ml. Failure of trabeculectomy would necessitate the use of a glaucoma drainage device such as the Baerveldt implant or Ahmed valve. In patients with naevus flammeus where trabeculodysgenesis is present, surgical treatment is preferred. EUA with experience in paediatric gonioscopy and a flexible surgical plan is needed as surgery is dependent on what is found intraoperatively.

Trabeculectomy has been proposed as a primary treatment for glaucoma in children but can be technically challenging due to difficulty in raising a partial thickness flap in buphthalmos and adjusting tension in the perioperative period. Other common post-operative complications include hypotony, hyphema, flat anterior chamber and their risk for causing amblyopia. In cases in which conventional glaucoma surgery has failed to control IOP, cycloablative procedures such as cyclocryotherapy or laser cyclophotocoagulation done under general anaesthesia may lower the IOP. For our patient who had glaucoma in the setting of PPV then it would seem that starting anti-glaucoma medication pending surgery was a good decision and that surgery (trabeculectomy with 5-fluorouracil) which was performed at the nearest opportune moment was in keeping with current practice in management of glaucoma in patients with this condition. Combined trabeculotomy-trabeculectomy has been shown to have an overall success rate of 79% in children of African descent with primary congenital glaucoma. 5-FU with combined trabeculotomy-trabeculectomy surgery appears to be a more effective procedure for congenital glaucoma refractory to goniotomy.

Looking at the effects of antimetabolites, combined surgery augmented with MMC has been noted to be associated with a more long-term effect on IOP control. Trabeculectomy with adjunctive 5-FU and MMC may also be an option for the control of paediatric glaucoma with a poor surgical prognosis. However, some studies have shown that it may also...
serve as the primary procedure in a selected group of paediatric patients with glaucoma where it was shown that 86% of IOPs remained stable after surgery for up to 3 years after surgery. Refraction will also be necessary to manage the high refractive error in the left eye due to the buphthalmos. Any attempt at correcting this refractive error will however have to take into consideration any amblyopia that may have set in, the high degree anisometropia and the aniseikonia that may result from its correction. Close follow-up to monitor further disc damage will also be necessary.

REFERENCES

The Fred Hollows Foundation (FHF) is an Australian-based humanitarian non-government development organization, established in 1992 to address inequities in access to eye health care - particularly to tackle the problem of avoidable blindness and visual impairment, and empower communities to run sustainable eye health services.

**OUR VISION**
We see a world in which no person is needlessly blind and citizens exercise their right to good health.

**OUR MISSION**
To support and advocate for, through partnerships, the provision of high quality, affordable, accessible and sustainable eye care services, and to empower the community to exercise their human right to health.

The Fred Hollows Foundation Kenya has since 2004 partnered with the Kenya Ministry of Health through the Division of Ophthalmic services (DOS) to develop sustainable models of affordable and high quality eye health care services for the rural population. FHF’s work is aligned with the National Strategic Plan for Eye Health and Blindness Prevention, and the core strategies of VISION 2020: The Right to Sight - Disease control, Human resource development, infrastructure and appropriate technology development.

**WHERE WE WORK**
The Foundation currently supports Eye Health activities in the counties of Baringo, Homabay, Migori, Nakuru, Kitui, Turkana, West Pokot, Narok and Samburu with plans to grow our partnerships into Kisumu, Siaya, Bungoma, and Busia Counties by September 2013.

**HIGHLIGHTS OF THE FRED HOLLOWS FOUNDATION SUPPORT TO THE MOH**
Working in 9 Counties and with plans to grow our partnerships into 4 additional Counties across the Country, we have supported:

- Human Resources Development
  - Retraining of ophthalmologists on improved surgical techniques, revolutionizing cataract surgery output and outcome
  - Training of Ophthalmologists and mid-level ophthalmic workers
- Elimination of blinding Trachoma, through surveys and Mass Drug Administration
- Electronic Health Information System rolled out in 24 eye units

**OUR FOCUS IN THE NEXT FIVE YEARS:**
- Support the elimination of Trachoma
- Partner with the Ministry of Health and Health Training Institutes to increase the capacity, skills, and numbers of eye health personnel
- Strengthening the Health System - The Foundation is working with the Kenyan Government to strengthen the broader public health system
- Work regionally with the Ministries of Health and World Health Organization toward a regional reduction of active Trachoma
- Strengthen our partnerships with the WASH sector to address water and environmental improvements

The Ministry of Health in conjunction with The Fred Hollows Foundation Kenya, recently opened the new Migori Hospital Eye Centre, an ultra-modern complex constructed through the support of The Foundation.

The Migori Hospital, situated in Migori County, about 263 km from Nairobi and approximately 200 km from Kisumu town, will service the eye care needs of approximately 950,000 people living in the local area.