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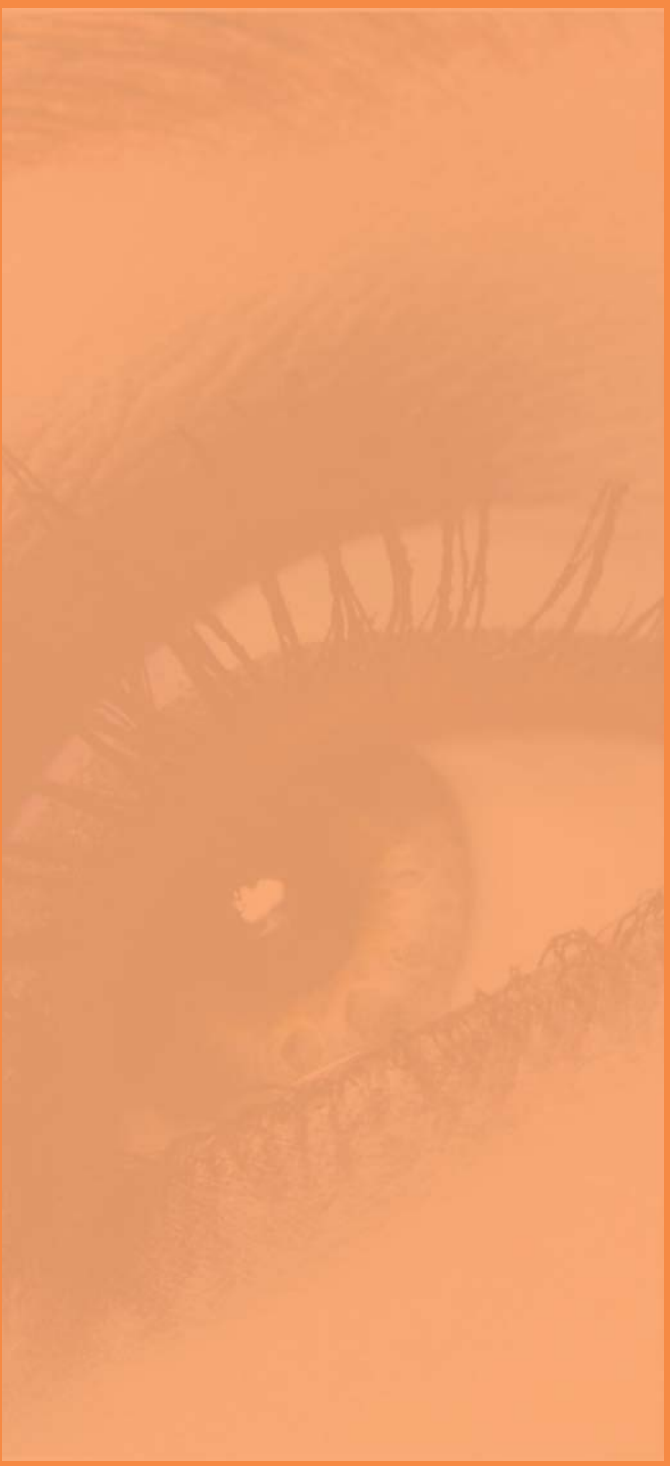

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Stand for action! Eye care and Sustainable Development Goals

The global community declared ambitious developmental goals to be achieved by the year 2030. These United Nations 17 goals hoped to transform our world to a better place to live in. Sustainable Development Goals (SDGs) have 17 goals and 169 associated targets. SDG-3 that promotes good health and wellbeing was one of these fundamental agendas. SDGs aspires inclusive development hoping that no one will be left behind regardless of his/her status of economy, disability, gender, age, colour, ethnicity, or religion[1].

The College of Ophthalmology of Eastern, Central and Southern Africa region (COECSA) and its members promote and advocate for the implementations of SDGs. By so doing COECSA, considers the theme of the 2018 annual congress to correlate with SDGs entitled as 'Stand for action! Eye care and Sustainable Development Goals.'

It is known that eye health is strongly linked to the SDGs framework as it prioritizes and advocates the allocation of government resources and promote a global partnership for development. SDGs will have bigger impact on eye health by alleviating poverty and reducing inequality. People with unavoidable blindness and visual impairment (people with disability=PWD) are given due consideration on 11 of the 17 goals which need due attention of inclusive development[1,2].

Vision loss and eye disorders cost the US health care system US$65.1 billion in 2013, the 6th leading causes of medical expenditures[3]. The total economic cost of vision loss in Australia is estimated to be US$16.6 billion or US$28,905 per person with vision loss aged over 40 years[4]. In 2015, the sub Saharan Africa prevalence of visual impairment (VA< 6/18) was about 4.5%. Based on most recent WHO estimates, in Africa 4.8 million people are blind and 16.6 million are visually impaired with respective huge economic impact and hindrance for sustainable development. Hence it is clear that billions of dollars could be saved annually if avoidable visual impairment was prevented or cured in Africa as well[5,6].

Goal 1: End poverty and all its forms everywhere: Visual impairment is both a cause and consequence of poverty. Blindness presents barriers to education and employment, and poverty makes it difficult to access eye health care services. Eye health care is an essential component of health system. The prevalence of visual impairment is much higher in Africa. Within Africa vulnerable communities are, the worst affected. Improving eye health and reducing visual impairment is achievable, cost effective and contribute significantly to poverty reduction. Despite significant rates of refractive error, cataract and diabetic retinopathy, eye health services in Africa remain under-resourced[7]. COECSA considers that building workforce capacity is essential to fostering sustainable eye health systems and reducing avoidable blindness, which is a known driver of poverty. It is important to use the local knowledge, international experience, resources and networks of local, national and international stakeholders.

Goal 2: End hunger, achieve food security, improved nutrition and promote sustainable agriculture: Nutritional blindness or Vitamin A deficiency (VAD) disorder is a common eye disease in children of Africa. Vitamin A supplementation for children prevent VAD as a cause of blindness. Poverty and malnutrition need to be alleviated for the prevention of nutritional blindness[8].

Goal 3: Ensure healthy lives and promote well-being for all at all ages: Many eye conditions are classified as Non-Communicable Diseases (NCDs) (Target 3.4) including cataract, glaucoma, Diabetic Retinopathy (DR), macular degeneration and even refractive error. NCDs exhibit early signs that can be detected by comprehensive eye examination. Primary eye care is therefore essential in the multi-disciplinary integrated approach to NCDs management. Screening of chronic eye condition is key component of integrated primary health care system[9]. For every US$1 invested in scaling up actions to address NCDs in LMIC, there will be a return to society of at least US$7 in increased employment, productivity and longer life[10].

Cataract is the leading cause of blindness in the world (nearly 35%). The world's ageing population continues to grow so will the number of cataracts. Cataract surgery is one of the most cost-effective interventions. In Africa, there is a critical shortage and uneven distribution of human resource for health. Coordination and planning at local, provincial and national levels is essential to ensure existing resources in eye health are operating efficiently and effectively[5,11].

"Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (Target 3.8)" need to address cataract surgical services which is found to be the main surgical service in African eye care. Surgical outcome monitoring using WHO tool needs implementation to ensure quality of care.

Diabetic retinopathy affects over a third of all people with diabetes and is the leading cause of visual loss in working age adults. Early detection and timely treatment can prevent the majority of diabetes related complications or vision loss. The management of diabetes and its

complication begins in primary health care system by screening and referral accordingly[12].

Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all: A child with a visual impairment has less opportunity for formal education. There are many reasons why children living with visual impairment and in poverty may miss education. Refractive errors constitutes the majority of visual problems in the children (12 million of the 19 million). Comprehensive school eye health programmes, primary eye care and spectacle dispensing can address these problems[5,13].

Goal 5: Achieve gender equality and empower all women and girls: Advocates prioritization of women in eye health, since huge burden of visual impairment is among women, accounting for 55% of all blind people globally and barriers to access services (Target 5.1)[5]. 'Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life' (target 5.5) which will improve eye care service uptake and gender equality. COECSA advocates for that among ophthalmologists for leadership and on service delivery by prioritizing women and girls.

Goal 6: Ensure availability and sustainable management of water and sanitation for all: Access to adequate, affordable and safe drinking water, and equitable sanitation and hygiene is necessary to eliminate infectious causes of avoidable blindness like trachoma, particularly for women. Inadequate water supply, insufficient sanitation, crowded living conditions, and poor hygiene are prevalent in many African countries with 77% of global trachoma burden[14]. Trachoma, the leading infectious cause of preventable blindness, is a public health problem in 41 countries and responsible for the visual impairment of approximately 1.9 million people globally. Rates of trachoma are higher in women (75%). Global Elimination of Blinding Trachoma by 2020 (GET 2020) initiative, supported by the WHO and international partners, advocates for the implementation of the SAFE strategy[14].

Onchocerciasis is the second most frequent infectious cause of blindness. More than 99% of infected people live in 31 African countries. Infection with a parasite *Onchocerca volvulus* causes inflammation within the eye and permanent blindness. Community directed treatment with ivermectin is core strategy in Africa[15].

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all: People with visual impairment have a number of barriers to find well-paid and productive employment. Health programs that develop eye health can reduce the burden of avoidable visual impairment, which empowers people by restoring sight to have greater access to employment[16].

Goal 10: Reduce inequality within and among countries: Equal access to appropriate and effective health service is essential in Africa to ensure development. Most eye care personnel are based in cities, which create inequalities in quality of care. Outreach programs and integrated primary eye care approach can promote service delivery to remote places. COECSA is working towards integration of training programs and regional collaboration on eye health capacity development. COECSA, WHO Afro, ICO, different NGO's, Universities and partners needs to strengthen working towards ensuring equalities[2,11].

Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development: This commitment is crucial to improve the eye care development in Africa that can be seen with existing NGO supported successful programs. North South, South-South and triangular cooperation is essential for ensuring global development and reducing disease burden of avoidable cause. However, it is undeniable fact that government commitment and community ownership of its own country program is cornerstone for successful implementation of Universal Health Coverage or Universal Eye Health[11]. "Enhance the global partnership for sustainable development, complemented by multi stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the SDG in all countries, in particular developing countries (Target 17.16)" is reflected in COECSA activities that expand the impact of blindness prevention work in the region. We believe that multisector collaboration and integrated health care service delivery has quadrupled financial return to eye health investment. All governments, communities and stakeholders need to work hard towards SDGs in order to reduce visual impairment and poverty[10].

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Outcomes of trabeculectomy among glaucoma patients in Uganda: A 4-year hospital based audit

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ABSTRACT

Objective: To determine the outcomes of trabeculectomy surgery and predictors of post-operative Intra Ocular Pressure (IOP) among glaucoma patients attending Ruharo Eye Centre.
Materials and Methods: In a clinical audit conducted from January to June 2016, we reviewed records of all patients who had undergone trabeculectomy at Ruharo Eye Centre (REC), at least in one eye prior to recruitment. We made phone calls to patients inviting them for a clinical examination. For the patients who turned up, we recorded their Best Corrected Visual Acuity (BCVA), Visual Fields (VFs), Intra Ocular Pressure (IOP), Cup-Disc Ratio (CDR), and any post-operative complications. We also asked patients about their general satisfaction with both the operation and vision. We did a before and after comparison analysis on several outcome measures using STATA v14. These included: visual acuity, intra ocular pressure, cup disc ratio and visual field. We defined treatment success as a post-operative IOP reduction of 40% from baseline and analyzed for its predictors in a multivariate regression model.
Results: Sixty-two eyes of 38 patients were included in this study. Median age was 66 years (range 24 to 91 years). Median observation time was 2.8 years (range 0.2-4.6 years). Overall treatment success rate was 95%. Mean IOP pre-and post-operatively was 32 mmHg (95% CI 29.3-34.7) and 12.9 mmHg (11.7-14.2) respectively, P=0.001; there was no significant worsening of visual acuity and visual field loss. Mean visual acuity Log MAR pre and post-operatively was 0.58 (95% CI 0.48-0.68) and 0.65 (95% CI 0.52-0.78), P=0.21. Mean visual field defect was 23.4 (95% CI 21.4-25.5) and 22.9 (95% CI 20-9-25.0), P=0.44.
Conclusion: Trabeculectomy in our setting seemed to have a good success rate and provided good IOP control, preservation of vision and visual fields.

Key words: Glaucoma, Trabeculectomy, Intraocular pressure, Uganda

INTRODUCTION

Glaucoma has been reported as the second leading cause of global blindness after cataract and furthermore as the leading cause of irreversible blindness largely due to primary open angle glaucoma[1]. Bilateral blindness from glaucoma is projected to have affected 11 million individuals worldwide by 2020[1-3].

Based on randomized controlled trials, the only reliable treatment for glaucoma is to decrease intraocular pressure. The therapeutic options in glaucoma include drugs, laser and surgical treatments. The appropriate glaucoma therapy must be considered according to the individual patient, the type of glaucoma, and the stage of the disease [4-6].

In developing countries, especially among blacks, surgical treatment of glaucoma is assumed to be preferable to medical treatment[7]. Although the Advanced Glaucoma Intervention Study (AGIS) stated that Argon Laser Trabeculoplasty (ALTP) may provide better outcomes than trabeculectomy in African patients; this method is not available in most eye units in Africa including Ruharo Eye Centre (REC) in Mbarara, South Western Uganda.

In Uganda, Primary Open Angle Glaucoma (POAG) is the commonest type accounting for almost 65%[8,7]. Trabeculectomy is the most common surgical procedure performed for POAG at REC[9,8]. This study sought to evaluate the long-term outcome of trabeculectomies performed at REC with the aim of determining the effectiveness of the procedure in relation with IOP control, visual acuity and visual field preservation.

MATERIALS AND METHODS

In a retrospective audit conducted from January to June 2016, we reviewed records of all adult glaucoma patients

who underwent trabeculectomy at Ruharo Eye Centre from January 2011 to December 2014. Ruharo Eye Centre (REC) is a tertiary eye hospital, located in Mbarara Municipality, South Western Uganda. The eye hospital receives patients mainly from South Western Uganda, Tanzania, Rwanda and Congo. It serves a population of about 5 million people.

The study population of interest were participants who had undergone trabeculectomy surgery in at least one eye at REC from 2011 to 2014. The comparison of interest was a before and after mean IOP. The main outcome measure was a reduction in the mean IOP. This being an audit, we planned to include all participants who had undergone trabeculectomy during that period. However, using a paired means sample size calculation with STATA 14, a sample of 44 eyes would be adequately powered (90%) to detect a pre and post trabeculectomy difference of 5mmHg and a significance level set at 0.05.

We included patients who had undergone trabeculectomy surgery in at least one eye at REC from January 2011 to December 2014. Post trabeculectomy patients who had other comorbidities or had undergone another eye operation were excluded. Approval to conduct the study was obtained from the Ethics Committee of Ruharo Mission Hospital and Department of Ophthalmology of Mbarara University of Science and Technology as well as informed consent from each patient.

A list of all patients who had undergone trabeculectomy surgery at REC from January 2011 to December 2014 was obtained from the hospital theatre records. The patients whose phone numbers were registered were identified and a call made to them by the study nurse. For those whose phones were not reachable, the nurse made another attempt twice or thrice over the next few days and then recorded them as non-responsive. The patients who responded to their phones were invited to come for examination at REC. For those who accepted to return, we retrieved data from their case records on demographics, pre-operative vision, IOP, Visual Fields, Cup Disc ratio and surgical notes. They were then examined at REC by the study ophthalmologist and post-operative data recorded. This included Best Corrected Visual Acuity (BCVA) with Snellen charts, Visual Fields (VFs) with Henson automated perimeter, IOP with Goldman applanation tonometer, Cup-Disc Ratio (CDR) and any complications of surgery. Patients were then interviewed separately by the study nurse to ask about their general satisfaction with the surgery and their vision. These were simple 5-scale questions ranging from 5: Very satisfied, 4: Satisfied, 3: Neither satisfied nor unsatisfied, 2: Unsatisfied, 1: Very un-satisfied.

We conducted a before and after comparison analysis with STATA v14 on several outcome measures including: mean visual acuity (Log MAR), mean Intra Ocular Pressure, mean Cup Disc Ratio and mean Visual Field defect using matched pair student t-test. For purposes of analysis, we considered treatment success as having IOP reduction of 40% from baseline according to the preferred practice guidelines for target IOP [12,13]. We considered visual field progression as a change of 1.00dB/year from the mean baseline visual field[7,11]. We analyzed for predictors of final IOP in a multivariate regression model. The variables tested included: age, sex, distance from hospital, type of anti-metabolite used, education level, pre-operative IOP, visual acuity, VF defect and period after surgery.

RESULTS

Out of a total of 479 patients who were eligible for enrolment, 62 patients returned to the hospital out of which only 38 patients (62 eyes) were eventually enrolled. Twenty four patients were excluded as per the exclusion criteria. Figure 1 shows how the patients were enrolled.

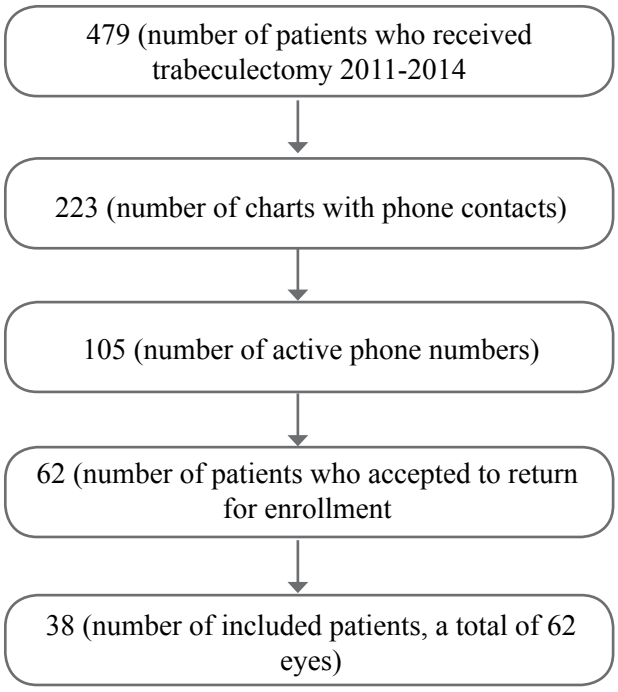

Figure 1: Flow diagram for participant enrolment

General characteristics: In total, 62 eyes of 38 patients were included in this study. Table one shows the general characteristics. About 2/3 of the participants were male; median age was 66 years (range 24-91 years). Their median follow-up period was 2.8 years (range 0.2-4.6 years). Out of the 62 patients, 24 had bilateral trabeculectomy. Two thirds of the trabeculectomies were with 5-FU (61%) and the commonest type of glaucoma was Primary Open Angle (POA) (84%).

Table 1: General descriptors of included participants (n=38 persons, 62 eyes)

Variable	Median	IQR	(Total Range)
Age	66	52-71	(24-91)
Distance from hospital in Kms	71	24-98	(2-525)
Period after surgery in years	2.8	1.8-3.6	(0.2-4.6)

Variable	Categories	N	(%)
Sex	Male	23	(61)
Education	No education	12	(32)
	Primary	8	(21)
	Secondary	15	(39)
	Tertiary	3	(8)
Type of glaucoma	Primary Open Angle	52	(84)
	Normal Tension	7	(11)
	Ocular Hypertension	1	(2)
	Angle Closure	2	(3)
Type of surgery	Trab + 5FU	38	(61)
	Trab + MMC	18	(29)
	Trab + no anti-metabolite	6	(10)

Key: Trab-Trabeculectomy, 5FU- Fluorouracil, MMC-Mitomycin C

Post-operative status versus pre-operative status: Table 2 shows a comparison of post-operative follow-up status versus pre-operative status on visual field type, mean visual field defect, vision, IOP and Cup Disc Ration (CDR). Mean post-operative IOP was almost 3 times less than the mean pre-operative IOP (12.9 Vs 32.0, P= 0.001). The 40% reduction target IOP was 19.2mmHg: this target IOP was achieved in 90% of the eyes. The mean visual acuity and visual field defect although higher post operatively were not statistically significant from pre-operative levels. Only 7 eyes had a post-operative mean visual field defect of more than 2DB with a median follow-up of 3.5 years (1 eye: 1.7 years, 1 eye: 2.2 years, 1 eye: 2.8 years, 4 eyes: >4 years). Paradoxically, the mean post-operative CDR was worse than the mean pre-operative CDR (0.89 Vs 0.83, P=0.001).

Table 2: Comparison of post-operative follow-up status versus pre-operative status

Variable	Pre-op		Post-op		P-value
	Mean	(95% CI)	Mean	(95% CI)	
Mean visual field defect	23.4	(21.4-25.5)	22.9	(20-9-25.0)	0.44
Mean maximum IOP	32.0	(29.3-34.7)	12.9	(11.7-14.2)	0.001
Mean Visual Acuity (LogMar)	0.58	(0.48-0.68)	0.65	(0.52-0.78)	0.21
Mean Cup Disc Ratio	0.83	(0.79-0.87)	0.89	(0.86-0.92)	0.001
Visual field defect					
Arcuate scotoma	14	(23)	12	(20)	
Atypical scotoma	4	(7)	4	(6)	
Loss of central vision	22	(36)	22	(36)	
Isolated scotoma	2	(3)	1	(2)	
Nasal step scotoma	4	(7)	3	(5)	
Paracentral scotoma	2	(3)	2	(3)	
Ring scotoma	13	(21)	17	(28)	
Vision category					
Normal/mild (6/6-6/18)	33	(53)	32	(52)	
Moderate (6/24-6/60)	22	(36)	21	(34)	
Severe (5/60-3/60)	2	(3)	4	(6)	
Blind (<3/60)	5	(8)	5	(8)	
IOP category					
<=10mmHg	0	(0)	21	(34)	
11-15mmHg	3	(5)	23	(37)	
16-20mmHg	5	(8)	15	(24)	
>20mmHg	54	(87)	3	(5)	

Predictors of achieving a target IOP: Table 3 shows a multivariate model of the factors which were associated with post -operative IOP. The variables tested included: age, sex, distance from hospital, type of surgery, education level, pre-operative IOP, visual acuity, VF defect and period after surgery. Out of these, education level, pre-operative IOP and period after surgery had a strong evidence of association.

Table 3: A multivariate analysis of predictors of post-operative IOP

Target IOP	Coefficient	P value	(95% Conf. Interval)
Period after surgery	1.07	0.026	(0.13-2.01))
Education	-1.47	0.009	(-2.58- -0.37)
Pre-operative IOP	0.13	0.011	(0.03-0.24)

DISCUSSION

The success rate of trabeculectomy is very dependent on the definition of success that is utilized, the duration of follow-up and the population studied. Thus, comparing results from different studies has to take multiple factors into account. In this study, we considered the following factors as indicators of a successful trabeculectomy. These included: reduction of IOP (IOP reduction of 40% compared to baseline), preservation of visual acuity, preservation of visual field and avoidance of further optic disc damage[7,12].

In terms of lowering IOP, our findings showed trabeculectomy was effective. The general IOP after surgery was almost 3 times less than pre-operative and 90% of the patients had a maximum post-operative IOP of less than 19.2mmHg. This was comparable to experiences

from a number of other studies where proportions ranged from 80-98%[13,14]. These older studies used a target IOP of less than 21mmHg.

Being able to predict which patients will benefit most is important to make a management and prognostic decision. Several factors come into play in securing a successful operation. These include: age, gender, type of surgery, indication, early post-operative IOP, duration after surgery and post-operative care[14-17]. Our study showed that post-operative IOP was strongly linked to duration after IOP with an increase of 1mmHg of IOP/ year after surgery. Considering that the mean post-operative IOP was 12.9mmHg, it would take about 7 years in our population to exceed the threshold target IOP of 19.2mmHg, assuming all factors remain constant. The Advanced Glaucoma Intervention Study (AGIS) also showed that a post-operative period of more than 7.7 years was more associated with deterioration[10]. Our follow-up was variable and ranged from 0.2-4.6 years. We intend to revisit this cohort after 7-10 years to evaluate their IOP.

Apart from duration after surgery, there was a very strong correlation between pre and post-operative IOP. A low pre-operative IOP was associated with a lower post-operative IOP. This might suggest the role of initial medical therapy to lower presenting IOP before doing a trabeculectomy. Lastly, similar to the AGIS, there was strong evidence of a better IOP control with increase in education with a reduction post-operative IOP of almost 1.5mmHg with every increase in the level of education.

Significant visual field deterioration is defined as a change in decibels of equal or more than 1.00/year[10]. Considering a median follow-up of 2.8 years, a significant visual field deterioration would have been 2.8dB. In our study, 7 eyes out of 62 (11.3%) had visual field defect progression between 3 and 5 dB from baseline. An 80 month trial at Moorfield's Eye Hospital showed that 20% of eyes had visual field progression 5 years after trabeculectomy[18]. In the CIGTS, perimetric progression was not significant for many years after trabeculectomy, but after 8 years the progression worsened by 3 dB in 21% of patients[11,19]. overall, our impression of our data is that visual fields were largely preserved: the mean pre and post-operative visual field defect was not statistically different. In fact, the post-operative mean score was better than the pre-operative. This could have been due to the learning curve effect. This correlated well with visual acuity which was also not different.

Interestingly, there was an observed increase of the CDR, however, although statistically significant, we felt it was not clinically important as the mean change of 0.06 was too small and did not affect visual field changes; it could be artefactual or age related.

LIMITATIONS

This study had a low enrolment rate. Out of the eligible 479 patients, we managed to enroll 38 (7.9%). Although his had sufficient power from our assumption to detect a difference in the pre and post trabeculectomy IOP, the sampling was not random. It is plausible that the patients who returned were the "happy patients". Therefore, this work provided some insight on the trend that needs to be confirmed in a carefully designed prospective study.

CONCLUSION

Trabeculectomy was an effective means of lowering the IOP with significantly high success rates, preservation of vision and prevention of further visual field loss. Presenting vision, duration after surgery and patients' education status were key predictors of post-operative IOP. We found trabeculectomy as a viable treatment option particularly in resource limited settings. A carefully designed prospective study is needed to provide stronger evidence of this effect.

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Diabetic retinopathy among patients with type 2 diabetes mellitus at Moi Teaching and Referral Hospital, Eldoret, Kenya

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ABSTRACT

Background: Diabetic Retinopathy (DR) accounts for 5% of the 39 million causes of blindness occurring worldwide and is estimated to contribute 3% of blindness in Kenya. Dyslipidemia, poor control of sugar, hypertension and obesity increase the risk of DR in patients with diabetes. This study addresses the gap in information on the magnitude of DR and its associated factors in patients with type 2 diabetes at Moi Teaching and Referral Hospital (MTRH).

Objectives: To determine the prevalence and severity of DR and its associated factors in patients with type 2 diabetes mellitus.

Methods: This cross sectional study was conducted amongst patients with type 2 diabetes mellitus in MTRH. Randomly selected participants underwent anthropometric, laboratory and visual acuity testing. Direct ophthalmoscopy was used to assess DR and macula edema. Grading of DR was done using international clinical diabetic retinopathy severity scale. A univariate and multivariate logistic regression model was used to assess associations of the variables with DR.

Results: Of the 329 participants enrolled, 187 (57%) were female with a mean age of 56.8 (10.99) years. One hundred and three (31%) had diabetic retinopathy and 39 (12%) had diabetic macula edema. Mild to moderate non proliferative diabetic retinopathy was the most prevalent grade at 79 (25%). One hundred and eighty four (56%) of participants had hypertension (133/80; IQR 120/70-150/89) mmHg and 158 (48%) had glycated haemoglobin between 7-10%. The median for the other assessed factors were as follows: duration of diabetes 5 (9) years, total cholesterol 4.6 (1.3) mmol/l and low density lipoprotein 3.0 (1.5) mmol/l. Increase in duration of diabetes by 5 years {OR 2.02(95% CI 1.11-3.69); p 0.02}, glycated haemoglobin > 6.5% {OR 2.13(95% CI 1.02-4.42); p 0.04}, systolic hypertension >160 mmHg {OR 1.02(95% CI 1.01-1.03); p 0.01} were associated with increased risk of diabetic retinopathy while male gender and body mass index did not. Only 15% of the participants in this study reported having had previous eye check-up.

Conclusion: A third of patients with type 2 diabetes on follow up at MTRH have DR. Systolic hypertension, increased duration of diabetes and high glycated haemoglobin were positively associated with increased risk of developing DR.

Key words: Diabetic retinopathy, Type 2 diabetes mellitus

INTRODUCTION

Diabetes Mellitus (DM) affects about 350 million people worldwide and results in considerable morbidity and mortality. There is significant increase in developing countries; thought to be the result of population growth, ageing, obesity, and sedentary lifestyles[1]. The International Diabetes Federation (IDF) has estimated the number of adults with DM in Africa will double in 20 years from 12 million in 2010 to 24 million in 2030[2]. Diabetes Retinopathy (DR) is a leading cause of vision loss in middle-aged and elderly people globally. Early detection and prompt treatment allow prevention of diabetes-related visual impairment[3].

Diabetes has many manifestations in the eye, of which cataracts and Diabetic Retinopathy (DR) are the most significant causes of visual impairment and blindness. People with diabetes are 25 times more likely than the general population to become blind with DR reported as the sixth leading cause of global visual impairment[4]. In developed countries, diabetic eye disease represents the leading cause of blindness in adults aged less than 75 years. Visual impairment as a result of DR has a significant impact on patients' quality of life and can compromise their ability to manage their disease, which can in turn have a negative impact on the incidence of other diabetic complications and overall life expectancy[4,5].

Diabetic retinopathy is estimated to contribute about 3% of blindness in Kenya. In Nairobi, it is estimated

that 50% of patients diagnosed with diabetes have DR, while 20% of patients in rural central province had DR[5]. Majority of patients diagnosed with DR have never undergone any eye examination[5,6]. Long duration of diabetes, hyperglycemia, hypertension, dyslipidemia, obesity, proteinuria and low socioeconomic status play important roles for development of retinopathy. Long duration of diabetes and inadequate glycemic control are most important[7]. Loss of productivity and quality of life for the patient with diabetic retinopathy will lead to additional socio-economic burdens on the community. Many cross sectional studies have been done on the prevalence as well as the associated risk factors for developing diabetes retinopathy in other parts of the world as well as Kenya. Moi Teaching and Referral Hospital does not have data on the prevalence of diabetic retinopathy and the particular risk factors associated with the condition hence this research work aims at addressing this gap. Identification of risk factors associated with diabetic retinopathy is essential if effective preventative measures are to be developed. It is hoped that publishing of such data at the hospital level will stimulate interest in development of programs aimed at prevention through early diagnosis, management of risk factors and treatment of advanced cases.

MATERIALS AND METHODS

Study design and setting: This was a cross-sectional study conducted at the Moi Teaching and Referral Hospital which is a referral hospital for Western Kenya and Rift valley.

Study participants: The participants were persons with type 2 diabetes mellitus recruited from the diabetes clinic and in-patient adult wards.

Sampling technique: This study employed simple random sampling technique. There are approximately 3000 patients with diabetes mellitus on follow up in diabetes clinic in Moi Teaching and Referral Hospital. About 30 to 70 patients are attended to during the clinic days. Patients were recruited during the clinic days (Tuesday, Thursday and Friday). The attendance list which had names of patients booked on a particular clinic day was used as a sampling frame. The participants were then randomly selected from the attendance list using a sampling table. The patients in the wards were enrolled on Monday and Wednesday. The admission list of the patients in the wards was used as the sampling frame. A sampling table was used to randomly select the participants.

Variables: The main exposure variable was Type 2 DM which was derived from the patients chart. The main outcome variable was diabetic retinopathy. Other covariates of interest were glycated haemoglobin, blood pressure, body mass index, age, lipid profile, previous eye check up and gender.

Inclusion criteria: Available documentary evidence (medical chart/file) of diagnosis of type 2 diabetes mellitus.

Exclusion criteria: Ocular diseases precluding slit lamp examination/ophthalmoscopy; Inability of a participant to consent.

Study procedures: Clients with type 2 diabetes mellitus on follow up in the diabetes clinic and those admitted in the adult wards were recruited into the study upon meeting all the inclusion criteria. The research assistant collected the participant's bio data, a comprehensive medical history and anthropometric measurements (weight and height). Blood pressure was recorded in the sitting position in the right arm using a mercury sphygmomanometer. Blood samples for glycated haemoglobin and lipid profile were drawn by the researcher/research assistant from patients who had fasted for >8 hours. Direct ophthalmoscopy was performed to assess diabetic retinopathy and diabetic macula edema. The findings were confirmed by an ophthalmologist before grading the participant degree of diabetic retinopathy using the international clinical diabetic retinopathy disease severity scale.

Data analysis: Data was explored for missing values, errors and inconsistencies. Descriptive statistics were summarized means (standard deviation) or medians (interquartile range). Univariate and multivariate logistic regression models were used to assess associations of clinical, biochemical and anthropometric variables with diabetic retinopathy. Odds ratios were calculated for the associations between covariates and the outcome. The univariate analyses that showed significant relationships ($p < 0.20$) between exposure variables and diabetic retinopathy were included into the multivariate analysis.

Study limitations: The performance of examinations through a dilated pupil by direct ophthalmoscopy is 50-70% that of the gold standards (color fundus photography) meaning some early cases of diabetic retinopathy could have being missed.

Ethical considerations: Ethical clearance was obtained from the Institutional Research and Ethics Committee (IREC) of MTRH and Moi University School of Medicine and permission from MTRH management. A written informed consent was obtained from all the participants.

RESULTS

Of the 329 participants included in the final analysis, 187 (57%) were female with a mean age of 56.8 years (SD 10.97). Among the in patients; reasons for admission included hyperglycemia and co-morbidities like diabetic foot, renal disease and stroke. The mean Body Mass Index (BMI) was 27 (SD 5). One hundred and eighty four (56%) of participants were hypertensive with the median blood pressure of 133/80 mmHg (IQR 120/70-150/89). The median duration of diabetes mellitus was 5 years (IQR 2-11) with a median glycated haemoglobin and total cholesterol of 8.65% (IQR7.2-11) and 4.48 mmol/l (IQR 3.59-5.37) respectively (Table 1).

Table 1: Overall participant characteristics and comparing those with and without diabetic retinopathy

Characteristics		Total n=329	With diabetic retinopathy (n= 103)	Without diabetic retinopathy (n = 226)
Age (years)	Mean (SD)	56.8 (11.0)	59.2 (9.4))	55.8 (11.5)
Gender	Male	140 (42.6%)	46 (44.7%)	94 (41.6%)
	Female	189 (57.4%)	57 (55.3%)	132 (58.4%)
Duration of DM in years	Median (IQR)	5 (9)	8 (11)	4 (9)
Hypertension	Yes	184 (55.9%)	72 (69.9%)	112 (49.6%)
	No	145 (44.1%)	31 (30.1%)	114 (50.4%)
Systolic BP (mm/hg)	Mean (SD)	135.6 (23.0)	143.7 (22.9)	131.8 (22.1)
Diastolic BP (mm/hg)	Mean (SD)	79.7 (13.2)	81.4 (14.2)	78.9 (12.7)
Hba1c (%)	< 7%	60 (18%)	4 (4%)	56 (25%)
	7 – 10%	158 (48%)	47 (46%)	111 (49%)
	> 10%	110 (34%)	52 (50%)	58 (26%)
BMI (kg/m^2)	Mean (SD)	27.1 (5.1)	27.0 (4.5)	27.2 (5.4)
Total cholesterol (mmol/l)	Median (IQR)	4.6 (1.3)	4.9 (1.3)	4.4 (1.3)
Triglycerides (mmol/l)	Median (IQR)	1.7 (1.4)	2.0 (1.3)	1.7 (1.4)
HDL-C (mmol/l)	Median (IQR)	1.0 (0.5)	1.0 (0.5)	1.0 (0.4)
LDL-C (mmol/l)	Median (IQR)	3.0 (1.5)	3.8 (1.6)	2.7 (1.4)
Previous eye check	Yes	73 (22.2%)	35 (34.0%)	38 (16.8%)
	No	256 (77.8%)	68 (66.0%)	188 (83.2%)

In the univariate model of risk factors associated with diabetic retinopathy (Table 2), every increase in age by a year (OR 1.12 (95% CI 1.03-1.22; p 0.001); presence of hypertension (OR 2.36 (95% CI 1.44-3.87; p 0.001) or elevated systolic blood pressure (OR 1.02 95% CI 1.01-1.03; p 0.0001) were associated with diabetic retinopathy. Other risk factors that were statistically significant in this model include every point increase in glycated haemoglobin, total cholesterol and low density lipoprotein levels.

Table 2: Univariate analysis showing unadjusted OR for the relationship between participant characteristics and diabetic retinopathy

Characteristics		UOR	95% CI	P value
Age (years)	(Increase in 10 years)	1.12	1.03 to 1.22	0.001
Gender	Female	ref		
	Male	1.13	0.71 to 1.81	0.602
Duration of DM in years	5 year increase in duration	1.15	1.25 to 1.82	0.001
Hypertension	No	ref		
	Yes	2.36	1.44 to 3.88	0.001
Systolic BP (mm/hg)	Mean (SD)	1.02	1.01 to 1.03	0.001
Diastolic BP (mm/hg)	Mean (SD)	1.01	1.00 to 1.03	0.113
Hba1c (%)	<6.5%	ref		
	>6.5%	4.62	2.12 to 10.05	0.001
BMI (kg/m^2)	Increase by a unit	0.99	0.95 to 1.04	0.780
Total cholesterol (mmol/l)	Mean (SD)	1.41	1.16 to 1.71	0.001
LDL-C (mmol/l)	< 3.2	ref		
	3.2 to 4.2	2.56	1.43 to 4.59	
	>4.2	7.53	3.98 to 14.21	0.001
Previous eye check	No Yes	ref 2.54	1.49 to 4.35	0.001

In the multivariate model (Table 3), longer duration of diabetes (OR 2.02; 95% CI 1.11-3.69); higher glycated haemoglobin (OR 2.13; 95% CI 1.02-4.42); and higher systolic blood pressure (OR 1.02; 95% CI 1.01-1.03) were positively associated with diabetes retinopathy. Higher LDL cholesterol (OR 1.14, 95% CI 0.59 to 2.26) and advancing age (OR 2.72, 95% CI 0.86 to 8.63) were not significantly associated with diabetic retinopathy in the final model.

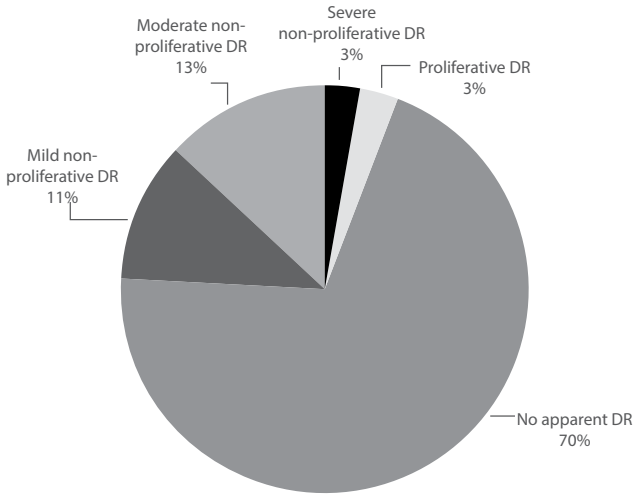

Figure 1: Distribution of the different stages of diabetic retinopathy

Table 3: Multivariate analysis showing adjusted Odds ratios for the participant characteristics and diabetic retinopathy

Characteristics	AOR	95% CI	P value
Age group (increase by 10 years)	1.03	0.92 to 1.15	0.57
Increase in duration of diabetes by 5 years	2.02	1.11 to 3.69	0.02
Systolic blood pressure >160mmHg	1.02	1.01 to 1.03	0.01
HBA1C > 6.5%	2.13	1.02 to 4.42	0.04
LDL cholesterol >3.2mmol/l	1.14	0.59 to 3.05	0.23
Previous eye check	1.52	0.76 to 1.35	6.28

DISCUSSION

This study found high prevalence of diabetic retinopathy among patients with type 2 diabetes at MTRH, with majority having mild to moderate non proliferative diabetic retinopathy. Longer duration of DM, poor glycemic control and higher blood pressure were significantly associated with higher likelihood of diabetic retinopathy.

The prevalence reported in this study (31%) is comparable to a systematic review of African studies on micro and macrovascular related complications in diabetes. The systematic review reported prevalence of diabetic retinopathy of 16 to 77% depending on the duration of diabetes and glycemic control, with severe retinopathy representing 15% of all cases[8]. Kohner *et al*[9] in 1998 through a large systematic review reported prevalence of diabetic retinopathy among patients with type 2 diabetes ranged from 30.2– 31.6% among various African countries. Similar studies done in Kenya in Nakuru and Embu reported a prevalence rate of 35.9% and 41% respectively and almost 50% of diabetics at Kenyatta National Hospital[10-12].

The estimated prevalence of macula edema is 12% which is less than 33.3% as found by Mathenge *et al*[10] in Nakuru. This might be because the study in Nakuru incorporated color fundus photography in diagnosing diabetic retinopathy and macula edema which is more sensitive than slit lamp examination or direct ophthalmoscopy. Generally, the prevalence of diabetic macula edema among patients with diabetes is generally much lower than that of diabetic retinopathy[13]. Among the population-based studies, prevalence of diabetic macula edema among patients with type 2 diabetes was between 1.4 and 12.8%[14].

Gender did not attain a statistical significance as a risk factor for diabetic retinopathy. This is in contrast to other studies which have shown varying results when predicting sex as a risk factor for developing diabetic retinopathy. Male preponderance in diabetic retinopathy has been shown in India[15,16]. Body mass index was not a risk factor for development of diabetic retinopathy. The evidence supporting a relationship between high body mass index and increased risk of diabetic retinopathy is inconclusive. Some studies have demonstrated a positive relationship between higher body mass index and diabetic retinopathy whereas others have reported conflicting results[9,17,18].

Increasing age was positively associated with increasing risk of diabetic retinopathy. This apparent association between older age and diabetic retinopathy might be due to collinearity between old age and longer duration of diabetes. Furthermore, it is believed that undiagnosed type 2 diabetes mellitus may occur 4 – 12 years before its clinical diagnosis and that diabetes may be present for five years before the onset of retinopathy thus the preponderance of diabetic retinopathy in old age[19, 20].

Duration of diabetes above 10 years, glycated haemoglobin > 10%, systolic blood pressure 160-179 mmHg and low density lipoprotein >3.4mmol/l were independently associated with diabetic retinopathy. The duration of diabetes has consistently been shown to be one of the most important determinants of diabetic retinopathy. It has been suggested that the duration reflects total glycemic control, a risk factor that involves cumulative damage[21].

High glycated haemoglobin was associated with diabetic retinopathy. This findings compares with the United Kingdom Prospective Diabetes Study Group (1998) and the Diabetes Control and Complications Trials (1993) which provided strong evidence that tight control of glycemia (glycated haemoglobin <7%) reduces the risk of development and progression of diabetic retinopathy in both type 1 and type 2 diabetes[16]. Hypertension is recognized as a risk factor for the development and progression of diabetic retinopathy as was evidenced in the present study. Multiple epidemiologic studies have identified hypertension as a risk factor for diabetic retinopathy and diabetic macula edema[22].

Univariate analysis of the lipid profile data showed total cholesterol and low density lipoproteins as risk factors associated with diabetic retinopathy but not on multivariate logistic model. No single lipid measure has been consistently found to be associated with diabetic retinopathy or diabetic macula edema[23]. In recent cohort studies, only the Madrid Diabetes Study[24] found an association between low density lipoprotein cholesterol and incidence of diabetes.

Previous eye check-up as used in this study meant that since diagnosis of diabetes mellitus whether the client has had his/her eyes screened. Only 15% of the participants in this study reported having had previous eye check-up. The most common eye symptom given was poor/hazy vision. Njambi *et al*[11] reported 71% of the patients had never had an eye examination before done by an ophthalmologist.

CONCLUSION

A third of patients with type 2 diabetes mellitus on follow up at Moi Teaching and Referral Hospital have diabetic retinopathy. There is need to restructure the existing diabetic eye screening programs to enhance prevention through early diagnosis. The health workers managing patients with diabetes should intensify efforts aimed at controlling hypertension and high glycated haemoglobin.

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Outcomes of surgery for stage 4 and 5 retinopathy of prematurity in a developing country

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ABSTRACT

Objective: To assess anatomical and visual outcomes plus complications of surgeries in patients with stage 4 and 5 retinopathy of prematurity in a tertiary eye care centre in Bangladesh.
Methods: Retrospective case series of all patients that underwent surgery for stage 4 and 5 retinopathy of prematurity between January 2015 and January 2018 was carried out. Anatomic outcomes, qualitative visual acuity as well as the complications were assessed.
Results: Thirty three eyes of 25 patients were recruited in the study (12 male and 13 female). Overall 22 (66.7%) of the eyes had complete retinal re-attachment. The percentage for complete re-attachment for stage 4A, 4B, and 5 were 89.5%, 66.7% and 12.5% respectively. Overall 19 eyes (57.6%) had ability to fix and follow objects. This included 14 eyes (73.7%) in stage 4A, 4 eyes (66.7%) in stage 4B and 2 eyes (25.0%) in stage 5. The commonest complications noted were cataracts (15.2%), vitreous haemorrhage (15.2%) and glaucoma (9.1%).
Conclusion: Anatomical outcomes of surgery for stage 4A retinopathy of prematurity are very encouraging while those of stage 4B and 5 are poorer. Consequently, visual outcomes for stage 4A are also better than those for stage 4B and 5.

Key words: Retinopathy of Prematurity, Outcomes, Surgery, Bangladesh

INTRODUCTION

Retinopathy of Prematurity (ROP) is a disease resulting from abnormal retinal vascular development. The main predisposing risk factors are prematurity and low birth weight[1,2]. Paediatric care around the world is improving. As a result increasingly more premature infants are surviving and that has raised the incidence of ROP to be one of the leading causes of child-hood blindness[3]. Dedicated ROP screening programs are now part of many neonatal care services and prompt treatment with laser when indicated has become the practice. Recently attention has also focused on use of anti-vascular endothelial growth factors for stage 3 ROP. The bevacizumab eliminates the angiogenic threat of retinopathy of prematurity (BEAT-ROP) study showed significant benefit of intravitreal bevacizumab for stage 3 zone 1 ROP[4] which hitherto was only managed by ablation.

Even though it has been shown that ablation therapy improves the outcomes of children with severe ROP[3], some children still progress to latter stages of the disease and develop retinal detachment[1,3,5,6].

Advanced stages of ROP (stage 4 and 5) usually require surgical intervention[7] to preserve both the anatomical and functional integrity of the eye. Some of the surgical methods employed in this regard include Scleral Buckling (SB), Lens-Sparing pars-plana Vitrectomy (LSV), pars-plana Lensectomy with Vitrectomy (LV) and open sky vitrectomy[1,7]. The choice of method depends on the stage of ROP and characteristics specific to each eye[7,8] such as the extent of the fibrovascular membranes and its relation to the lens as well as surgeon's preferences.

Even though surgical outcomes for the various stages vary widely, in stage 4A the macular is preserved and thus timely reattachment of the peripheral detached retina can halt the progression of the disease and preserve central vision. Consequently children with stage 4A ROP tend to have better outcomes[9]. Once the detachment encroaches on the macula however, outcomes tend to be more guarded and can often lead to irreversible loss of vision[1,8]. In this study we present the results of surgery for stage 4 and 5 ROP in a tertiary institution in a developing country. We describe visual outcomes, anatomical results and complications associated with these surgeries in our setting. The results will inform us on the capabilities of our ROP program in terms of managing latter stages of the disease as well as give an idea of capabilities of similar programs especially in other developing countries.

MATERIALS AND METHODS

We carried out a retrospective consecutive case series of all patients with stage 4 or 5 ROP who underwent surgery. The study was carried out at Ispahani Islamia Eye Institute and Hospital which is a tertiary ophthalmic care centre in Bangladesh between January 2015 and January

2018. It was authorized by the institution's review board and performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the parents or guardians of all participants before examination under anaesthesia and surgery. Case files were identified and retrieved from the institutions medical records department and the following demographic data recorded: date of birth, sex, gestational age and birth weight.

The following clinical data was obtained: whether the infant had undergone laser photocoagulation and or anti-vascular endothelial growth factor treatment before surgery, stage of ROP, presence of plus disease, type of surgery done, intra-operative complications, post operative complications, duration of follow up after surgery, anatomic status of the retina on last follow up and the visual acuity at the last follow up. The stages of ROP were defined in accordance with the international classification of ROP and plus disease[10].

Data was analyzed using SPSS version 20.0. A p-value of <0.05 was considered statistically significant. The primary outcomes were anatomical attachment and presence or absence of fixation ability. Anatomic outcome was categorized as either fully attached retina (both within and without the arcades), attached only at the posterior pole (within the arcades) or not attached at all (posterior pole off).

The surgical techniques: All the surgeries were done by two vitreoretinal surgeons (NN and SKD) who have also undergone training in ROP. The surgical procedures in this series included SB, LSV and LV and have been described elsewhere[7,11,12]. In our case we employed the 3 port technique for vitrectomy and used vitreous cutter and membrane peeler cutter scissor. We used 23 gauge systems. The eye was entered 1mm from the limbus via the pars plicata. Core vitrectomy was performed and all membranes peeled off as much as possible. Lensectomy was carried out for those eyes needing more extensive anterior dissection close to the lens. There after fluid–air exchange was performed. The sclerotomies were closed, and the child positioned face down.

SB involved placement of an encircling band under the rectus muscles and as close to the ridge as possible. We used mattress sutures in each quadrant to further secure the band. When the surgeon was satisfied with the amount of indentation achieved, paracentensis was then carried out to normalize intraocular pressure. We routinely remove the band at 6 months post operatively.

Postoperatively, all patients were examined in the clinic or under anaesthesia. The interval of examination depended on the surgeon's judgment, informed by individual patient and ocular characteristics. Visual rehabilitation was done in conjunction with the paediatric ophthalmologist and the low vision specialist as deemed appropriate. Aphakic correction was provided by either contact lenses or spectacles.

RESULTS

A total of 33 eyes of 25 children were enrolled in this review (12 male and 13 female). The mean gestation age was 31 ±2.8 weeks and the mean birth weight was 1414.4 ±292.1 grams. The median duration of follow up after surgery was 5.9 months (range1 month 4 days to 16 months 2 days). Table 1 shows the patient demographics and characteristics of the operated eyes.

Table 1: Demographic data of the patients and status of operated eye

Characteristics	
No of patients (eyes)	25(33)
Sex (n), Male/Female	12/13
Gestation age (Weeks), mean ± SD	31.0±2.8
Birth weight (grams) mean ± SD	1414.4±292.1
Prior treatment, Laser/laser+Avastin/None	24/7/2
Surgery type, LSV/ LV/ SB	19/6/8
ROP stage at time of surgery, 4A/4B/5	21/1/11
Plus disease, Present/ Absent	6/27

Abbreviations: LSV=Lens sparing vitrectomy, LV=Lensectomy with vitrectomy, SB=Scleral Buckling

Anatomic outcomes: Overall out of the 33 eyes that underwent surgery, 22 (66.7%) had fully attached retina, 5 (15.2%) had attachment only at the posterior pole while 6 (18.2%) remained unattached. Of the 19 eyes with stage 4A disease, 17 (89.5%) had fully attached retinas while 2 (10.5%) had attachment only at the posterior pole. In stage 4B, 4 out of 6 eyes (66.7%) had fully attached retina, one was attached only at the posterior pole while one remained unattached. In stage 5, 6 out of 8 eyes (62.5%) remained unattached, 2 (25.0%) were attached only at the posterior pole while one eye (12.5%) had fully attached retina. All except one eye in stage 4A (94.7%) had undergone preoperative laser ablation as well as 4 out of 6 eyes in stage 4B (66.7%).

Visual outcomes: Visual outcomes varied across the groups. Overall 19 out of the 33 (57.6%) eyes were able to fix and follow objects, while 6 (18.2%) eyes had light perception. The remaining 8 (24.2%) eyes could not be assessed either because the child had neurologic conditions (3 eyes) or because the child was uncooperative (5 eyes). In stage 4A, 14 (73.7%) eyes could fix and follow objects while 5 (26.3%) eyes could not be examined. In stage 4B there were 4 (66.7%) eyes that could fix and follow objects, 1 (16.7%) eye had light perception while another 1 (16.7%) eye could not be examined. In stage 5, 2 (25.0%) eyes were able to fix and follow objects while 3 (37.5%) eyes had light perception and another 3 (37.5%) eyes could not be examined.

Complications: There were no recorded intra-operative complications. However, post operatively, 5 (15.2%) eyes

developed cataracts and had to undergo cataract surgery. Three (9.1%) eyes developed glaucoma and underwent glaucoma surgery (trabeculectomy plus trabeculotomy). Intraocular pressure was controlled thereafter. Five (15.2%) eyes developed vitreous haemorrhage of which 4 had plus disease pre-operatively. All of these were managed conservatively. The other complications observed included uveitis (2 patients), transient hypotony (1 patient) and strabismus (1 patient).

DISCUSSION

Early and timely interventions in ROP is key in forestalling the progression of the disease to retinal detachment. For children who develop detachment, surgery presents a viable option for management. The main aim of the various surgical modalities employed is to relieve traction on the retina and hence reattach it to the retinal pigment epithelium. Scleral buckling achieves this by indenting the globe thus counteracting the forces exerting traction on the retina[13]. It is often used alone or in combination with vitrectomy especially in eyes with extensive traction anterior to the equator[7]. Vitrectomy on the other hand not only physically eliminates the tractional membranes but is also hypothesized to remove growth factors that contribute to vascular activity[1]. Lensectomy is often added to enable the surgeon to access more anteriorly located membranes than would otherwise not be reachable without the risk of touching the lens. It can also be done to advance clarity of fundus view and to rid the lens in case of inadvertent lens touch with cataract development.

In stage 4A ROP, outcomes without interventions have been reported to be poorer than when surgery is rendered[1]. In our study we found a complete attachment rate of 89.5% (17/19) eyes in stage 4A. In addition, 14 (73.7%) eyes were able to fix and follow objects. Similar findings have been reported by Capone and Trese[12] who studied outcomes in patients who had undergone LSV. They found that 90.0% (36/40) of eyes showed retinal reattachment and fixation behavior at their last follow-up visit. Elsewhere, Hubbard *et al*[14] found that 21/25 (84.0%) of eyes with stage 4A ROP had complete retinal reattachment after surgery and 19/25 (76.0%) were able to fix and follow. These findings thus demonstrate that for stage 4A eyes prompt intervention can yield good outcomes.

Outcomes for detachments involving the macula in stage 4B ROP are worse compared with stage 4A[1]. In this study 4 (66.7%) eyes had fully attached retina and all 4 (66.7%) had fixation and following ability. These numbers are however too small to establish a strong trend and the qualitative nature of the measured visual acuity make direct comparisons with other studies difficult. However a review of case series by Asano *et al*[1] revealed that only 12.0% of the 141 eyes had measurable acuity better than 20/2000. In addition, El Rayes *et al*[15] found full attachment in 73.2% (41/56) eyes, and in terms of visual acuity they found that 57.2% (32/56) eyes had vision worse than 20/800. It's apparent therefore that once the macular is involved outcomes tend to be more guarded. Surgeons should thus be vigilant and intervene earlier when detachments are still outside the macula.

Anatomical and visual outcomes for stage 5 surgeries are even worse compared to stage 4B. In this study out of the 8 eyes in stage 5 only 1 (12.5%) eye had full retinal attachment, 2 (25.0%) had attachment only at the posterior pole while the rest (62.5%)) remained unattached. In addition, only 2 (25.0%) eyes were able to fix and follow objects. Similarly, Choi *et al*[16] reported full retinal attachment in only 13% of cases and partial attachment in 27.6%, whereas fixation and following ability was noted in only 17.2% of the eyes. Stage 5 eyes tend to have very extensive fibro-proliferative membranes making surgery not only difficult but the settling of the retinal is also less predictable.

In this study most patients with stage 4A and 4B disease had undergone preoperative laser ablation. However because of the low numbers involved, the advantage conferred by laser in this study could not be analyzed. However, elsewhere El Reyes *et al*[15] observed that retinal ablation was associated with better anatomical outcomes. Laser ablates the ischemic retina thus reducing oxygen demand by the retina. As a result there's down regulation of vascular endothelial growth factor and subsequent involution of abnormal new vessels hence slowing fibro-proliferation and traction on the retina. It's thus desirable that whenever possible ablation therapy should be done before surgery. However this is not always possible as not all children are captured by the screening programs and so some show up when the retina is already extensively detached.

In our study the foremost complications were cataract in 5 (15.2%) eyes, vitreous haemorrhage in 5 (15.2%) eyes and glaucoma in 3 (9.1%) eyes. Similar complications have been reported by Choi *et al*[16].

Notably, of the 5 eyes in our study that developed vitreous haemorrhage post operatively, 4 (80.0%) eyes had plus disease. Hartnet[17] suggested that the presence of plus disease at the time of LSV could be a cause of surgical failure. In addition, Xu *et al*[18] reported better anatomic and visual outcomes in eyes with vascularly active disease that had undergone preoperative anti-VEGF injection compared to those that had not. They also reported no vitreous haemorrhage among those eyes that received anti-VEGF compared to 2 (20%) among those that did not. In spite of the benefits of anti-VEGF, the surgeon sometimes has no choice but to operate eyes with plus disease or risk further progression while waiting for regression.

A limitation of the current series is that it is a retrospective study. Secondly the visual acuity records were qualitative and thus limited the comparison we could draw to fully understand the impact of the operations. Thirdly, sample sizes in the sub groups were small

making generalizations difficult to draw. We also had a limited follow up as some patients were lost to follow up. That meant that long-term complications such as re-detachments could not be ascertained.

CONCLUSION

Our study shows that surgical and visual outcomes for stage 4A ROP are good while the outcomes for stage 4B and 5 are poorer. Surgeons should therefore endeavor to operate on the eyes with retinal detachment due to ROP early before the macula gets involved.

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Prevalence of keratoconus in patients with allergic conjunctivitis attending Kenyatta National Hospital eye clinic

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ABSTRACT

Objective: To determine the prevalence of keratoconus among patients with allergic conjunctivitis aged between 8 and 30 years, attending Kenyatta National Hospital eye clinic.
Methods: A cross sectional study of patients on follow up for allergic conjunctivitis. They were examined on the slit lamp, clinical signs of keratoconus were elicited, and then keratometry and corneal topography was done on each of them. The social demographic and clinical data was captured in a questionnaire. Descriptive analysis of the data was done to determine means, frequencies and proportions of the various variables. The relationship between the demographic characteristics of the patients, the duration and severity of allergic conjunctivitis, with keratoconus was assessed.
Results: Two hundred and forty six eyes of 123 patients were examined. Keratoconus prevalence was found to be 10.6% by clinical diagnosis, 14.6% by keratometry and 30.9% by topography. Majority of those diagnosed with keratoconus were aged 10 to 14 years (42.1%). The male: female ratio of those with keratoconus was 1.9:1, and among them 34.2% had moderate allergic conjunctivitis, and 42.1% had severe allergic conjunctivitis, which was statistically significant. Patients with allergy symptoms for more than 10 years formed the largest proportion of those with keratoconus (42.1%).
Conclusion: The prevalence of keratoconus in patients with allergic conjunctivitis was found to be high and the majority were male. Corneal topography diagnosed more patients with keratoconus, and therefore is highly recommended as part of the follow up investigations for all patients with allergic conjunctivitis. This will ensure early detection and management of the condition.

Key words: Keratoconus, Allergic conjunctivitis, Kenyatta National Hospital

INTRODUCTION

Keratoconus is a bilateral progressive disorder of the cornea, characterised by central or paracentral asymmetrical, non-inflammatory, corneal thinning and protrusion, assuming a conical shape. This induces irregular astigmatism, myopia and corneal scarring, which may cause mild to severe visual impairment. Onset is usually at puberty and the condition progresses up to the third or fourth decade. Progression may halt at any stage between mild to severe keratoconus.

The prevalence of keratoconus varies widely depending on geographical location, cohort of selected patients, diagnostic criteria used and ethnicity of patients. In the general population, it ranges from 0.3 per 100,000 as reported by Gorskova and Sevost'ianov in Russia, to 2,300 per 100,000 as reported in Central India by Jonas *et al*[1]. In the USA, keratoconus is estimated to affect 1 in every 2,000 people[2], while in Denmark Nielsen *et al*[3] reported the incidence of keratoconus of 1.3 per 100,000 per year, and a prevalence of 86 per 100,000.

Ethnicity has also been shown to influence the incidence and prevalence of keratoconus as demonstrated by Cozma *et al*[4] who found an incidence rate of 32.3 per 100,000 per year among Asians, and 3.5 per 100,000 per year among whites. It was also noted that the Asian patients were significantly younger at time of diagnosis than whites[4]. Keratoconus is associated with some genetic disorders, like Down's syndrome with a reported prevalence of 0.5% to 15% that is 10-30 fold of normal population. The hypothesis of hormonal involvement in keratoconus is supported by the fact that it generally begins at puberty and has also been shown to progress more during pregnancy[5].

A strong association between allergic conjunctivitis and keratoconus has been proven in various studies. For instance, Bawazeer *et al*[6] demonstrated that eye rubbing due to allergy was a major cause of keratoconus, whereas Lapid-Gortzak *et al*[7] found corneal topography patterns consistent with keratoconus in 15% of children with VKC but none in those without. Totan *et al*[8] found 26.8%, incidence of keratoconus among those with VKC which was associated with male gender, and mixed and palpebral forms of VKC. Similar findings were demonstrated by Shonja and Besharati[9] who found an incidence of 28% in Iran.

Few studies have reported the prevalence of keratoconus in Africa. In Gambia, Wade *et al*[10] found a prevalence of 0.9% of keratoconus, among patients with ocular allergy, where as in Rwanda, De Smedt *et al*[11] found 1.7% of the children had corneal astigmatism or keratoconus.Waweru and Bhaiji[12] did a study on vernal keratoconjunctivitis as seen at KNH, and he found 3% of the patients had keratoconus. The lower prevalence reported in Africa, compared to the West and Asia, could be attributed to the different methods of diagnosis, because in Africa keratoconus was diagnosed by clinical signs, while in the west, corneal topography was used, which detects earlier signs of keratoconus. This has been demonstrated in some studies where the prevalence of clinically diagnosed keratoconus was found to be lower than when corneal topography was used[8,13]. Keratoconus is best managed in the early stage for good visual prognosis. It is therefore necessary to have data demonstrating the importance of adopting corneal topography as a diagnostic tool in our set up.

MATERIALS AND METHODS

A hospital based cross sectional study was done at Kenyatta National Hospital eye clinic, where consecutive patients presenting for follow up for allergic conjunctivitis, were recruited into the study. The patients were aged between 8 to 30 years because keratoconus mostly develops between puberty and the 3rd decade of life[14]. Those with corneal ulcers, corneal scars from causes other than hydrops and those who did not complete the study were excluded. The patients were recruited from February 2016 to April 2016. Ethical approval had been obtained from Kenyatta National Hospital/University of Nairobi ethics and research board. Informed consent was obtained from all the adult patients participating in the study, and for those under the age of 18 years, consent was given by the parent/guardian while the child assented to the study.

Relevant history was taken from each patient, presenting visual acuity was recorded and clinical signs of keratoconus were demonstrated. Allergic conjunctivitis was graded according to severity as proposed by Bore and Ilako[15]. Clinical diagnosis of keratoconus was made if a patient had stromal corneal thinning by slit lamp evaluation accompanied by 1 or more of: Munson sign, irregular or crowded mires on hand held placido disc, scissoring on retinoscopy, or if they had stromal thickening due to hydrops. Diagnosis and grading of keratoconus using keratometry was done: mild keratoconus K<48D, moderate keratoconus K48-54D, severe keratoconus K>54D. Corneal topographic was done on each patient, and diagnosis of keratoconus was made using the Pentacam derived Amsler-Krumeich staging.

Statistical analysis was done using the Statistical Package for Social Scientists (SPSS) version 20.0. Study population was described using socio-demographic and clinical characteristics by summarizing categorical and continuous variables into percentages and means or medians respectively. Prevalence of keratoconus in allergic conjunctivitis was calculated as a percentage number of patients with 95% Confidence Interval (CI). Grade of keratoconus was correlated with the severity of allergic conjunctivitis using chi square test. Furthermore, presence of keratoconus was correlated with other variables such as age, sex, duration and severity of allergic conjunctivitis using chi square test for categorical variables and student's t test for comparison of means. All statistical tests were conducted at 5% level of significance (p value less or equal to 0.05).

RESULTS

The study had a response rate of 88%, and 246 eyes of 123 patients were examined (Figure 1).

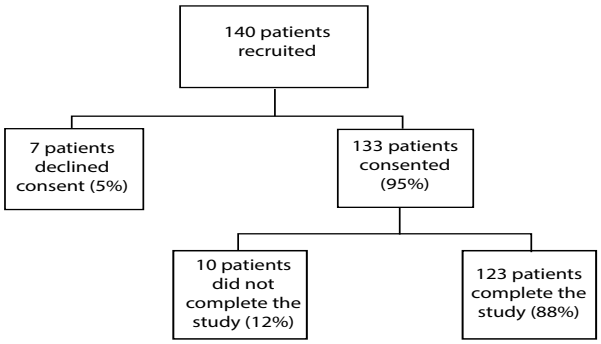
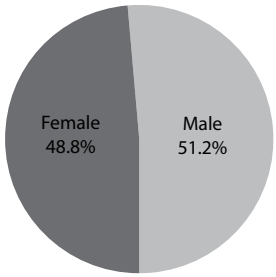


Figure 1: Flow chart of patients' recruitment



Male: Female ratio 1.05:1

Figure 2: Distribution of patients by sex

Most patients were aged 10 to 14 years (33.3%). The mean age was 16 years (SD ± 7), the range was 8-30 years. The median age was 14 years, and the mode 16 years (Figure 3).

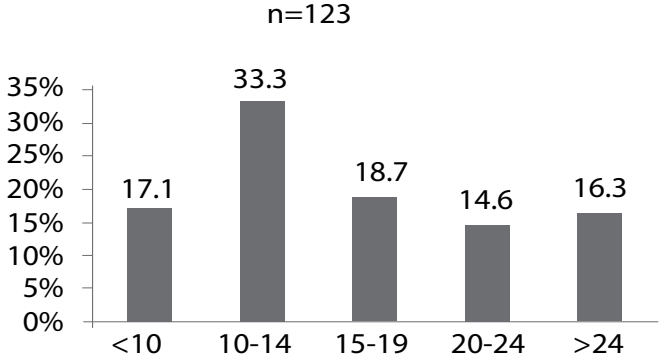


Figure 3: Distribution by age

The mean duration of allergy was 4.1 years with SD of 3.2 (Figure 4).

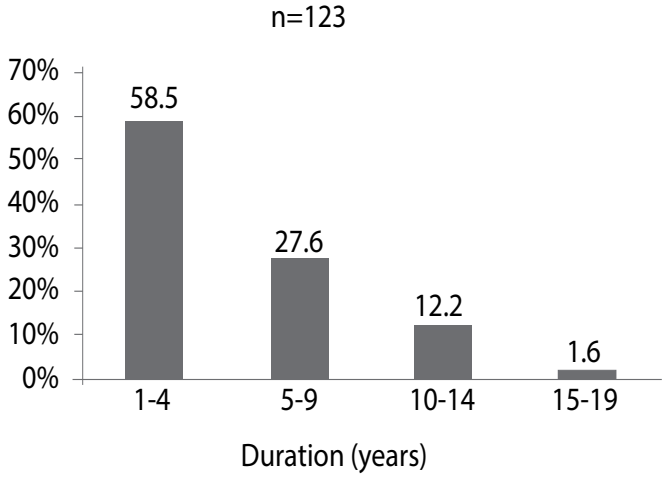


Figure 4: Duration of allergic conjunctivitis symptoms

Majority of the patients had mild allergic conjunctivitis, followed by moderate and severe (Figure 5).

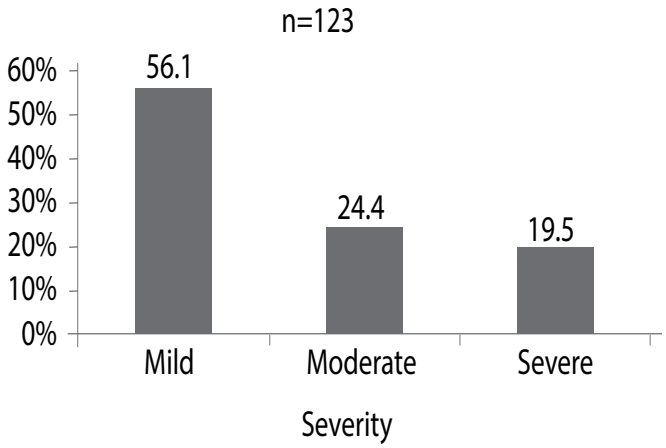


Figure 5: Severity of allergic conjunctivitis

The highest prevalence of keratoconus was diagnosed with topography, which was significant in comparison to clinical diagnosis and keratometry with p value <0.001 (Figure 6).

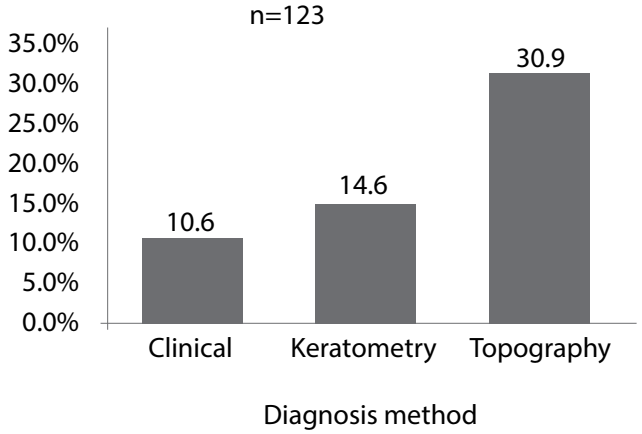


Figure 6: Prevalence of keratoconus

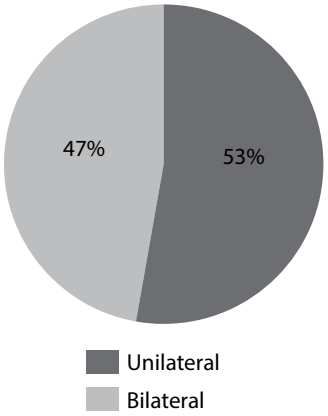


Figure 7: Keratoconus laterality

Most of the patients with keratoconus were between 10-14 years, followed by those aged 15-19 years.The mean age of the patients diagnosed with keratoconus was 14.9 SD 5.9 (Figure 8).

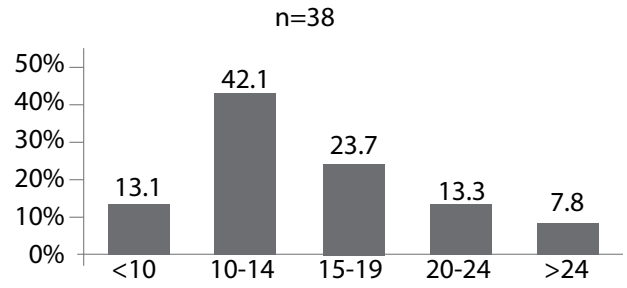


Figure 8: Distribution of patients with keratoconus by age

The proportion of patients with bilateral keratoconus increased with increase in age (Figure 9).

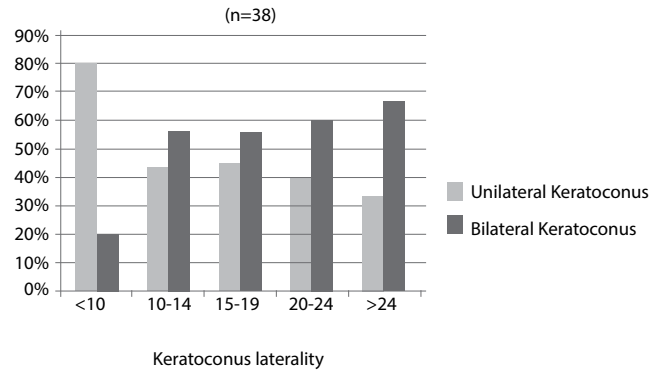


Figure 9: Distribution of keratoconus laterality by age

Table 1: Presenting visual acuity of all the eyes (246 eyes)

Presenting visual acuity	Keratoconus n (%)	No keratoconus n (%)
6/6-6/18	39 (17.5)	184 (82.5)
<6/18-6/60	9 (69.2)	4 (30.7)
<6/60-3/60	2 (100)	
<3/60	8 (100)	

Table 2: Keratoconus severity

Severity of keratoconus	Keratometry n=34 eyes n (%)	Topography n=54 eyes n (%)
Mild	4 (11.8)	18 (31)
Moderate	10 (29.8)	16 (27.6)
Severe	20 (58.8)	24 (41.4)

Thirteen eyes were diagnosed with keratoconus clinically, 3 of which had hydrops. Four of the eyes that were diagnosed clinically were found to have moderate keratoconus by keratometry, and 6 had severe keratoconus by keratometry. All the eyes that had keratoconus by clinical diagnosis, had severe keratoconus by corneal topography.

Table 3: Presenting visual acuity of the eyes with keratoconus (54 eyes)

Visual acuity	Mild keratoconus n (%)	Moderate keratoconus n (%)	Severe keratoconus n (%)
6/6-6/18	15(38.5)	14(35.9)	10(25.6)
<6/18-6/60	2(22.2)	3(33.3)	4(44.4)
<6/60-3/60	-		2(100)
<3/60	-		8(100)

All the patients with visual acuity less than 6/60 had severe keratoconus by topography.

Table 4: Factors associated with keratoconus

Variable	Corneal topography		OR (95% CI)	P value
	Keratoconus	No keratoconus		
Sex				
Male	25 (65.8%)	38 (44.7%)	2.4 (1.1-5.3)	0.031
Female	13 (34.2%)	47 (55.3%)	1.0	
Severity of AC				
Mild	9 (23.7)	60 (70.6)	1.0	
Moderate	13 (34.2)	17 (20.0)	5.1 (1.9-13.9)	0.002
Severe	16 (42.1)	8 (9.4)	13.3 (4.4-40.1)	<0.001
Allergies/asthma				
Yes	6 (15.8)	11 (12.9)	1.3 (0.4-3.7)	0.672
No	32 (84.2)	74 (87.1)	1.0	

Table 5: Association of duration of allergy with keratoconus

Duration of allergic conjunctivitis	Keratoconus	No keratoconus	OR (95% CI)	P value
Median (IQR)	5 (4-8)	2 (1-5)	-	0.001
Category, n (%)				
1-4 years	16 (22.2)	56 (77.8)	1.0	
5-9 years	13 (38.2)	21 (61.7)	2.2 (0.9-5.3)	0.088
>10	9 (53)	8(47)	5.3 (1.6-17.0)	0.006

The mean duration of allergy symptoms in patients with keratoconus was 5.8 years, SD 3.8.

DISCUSSION

Demographic characteristics: In this study, 246 eyes of 123 patients were examined (Figure 1). The male to female ratio was almost equal 1.05:1 (Figure 2), unlike in other similar studies where the male:female ratio was higher. Shoja and Besharati[9] found a male:female ratio of 1.7:1, and Totan *et al*[8] found a ratio of 3:1. This could be attributed to the fact that all types of allergic conjunctivitis were examined in this study unlike in the other studies where they looked at patients with VKC, which has been found to affect males more than females.

The patients' ages ranged from 8 to 30 years with the majority aged between 10 to 14 years (33.3%). The mean age was 16 years SD 7 (Figure 3). This is comparable to the study by Totan *et al*[8] and Shoja and Besharati[9] whereby the mean age (SD) in their studies was 15.04 (6.11) and 13.07 (4.71) respectively. This can be attributed to the fact that allergic conjunctivitis mainly affects patients between the ages of 5-20 years with a peak at 11 to 15 years[16]. A similar age distribution has been demonstrated in several studies including that done by Waweru and Bhaiji[12] at KNH.

Severity and duration of allergic conjunctivitis: Most of the respondents had symptoms of allergic conjunctivitis for duration of 1 to 4 years, with a mean duration of 4.1(SD 3.2) years (Figure 4). This duration is shorter by 1 year compared to what was found by Totan *et al*[8] of 5.52 ± 4.16 years and Shoja and Besharati[9] who found 5.12 ± 4.29 years. Allergic conjunctivitis was graded according to the criteria proposed by Bore and Ilako[15] which takes into consideration conjunctiva signs, cornea and limbal involvement. Majority of the patients had mild allergic conjunctivitis (56.1%), whereas 24.4% had moderate allergy and 19.5% had severe allergy (Figure 5).

Prevalence of keratoconus: The prevalence of keratoconus was found to be 10.6% by clinical diagnosis, 14.4% by keratometry and 30.9% of the patients had keratoconus by topographic criteria (Figure 6). The difference in the prevalence found by corneal topography was statistically significant when compared to keratometry and clinical diagnosis, with a p value <0.001. This is because topography diagnosed eyes with early signs of keratoconus, which did not have evident clinical and keratometry changes. This difference in prevalence depending on the diagnosis method compares to what Totan *et al*[8] found; 8.5% by slit lamp biomicroscopy, 18.4% by keratometry and 26.2% by corneal topography. It is also similar to what Dantas *et al*[13] found in Brazil where the prevalence was 9.85% by clinical diagnosis and a higher prevalence of 22.5% by topographic diagnosis. Shoja and Besharati[9] found a comparable prevalence of 28% in Iran after using topography to diagnose keratoconus.

This study found a higher prevalence of keratoconus by topography as compared to other studies, which could mean that the allergic conjunctivitis patients in our set up have a slightly higher prevalence of keratoconus than in other geographical regions, especially since Africa is considered as one of the regions with a higher prevalence of VKC. The topography diagnostic criteria should also be taken into account, and in this case the Pentacam

derived Amsler staging which was used, has been shown to have highly sensitive measures for early detection of ectatic corneal disorders[17].

The prevalence of keratoconus by clinical diagnosis in other studies is lower compared to what our study found. In Rwanda, De Smedt *et al*[11], evaluated children with VKC, and found 1.7% had keratoconus. Waweru and Bhaiji[12] also did an evaluation of patients with VKC at Kenyatta National Hospital and found 3% had keratoconus by clinical diagnosis. This can be attributed to the difference in clinical diagnostic criteria used, or the fact that the other two studies were generally evaluating all the clinical features in patients with VKC while this study concentrated on diagnosing keratoconus in patients with allergy, therefore picking more signs of keratoconus.

Of note is that, only two patients in this study had been diagnosed with keratoconus previously, while for the others this was the first time the diagnosis was made. This implies that most clinicians don't concentrate in looking for signs of keratoconus in patients with allergic conjunctivitis. It could also be attributed to limited resources for diagnosing keratoconus especially topography which was found to be more effective in diagnosing early keratoconus in this study.

Characteristics of patients diagnosed with keratoconus: Among the patients who were diagnosed with keratoconus in this study, majority were aged 10 to 14 years followed by those aged 15 to 19 years and the reported mean age 14.9 ±5.9 (Figure 8). The mean age of patients with keratoconus in this study is comparable to the mean age found in other studies; Dantas *et al*[13] found 13.9 ±4.3, Totan *et al*[8] found 15.78 ±4.728, and Shoja and Besharati[9] found 14.5 ±5.349. This is the same age group that forms the highest proportion of patients with allergic conjunctivitis, therefore the most likely to have keratoconus. Hormonal changes have also been postulated to have a role in pathogens on keratoconus which could also be one of the reasons why the incidence of keratoconus is high in the teenage years.

There was male predominance in those with keratoconus, a male: female ratio of 1.9:1 (Table 4). This has also been the case in the studies done by Totan *et al*[8], M:F=2.7:1, and Shoja and Besharati[9] M:F=1.8:1. Keratoconus has been associated with male sex in some studies, although the reasons are not well understood[18,19]. However, not all studies are in consensus with the male predominance theory, as some have found equal sex distribution while others have found female predominance, as highlighted by Gordon-Shaag *et al*[1].

Among the patients diagnosed with keratoconus, 47% had unilateral, whereas 53% had bilateral keratoconus (Figure 7). The proportion of those with bilateral keratoconus increased with increasing age. This can be explained by the natural course of keratoconus where by it has been found to be a bilateral but asymmetrical condition. It therefore means that if a patient is diagnosed with keratoconus in one eye they are likely to develop similar signs in the other eye at a later period as they get older.

In terms of keratoconus diagnosis and severity, clinical diagnosis picked 13 eyes, of which 3 presented with hydrops. The number of eyes diagnosed with keratoconus by keratometry was 34 and by topography 54 (Table 2). All the eyes diagnosed clinically were also picked by keratometry and topography. By keratometry, 6 of the clinically diagnosed eyes were graded as moderate and the rest as severe, whereas by topography, they were all graded as severe keratoconus. Clinical criteria picked the more advanced keratoconus in contrast to topography which picked more eyes with mild keratoconus (31%).This is not surprising because it has been proven that corneas with keratoconus exhibit topographic, tomographic and pachymetry changes way before slit lamp and clinically detectable signs[19].

In this study, most of the eyes presented with a visual acuity better than 6/18 followed in proportion by those who presented with visual acuity worse than 6/18 but better than 6/60 (Table 1). Most of the patients with keratoconus presented with visual acuity better than 6/18 (72%). Majority of them had mild to moderate keratoconus. All the patients who had visual acuity worse than 6/60, had severe keratoconus (Table 3). This shows that visual performance is not clearly predictable in keratoconus and can present with wide variation[17]. It also emphasises on the importance of diagnosing keratoconus in its early stages in order to intervene before the vision is severely impaired especially in our set up where corneas for PKP are not readily available.

In this study, 23.7% of the patients with keratoconus had mild allergy, 34.2% had moderate allergy which was statistically significant, with a p value=0.002, and 42.1% had severe allergy, which was also statistically significant with a p value <0.001 (Table 4).This could be attributed to the fact that patients with severe allergies are likely to rub their eyes more therefore causing more trauma to their corneas and release more immune mediators into the tears, which has been postulated to have a role in the pathogenesis of keratoconus[20] .

The mean duration of allergy symptoms among those with keratoconus was 5.8 ±3.6 (Table 5). This is slightly lower than that found by Totan *et al*[8] 6.65 ±4.75 and Shoja and Besharati[9] 7.65 ± 4.32. This implies that the patients in our set up may develop keratoconus much earlier than those of Turkey and Iran. Among the patients in this study, 53% of those who had allergy symptoms for >10 years had keratoconus compared to, 22.2% with symptoms for 1 to 5 years, and 38.2% with symptoms for 5 to 9 years, implying that the longer the duration of allergic conjunctivitis symptoms, the higher the proportion of those with keratoconus. This was statistically significant with a p value of 0.006 (Table 5). Patients with allergic conjunctivitis for more than 10 years were found to have a higher chance of developing KC. Emphasis should be put

on the follow up allergic conjunctivitis patients, to reduce both the severity and duration of the symptoms as they seem to have an impact on keratoconus.

Out of those diagnosed with keratoconus, 15% had other atopies (Table 4), but this association was not statistically significant in this study probably due to the sample size. However, the association between the two cannot be ruled out and more studies with larger sample size should be done to determine this.

CONCLUSIONS

The prevalence of keratoconus in patients with allergic conjunctivitis was found to be high and the majority were male. Corneal topography diagnosed more patients, especially those with mild keratoconus and good vision, compared to keratometry and clinical diagnosis. Long standing symptoms and moderate to severe allergic conjunctivitis were associated with a higher proportion of patients with keratoconus. Corneal topography is therefore recommended as part of the follow up investigations for patients with allergic conjunctivitis to ensure early detection and management of keratoconus. These patients can benefit from crosslinking which is known to slow down or stop keratoconus progression, thus reducing the need for keratoplasty. This is of great importance especially in our setup where corneal tissues are not readily available.

In areas with limited resources, all the patients on follow up for moderate or severe allergic conjunctivitis, or visual acuity of 6/18 or worse, should be referred to an ophthalmologist for corneal topography.

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Profile of amblyopia at Sabatia Eye Hospital

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ABSTRACT

Background: Amblyopia is a visual development disorder whose onset is in childhood. It becomes resistant to treatment after the critical age of 7 – 8 years when the visual system is estimated to have matured. Early diagnosis is vital to the prevention of visual impairment caused by amblyopia.
Objective: This study aims to determine the proportion and profile of amblyopia among children who presented at the Sabatia Eye Hospital in 2014.
Methods: This was a quantitative, hospital-based, retrospective case series. All children aged below 16 years who fit the amblyopia case definitions and were seen at Sabatia Eye Hospital between 1st January and 31st December 2014 were included in the study. The 2014 outpatient records were used to recruit the study population.
Results: A total of 268 patients (451 eyes) were recruited in the study from the 4,269 files assessed, giving a proportion of 6.3%. Most patients [183 (68.28%)] had bilateral amblyopia. Refractive amblyopia (56.54%) was the most common type and it was predominantly due to ametropia. Two thirds of children with refractive amblyopia presented after the age of 8 years. The second most common type of amblyopia was combined (31.49%) followed by sensory deprivation (9.31%) and strabismic (2.66%) amblyopia. Moderate amblyopia (58.47%) was more common than deep amblyopia (41.53%) and was predominantly due to refractive errors.
Conclusion: Refractive amblyopia is the most common type of amblyopia and has a predominantly late diagnosis. Pre-school vision screening programmes are recommended for early diagnosis and timely treatment.

Key words: Amblyopia, Paediatric ophthalmology, Kenya, Sabatia Eye Hospital, Strabismus, Refractive error, Sensory deprivation

INTRODUCTION

Amblyopia is a reduction in the best spectacle corrected visual acuity that cannot be attributed to any structural abnormality of the eye or the posterior visual pathways[1]. There are 3 main types – strabismic, refractive and stimulus deprivation amblyopia.

Vision normally develops when the brain is stimulated by a clear retinal image from each eye. If the retinal image is not clear, the brain learns to ignore images from this eye and use the clear image from the other dominant eye leading to amblyopia.

The first few months of life are the most vulnerable to amblyopia, and this vulnerability to induction of amblyopia decreases with increasing age. There is a critical period, estimated to be up to 7 - 8 years, when amblyopia is reversible using various treatments options because the visual system is still developing. At the end of the critical period, the visual system has usually developed to full maturity, and the decrease in visual acuity is irreversible. Delay in or lack of treatment results in a lifetime of irreversible visual impairment in one or both eyes. Early diagnosis is therefore vital in the prevention of blindness and visual impairment caused by amblyopia. Response to treatment varies based on age of the patient[1-3] depth of amblyopia[1-3], type of amblyopia[1,4], choice of therapeutic approach[1,3] and compliance with treatment[1,4].

The United Kingdom[5] and United States of America[6] have published recommendations for vision screening in children in order to pick up strabismus, amblyopia and refractive errors. In Kenya, the Maternal and Child health booklet includes an eye assessment at birth, 6 months and 9 months aimed at picking up squint and a white reflex.

It is notable that studies in Kenya[7,8] have shown amblyopia to be a cause of visual impairment and blindness in children. However, there is lack of amblyopia-specific studies in Kenya. This study was therefore justified given the fact that amblyopia is a treatable cause of low vision and blindness (with long term impact on quality of life and occupation in adulthood), and that treatment is more successful if started within the critical period of visual development.

The objective of this study was to determine the proportion of amblyopia among the children who presented at Sabatia Eye Hospital in 2014, to determine the different types of amblyopia, to determine the depth of amblyopia, and to assess the catchment area of these children.

MATERIALS AND METHODS

Design: Quantitative, hospital-based, retrospective case series study at Sabatia Eye Hospital, a tertiary/referral eye hospital in the rural setting of Vihiga County, western Kenya.

Study population: All children aged below 16 years who fit the amblyopia case definitions and were seen at Sabatia Eye Hospital between 1st January 2014 and 31st December 2014 were included. Missing files, and files with incomplete records were excluded.

Case definitions

Unilateral amblyopia
Quantitative visual acuity measurement: ≥2-line interocular difference in Best Corrected Spectacle Visual Acuity (BCSVA) or BCSVA of Snellen ≤6/12 (20/40) (LogMAR 0.3), AND amblyogenic risk factor (Strabismus, Refractive error, Stimulus deprivation), AND no other structural abnormality of the eye or the posterior visual pathways.
Qualitative visual acuity measurement: Strong fixation preference for one eye and inability to hold fixation with the non-preferred eye, plus unilateral amblyogenic factor, AND no other structural abnormality of the eye or the posterior visual pathways.

Bilateral amblyopia: Bilateral subnormal Best Corrected Spectacle Visual Acuity (BCSVA) [worse than 20/50 (6/15) (LogMAR 0.4) in 30 to 47 month old children, or worse than 20/40 (6/12) (LogMAR 0.3) in ≥ 48 month old children], AND either of evidence (past or present) of bilateral visual axis obstruction or bilateral ametropia (≥ 4.00D spherical equivalent hyperopia; ≥ 6.00D spherical equivalent myopia; ≥ 2.50D astigmatism), AND no other structural abnormality of the eye or the posterior visual pathways.

Strabismic amblyopia: Amblyopia (as per case definitions above) and heterotropia at distance or near fixation or a history of strabismus surgery and absence of combined amblyopia.

Anisometropic amblyopia: Amblyopia (as per case definitions above) AND anisometropia (≥ 1.00 D anisohyperopia or ≥3.00 D anisomyopia or ≥1.50 D anisoastigmatism) AND absence of combined amblyopia.

Ametropic amblyopia: Amblyopia (as per case definitions above) AND bilateral high ametropia (≥ 4.00 D hyperopia or≥ 6.00 D myopia or ≥ 2.50 D astigmatism) AND absence of combined amblyopia.

Meridional amblyopia: Amblyopia (as per case definitions above) AND potential visually significant astigmatism in both eyes (Regular astigmatism >1.00 D of astigmatism in any meridian or irregular astigmatism in both eyes) AND absence of combined amblyopia.

Sensory deprivation amblyopia: Amblyopia (as per case definitions above) and past or present visual axis obstruction by cataract, corneal opacities, vitreous haemorrhage, congenital ptosis, hyphema, occlusion amblyopia or any other media opacity and absence of combined amblyopia.

Combined mechanism amblyopia: A combination of the various types of amblyopia: Combined strabismic and refractive amblyopia; Combined strabismic and sensory deprivation amblyopia; Combined sensory deprivation and refractive amblyopia; Combined strabismic, refractive and sensory deprivation amblyopia.

Data collection methods

Outpatient records book was used to identify all children <16 years who were seen between 1st January to 31st December 2014. The files were perused to identify children who met the case definitions and in whom onset of the amblyogenic factor was before the age of 8 years. The study data collection form was filled out for each case of amblyopia and the data analyzed. Information collected included age at first presentation, residence, cycloplegic refraction, best corrected spectacle visual acuity, strabismus type, prism diopters and type of sensory deprivation.

Ethics

Written approval for the study was obtained from Sabatia Eye Hospital and the Kenyatta National Hospital - University of Nairobi (KNH/UON) Ethics and Research Committee.

RESULTS

A total of 268 children (out of the 4,269 files perused) met the case definitions and were enrolled in the study. Therefore 6.3% of the children who visited the hospital in 2014 had amblyopia. There were 136 (50.75%) male and 132 (49.25%) female children. Bilateral amblyopia [183 (68.28%)] was more common than unilateral amblyopia [85 (31.72%)]. Due to the bilateral cases, the total number of eyes in the study was 451.

Table 1: Types and subtypes of amblyopia (n = 451)

	Amblyopia type	No.		(%)
1	**Refractive amblyopia**	255		56.54
	a) Combined ametropia and meridional		108	23.95
	b) Pure ametropia		55	12.20
	c) Pure meridional		40	8.87
	d) Combined anisometropia and meridional		25	5.54
	e) Combined anisometropia, ametropia and meridional		21	4.66
	f) Combined anisometropia and ametropia		4	0.89
	g) Pure anisometropia		2	0.44
2	**Combined amblyopia**	142		31.49
	a) Combined sensory deprivation and refractive		109	24.17
	b) Combined strabismic, refractive and sensory deprivation		16	3.55
	c) Combined strabismic and refractive		11	2.44
	d) Combined strabismic and sensory deprivation		6	1.33
3	**Pure sensory deprivation amblyopia**	42		9.31
4	**Pure strabismic amblyopia**	12		2.66
	Total	451		100.00

There were 4 main types of amblyopia with refractive amblyopia (56.54%) being the most common and pure strabismic amblyopia (2.66%) being the least common type. The other two types of amblyopia were combined amblyopia and pure sensory deprivation amblyopia. Refractive amblyopia was further classified into 7 subtypes while combined amblyopia was further classified into 4 subtypes. Combined ametropic and meridional amblyopia (42.35%) was the most common sub-type of refractive amblyopia followed by pure ametropia (21.57%). Combined sensory deprivation and refractive amblyopia was the dominant (76.76%) subtype of combined amblyopia.

The two largest contributors to bilateral amblyopia were refractive (62.30%) and combined (27.87%) amblyopia (Figure 1).

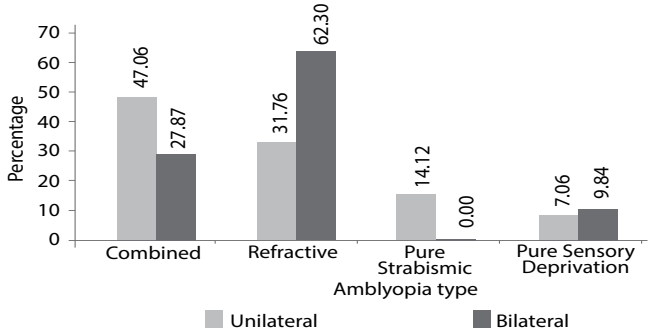


Figure 1: Bar chart showing the contribution of each amblyopia type to unilateral and bilateral amblyopia (n=451).

Half of the patients with all types of amblyopia first presented after the critical age of 8 years. The modal age at first presentation was 10 years (11.97%) (Table 2).

Table 2: Frequency distribution table showing age at first presentation for all amblyopia types (n=451)

Age (years)	Number of eyes	Relative frequency (%)	Cumulative %
<1	32	7.10	7.10
1	14	3.10	10.20
2	24	5.32	15.52
3	11	2.44	17.96
4	17	3.77	21.73
5	35	7.76	29.49
6	29	6.43	35.92
7	20	4.43	40.35
8	43	9.53	49.89
9	25	5.54	55.43
10	54	11.97	67.41
11	19	4.21	71.62
12	37	8.20	79.82
13	32	7.10	86.92
14	38	8.43	95.34
15	21	4.66	100.00
Total	451		

Only 32.16% of children with refractive amblyopia had their first presentation on or before the age of 8 years. In contrast, most of the children with pure sensory deprivation amblyopia (61.9%), pure strabismic (75%) and combined (76.06%) amblyopia had their first presentation to hospital on or before the critical age of 8 years (Figure 2).

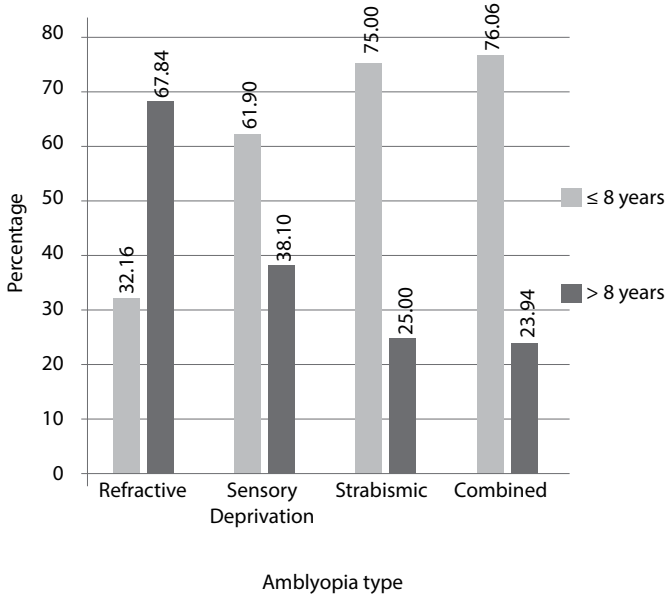


Figure 2: Age at first presentation for the four amblyopia types

The overall median age at first presentation was 9 years. It was highest for refractive amblyopia at 10 years and lowest for strabismic amblyopia at 3 years. It is notable that the modal age at first presentation for children with combined amblyopia was <1 year (Table 3).

Table 3: Measures of location for age at first presentation (n = 451)

	Amblyopia type	Age at first presentation		
		Mean	Median	Mode
1	Refractive Amblyopia	10.09	10	10
2	Sensory Deprivation Amblyopia	6.77	6.5	5
3	Combined Amblyopia	5.52	5	<1
4	Strabismic Amblyopia	4.40	3	4
	Total	8.19	9	10

Table 4: Measures of location for spherical equivalent based on amblyopia type and subtype

	Amblyopia type	Spherical equivalent		
		Mean	Median	Mode
1	Pure strabismic amblyopia	+0.60	+0.75	+1.00
2	Combined amblyopia	+0.19	-1.25	-1.38
3	Pure sensory deprivation amblyopia	-0.17	-0.38	-0.38
4	Refractive amblyopia	-8.05	-8.50	-9.00
	Total	-4.75	-5.00	-9.00

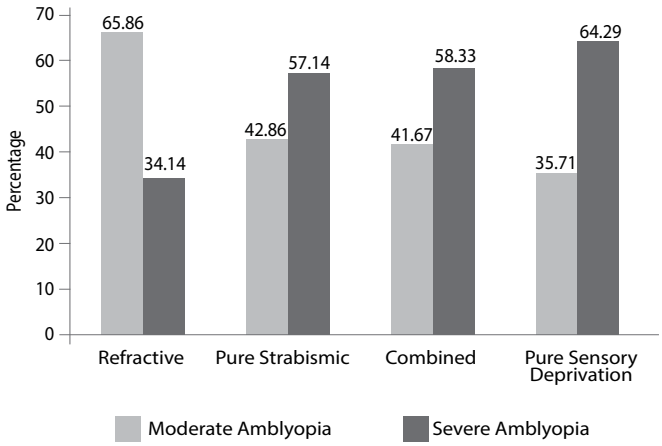
Eyes with refractive amblyopia were highly myopic

Causes of sensory deprivation: Sensory deprivation was an amblyogenic factor in 173 eyes (108 patients). Cataract was the most common (88.20%) cause of sensory deprivation. Other causes included corneal opacity, posterior capsule opacity, congenital pupillary membrane and congenital ptosis.

Type of tropia in the eye with strabismic amblyopia: Strabismus was an amblyogenic factor in 45 out of the 451 eyes enrolled in the study. Esotropia (67%) was found to be the most common form of strabismus, followed by exotropia (31%) and hypertropia (2%) (p-value 0.00).

Most (73%) of the eyes with strabismus were in the combined amblyopia category, as opposed to the pure strabismic amblyopia (27%) category.

Depth of amblyopia was predominantly moderate for refractive amblyopia (65.86%) [p-value 0.00] and predominantly severe for pure sensory deprivation amblyopia (64.29%) [p-value 0.04] and pure strabismic amblyopia (57.14%) [p-value 0.01] (Figure 3).



*354 of the 451 eyes had quantitative amblyopia assessment. The remaining 97 (21.51%) had a qualitative amblyopia assessment.

Figure 3: Clustered bar chart showing the percentage of moderate and severe amblyopia for the four amblyopia types (n=354*)

All the patients came from the Western and North-Western parts of Kenya. Most of the patients came from Kisumu county (19.78%) followed by Kakamega county (13.81%) and Vihiga county (12.69%) (Figure 4).

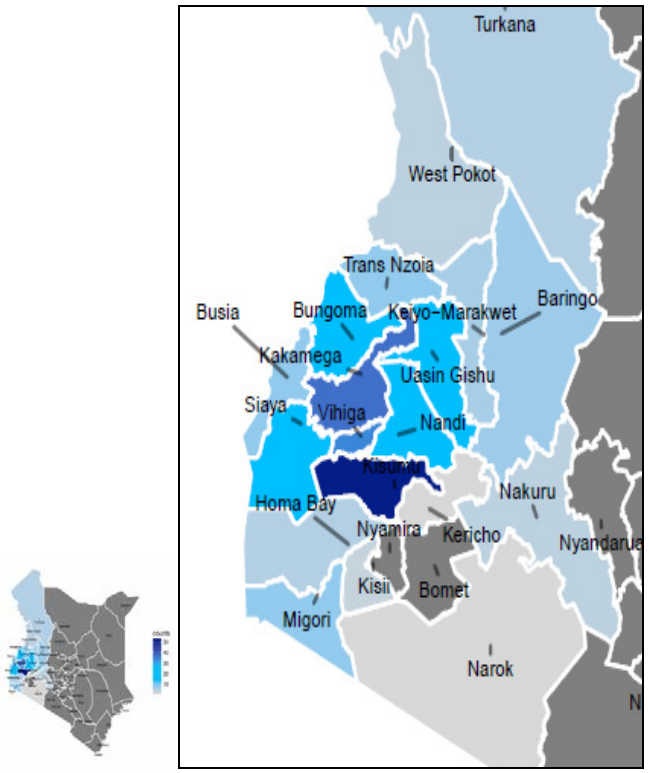


Figure 4: Catchment area for all children with amblyopia (n=268)

DISCUSSION

Proportion: This study found that 6.3% of the children aged <16 years who attended Sabatia Eye Hospital outpatient eye department in 2014 had amblyopia. This proportion was found to be 9.1% at Menelik II Hospital paediatric ophthalmology clinic in the capital city of Ethiopia[10] and 14.3% at Grarbet Eye Hospital outpatient eye department in rural Ethiopia[11].

The type of hospital setting where the patients present may have an influence on the proportions obtained in various studies, that is, whether they presented to a general or eye hospital; the general outpatient eye department[9,11,12] or to a specialized paediatric ophthalmologist[10,13] or orthoptic clinic[12,14,15].

This proportion of 6.3% gives us an indication of the burden of the disease in this rural hospital and is useful for planning purposes. The proportion may seem relatively low, but is actually significant considering that these are children who still have many years ahead of them. The Disability-adjusted Life Year (DALY) and Quality-adjusted Life Year (QALY) will be affected significantly in the children with unilateral amblyopia, while blind-person years will be increased for the children with untreated severe bilateral amblyopia.

Demographics: The number of male [136 (50.75%)] and female [132 (49.25%)] patients was almost equal. This finding is similar to that of Woldeyes *et al*[10] in Ethiopia where 49.7% were male while 50.3% were female. Bilateral amblyopia [183 (68.28%)] was more common compared to unilateral amblyopia [85 (31.72%)] [p-value of 0.00]. This is explained by the finding that 94 patients (35.07%) in this study had ametropia which by definition is bilateral. Additionally, 60 patients (22.3%) had bilateral sensory deprivation due to bilateral cataract. In contrast, Woldeyes *et al*[10] found 88% of cases were unilateral and the most common cause of amblyopia was strabismus.

Types and subtypes of amblyopia: Comparison of the types of amblyopia among different studies was challenging due to the variation in classifications and specific case definitions among the different studies. For example, in the "ametropic amblyopia" case definition, Chua *et al*[12] and Menon *et al*[14] used a cut-off of >1D spherical equivalent, while Woldeyes *et al*[10] used >1.5D spherical equivalent. This study's cut-offs (≥ 4.00D spherical equivalent hyperopia, ≥ 6.00D spherical equivalent myopia and ≥2.50D astigmatism) were based on the Multi-Ethnic Pediatric Eye Disease Study Group (MEPEDS)[17] and Baltimore Pediatric Eye Disease Study (BPEDS)[18] which are cognizant of the normal variations in refractive status of younger children and that high (not low) bilateral refractive errors are amblyogenic.

It has been widely reported in various books[1] and studies[10,12,15] that strabismus is the most common cause of amblyopia. However, refractive amblyopia was the most common type in this study. It is not uncommon for an amblyopia study to find high proportions of refractive amblyopia compared to strabismic amblyopia. Ganekal *et al*[16] had results that are quite similar to this study in that a large proportion of eyes had refractive error and few had strabismus – ametropia 50%; anisometropia 40.9%; strabismus 6.8%. Anisometropic amblyopia was the most common type in studies by Sharma *et al*[13] (33.33%) and Høeg *et al*[19] (45.5%). Chia *et al*[20] in Singapore found refractive (85%) to be the most common amblyopia type followed by strabismus (15%) with the most frequent refractive errors being anisometropia (42%) and isometropia / ametropia (29%).

The high proportion of refractive amblyopia in this study is suggestive of a high population prevalence of refractive errors which are diagnosed late. A screening programme would therefore be useful.

Age at first presentation: Late presentation was mostly attributable to refractive amblyopia as 67.84% presented after the age of 8 years unlike sensory deprivation (38.1%), strabismic (25%) and combined (23.94%) amblyopia. Possible explanations are that pure refractive amblyopia does not have an outwardly visible manifestation, tends to give a moderate rather than severe amblyopia which is easier to miss, and the child is unlikely to complain of poor vision. The interquartile range for refractive amblyopia (8 to 13 years) is the school going age. It's therefore likely that poor visual acuity was picked up when the child started going to school and noted to have difficulty seeing the blackboard. In contrast, the interquartile range for sensory deprivation (2 to 10.75 years), strabismic (0.96 to 5.5 years) and combined amblyopia (2 to 8 years) included the pre-school years.

The modal age at first presentation for combined amblyopia was <1 year. The most likely explanation for this is that the multiple amblyogenic factors in combined amblyopia cause a more severe amblyopia and when combined with a visible manifestation (like squint or cataract), would cause the parent or guardian to seek medical care early. Woldeyes *et al*[10] in Ethiopia found an overall median age of 7 years which is relatively close to this study (9 years).

The overall mean age at first diagnosis of 8.19 years in this study is comparable to Menon *et al*[14] in India (7.97 ± 6.18 years), and Sapkota *et al*[9] in Nepal (7.74 ±2.97 years). In sharp contrast, the mean presenting age for Chua *et al*[12] in Australia was 32.9 months (≈2.7 years) and 4.0 years for Woodruff *et al*[15] in United Kingdom. These are countries with relatively good health and referral systems resulting in earlier diagnosis. Additionally, United Kingdom is known to have established pre-school vision screening programmes.

Depth of amblyopia: This study found moderate amblyopia (<0.7 LogMAR BCSVA) to be more common (58.47%) than severe amblyopia (≥0.7 LogMAR

BCSVA). This can be explained by the fact that the most common amblyogenic factor was refractive which is known to cause a milder amblyopia than strabismic or sensory deprivation[1].

A breakdown of type versus depth of amblyopia found that most refractive amblyopia (65.86%) was moderate [p-value 0.00] while most pure sensory deprivation amblyopia (64.29%) and pure strabismic amblyopia (57.14%) were severe [p-value 0.04 and 0.01 respectively]. Menon *et al*[14] had similar findings in that the BCSVA in the amblyopic eye showed a significant association with the diagnosed subtype of amblyopia ($p<0.001$). Additionally, the proportion of severe amblyopia (41.53%) in this study is similar to those found by Sapkota *et al*[9] (40%).

For combined amblyopia, the difference between moderate (41.67%) and severe (58.33%) amblyopia was not statistically significant. Combined amblyopia is therefore just as likely to cause deep amblyopia as it is likely to cause moderate amblyopia. This is probably due to the wide variability that can be obtained with different combinations of the amblyogenic factors.

Depth of amblyopia could not be established in 97 eyes (21.51%) because they had a qualitative assessment of amblyopia. This is similar to Woodruff *et al*[15], where 20% had qualitative assessment of amblyopia. In the Woldeyes *et al*[10] study, 8.3% of patients had a qualitative amblyopia assessment.

Catchment area: The children came from the Western and North-Western parts of Kenya with the highest proportion coming from Kisumu county followed by Kakamega and Vihiga counties. These are therefore the areas that could be initially targeted when initiating a pre-school vision screening programme. Most of the counties listed are largely rural and therefore there may be a challenge in accessibility to specialized paediatric eye care.

STUDY LIMITATIONS

The retrospective study design is a limitation as it is dependent on availability of files, as well as accuracy and completeness of record keeping.

CONCLUSIONS

The burden of amblyopia at Sabatia Eye Hospital is estimated to be 6.3%. Refractive amblyopia is the most common type, has a late diagnosis, and was predominantly due to ametropia which is bilateral. Moderate amblyopia is more common than deep amblyopia, and is predominantly due to refractive errors. The patients came from the Western and North-Western parts of Kenya.

RECOMMENDATIONS

There is need to standardize amblyopia case definitions for the purposes of comparison among various studies. Pre-school vision screening programmes are recommended for early diagnosis and timely treatment of refractive errors.

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Developing a sustainable and scalable control programme for Retinopathy of Prematurity in Kenya: a health system perspective

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ABSTRACT

Disease-control programmes have an important role to play in strengthening health systems to deliver the interventions they recommend. In low and middle income countries, there is a shortfall in the coverage of interventions for primary, secondary and tertiary interventions for the control of Retinopathy of Prematurity (ROP)-related childhood blindness and visual impairment. We need strong health systems to ensure prevention, timely diagnosis and access to effective care for ROP. If a health system strengthening approach is employed as ROP interventions are being planned, health system issues that will affect implementation and outcomes can be identified.

Key words: Retinopathy of Prematurity, Health systems, Kenya

The challenge of ROP

Retinopathy of Prematurity (ROP) is a sight-threatening disease associated with abnormal vascularization of the retina in premature infants. Each year, 15 million babies are born preterm worldwide, and over 30,000 of them become visually impaired or blind from ROP[1]. A recent study in Nairobi, Kenya found that 41.7% of premature babies screened for ROP in one hospital had ROP[2]. The main risk factors for ROP are gestation of ≤32 weeks (term gestation is 37-42 weeks), and very low birth weight (VLBW, ≤1500g)[3,4]. ROP is not present at birth, but develops in the first few weeks of life in infants at risk. Although blindness from ROP is avoidable, vision lost from ROP usually cannot be restored. The affected neonates risk life-long blindness with high costs, including reduced quality of life[5].

With the increase in the survival of preterm babies in most parts of the world, ROP has become a leading cause of preventable childhood blindness[6]. Low and Middle-Income Countries (LMICs) are particularly vulnerable to rapid increase in the burden of ROP, because improved access to neonatal services has led to increased survival of VLBW and premature babies[7]. The health systems in LMICs are already overstretched, for instance due to a severe health workforce crisis. This means that neonatal services for screening, detection and treatment of ROP are often less than optimal, which in turn increases the risk of sight-loss from ROP. These trends draw attention to the role of context in ROP control programmes, and the necessity of strengthening health systems.

Good antenatal perinatal and neonatal care, early detection and treatment are key to controlling ROP-related visual loss. The path to developing sustainable ROP control programmes that model these interventions particularly in LMIC is multi-pronged. Investment in the different aspects of the health system would determine the extent to which such a programme will be successful. In Kenya, a technical working group is taking forward the agenda of the Kenya retinopathy of prematurity control programme. This includes development of national clinical practice guidelines. The deliberations of this group have provided an opportunity for convergence and reconciliation of both health system perspectives and technical ROP-specific perspectives. In this article we consider the vital importance of taking a health system perspective when planning programmes for control of ROP.

How can we strengthen the health system for prevention of blindness from ROP?

What does it take to prevent one premature/VLBW infant from blindness from ROP? Primary prevention of ROP can

be achieved through optimal neonatal care[8]. Secondary prevention of ROP is also achievable through:- screening for ROP within the first 30 days of life, urgent treatment for babies with sight-threatening ROP and appropriate follow-up to identify other conditions that can cause vision loss, such as refractive error or strabismus. Tertiary prevention includes surgical procedures for advanced ROP.

The overall goal of an ROP control programme is to reduce the prevalence and incidence of avoidable blindness and visual impairment caused by ROP in the population. A successful disease control programme strengthens the existing health system to enable it to deliver the programme interventions[9]. The World Health Report in 2000 defined a health system as 'all organizations, people and actions whose primary intent is to promote, restore or maintain health'[10]. The World Health Organization's (WHO) health systems framework has identified six inter-related building blocks of a well-functioning health system (Figure 1): leadership and governance; medicines and technologies, health management information systems; the health workforce; service delivery and financing. This framework is widely used, and has already been found to be a useful tool for planning for eye care services such as cataract services and diabetic retinopathy services[9,11].

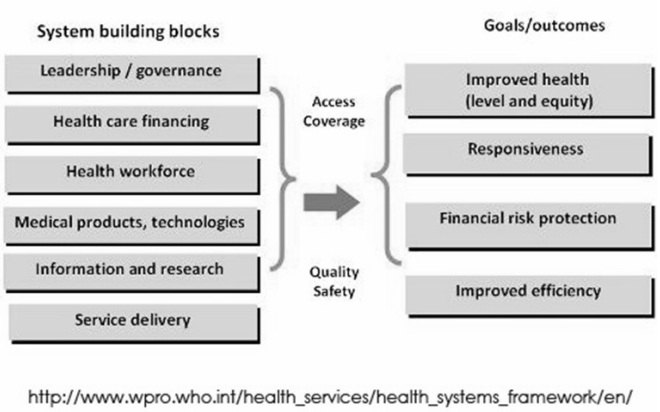

Figure 1: The WHO Health Systems Framework

Building on the WHO framework, Kenya has added two other building blocks in the Kenya Health Policy Framework (2014-2030), (health infrastructure, research and development)[12]. A recent Eye Health System Assessment (EHSA) in Kenya identified lack of capabilities to mobilise resources for implementation and sustenance of eye care services as one of the key weaknesses[13]. The health system of each country is unique, and unrecognized weaknesses in the building blocks can be a barrier to an effective national response to ROP. The following considerations emerged during the discussions of the ROP technical working group.

Leadership and governance: Is crucial for stakeholder coordination, mobilisation of resources, effective decision-making and accountability of all the actors. Some of the questions the ROP programme has considered are: What should be included in the clinical practice guidelines? How can teamwork be fostered between neonatal services and eye care services? As managing ROP is broader than just a public sector response, how can public –private institutional partnership be implemented to improve access to services? Advocacy is particularly an important facilitator for mobilising the necessary equipment for neonatal care, including oxygen delivery and monitoring systems. The targeted actors will include policy makers; professional societies; managers of neonatal and eye care programmes; private practitioners, training institutions, and parents of newborn babies.

Service delivery: What is the coverage of interventions such as antenatal corticosteroids given within 48 hours before preterm delivery? How can neonatal care be improved? How can mothers be encouraged to play their role in the care of the infant, such as breastfeeding or kangaroo care? What ROP screening and treatment criteria will apply in the country? How can absence or interruptions in these services be avoided? How can adverse outcomes at screening and treatment be monitored? What are the referral pathways for ROP?

Human resource for health: Are there sufficient numbers of neonatologists/paediatricians, paediatric ophthalmologists/general ophthalmologists or vitreo-retinal surgeons, and nurses? Are staff distributed where their services are needed? How do we embark on capacity-development at pre-service? Can an education package be provided as on-job training locally to increase the capacity of the health workers? How can we be sensitive to the time constraints and competing priorities that will be faced by these clinicians?

Health finance: How much does ROP screening and treatment cost? Cost is often a significant barrier to access and quality of care. How can we advocate for funding to meet any finance gaps? How can the cost of retinal laser, anti-Vascular Endothelial Growth Factor (anti-VEGF) treatment or vitreo-retinal surgery be driven down? What about the cost of equipment, training, space and human resources for the ROP programme - how can additional and sustainable financing be invested in these areas? Can technology such as telemedicine reduce the costs and improve efficiency in the programme? How do we measure the allocative and technical efficiency of these investments?

Pharmaceuticals and other medical products: Access to drugs and laser must be considered. How can supply-chain management for the drugs be improved? The majority of the neonates at risk will only require a screening examination; but this also requires medicines such as topical analgesics and mydriatics. Fewer of the neonates require retinal laser treatment or intraocular injections, and even fewer need surgery. However these

services need to be available at short notice, which calls for flexibility in the supply chain and availability of the equipment.

Health Management Information System (HMIS): What data needs to be collected in the programme? How is this data captured in the registers or other records? Some of the process indicators are: percentage of babies meeting the screening criteria who receive at least one ROP screening examination; percentage of babies meeting the treatment criteria who receive the appropriate intervention; and percentage of babies needing ROP treatment who are treated within 48 hours of the decision to treat. How will the monitoring and evaluation framework be implemented?

Health infrastructure: Optimal neonatal care requires adequate equipment in the newborn unit, such as temperature monitors, oxygen blenders, pulse oximeters and technologies for infection control. The screening examination requires the use of cameras, indirect ophthalmoscopes, lenses, and eye speculums. Sterilization facilities, sterile facilities for administration of anti-VEGF, and indirect laser facilities are also required.

Research and development: There is need to advance research, beginning with a nationwide needs assessment for ROP services in newborn units. The number needed to screen for one infant with sight-threatening ROP to be identified in this population needs to be investigated. The research agenda should also include innovative approaches to implement the ROP programme in a country with inadequate neonatologists, ophthalmologists and nurses. As most of the equipment and human resource required need not be specific to ROP, research is necessary to determine marginal cost of the programme. It is also important to identify the contribution of the programme to reducing the ROP burden and strengthening national capacity to handle ROP.

Sustainability and scaling up of the ROP programme

The main outputs of the health system for ROP are increased access and improved quality of care. To achieve these, the ROP programme will need to be sustainable in all the health system building blocks. Strong and sustainable health systems focus on primary care, which in the case of ROP includes strengthening antenatal care (to reduce premature or VLBW births), neonatal care and ROP screening. Interventions to improve neonatal care are essential to the programme as they reduce the development of the disease. More importantly, optimal neonatal care reduces the risk not only of developing ROP, but also other causes of neonatal morbidity and mortality. Similarly, screening provides an opportunity for identifying and treating other sight-threatening conditions such as congenital cataract and retinal diseases, besides ROP.

Three main issues are likely to contribute to the success of the ROP programme: integration with the health system, collaboration between neonatal and ophthalmic services, and leadership (Figure 2). As these factors are vital to the long-term success of the programme, the way they will be implemented should be well articulated. The success of the ROP programme should also be measured not just on the medical benefits but also on the health system benefits.

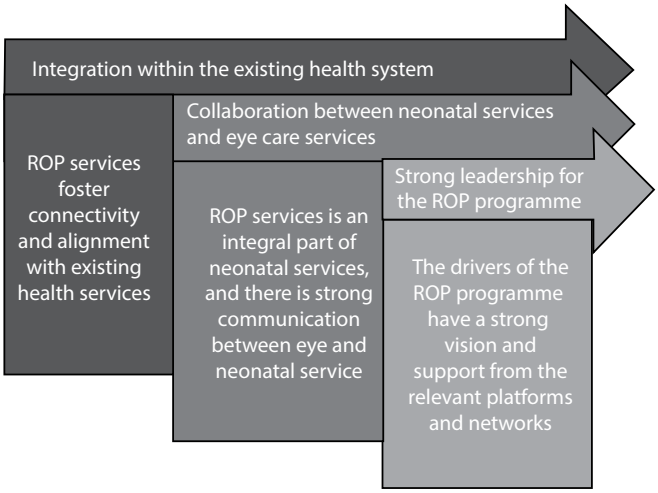

Figure 2: Potential success factors for the Kenya ROP programme

CONCLUSION

Delivering ROP care through the ROP programme must be pragmatic, synergistic, and simultaneously advance both medical and health system goals. Given that other countries are also developing national programmes for ROP, sharing the health system perspective can help address potential barriers to implementation and scale up of the programmes.

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Traumatic central retinal artery occlusion with optic neuropathy: a case report

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ABSTRACT

Traumatic optic neuropathy with central retinal artery occlusion is rare. We report a case of an 11 year old male patient who presented with poor vision in the left eye after blunt trauma to the forehead. The visual acuity was light perception and he had relative afferent pupillary defect. Examination and investigations revealed optic neuropathy with central retinal artery occlusion and patent cilioretinal artery. In spite of treatment with oral prednisolone for 2 weeks the visual acuity remained light perception after 3 months of follow up. The right eye was found to be normal. Traumatic central retinal artery occlusion is rare but should be ruled out in patients with poor vision due to trauma to the head.

Key words: Traumatic optic neuropathy, Central retinal artery occlusion, Cilioretinal artery

INTRODUCTION

Central Retinal Artery Occlusion (CRAO) is the occlusion of the central retinal artery with resultant infarction of the retina and vision loss[1]. It's an emergency and the ocular analogue of brain stroke[2]. CRAO occurs mainly among the elderly with evidence of artheromatous emboli[3]. Cases in young patients are often associated with systemic conditions such as hyperhomocysteinemia, antiphospholipid antibody, thrombocytosis, vasculitis, occasionally cardiovascular risks etc[3-5].

Though reported before[6-9], blunt trauma remains a rare cause of CRAO, especially in association with Traumatic Optic Neuropathy (TON). We present a case of an 11 year old male patient with TON and CRAO with cilioretinal artery sparing following blunt trauma to the head.

CASE REPORT

An 11 year old male patient presented to us 5 days after blunt trauma to the forehead with sudden loss of vision in the left eye. There was no associated headache, loss of consciousness, convulsion or drowsiness. There was also no rhinorhoea or otorhoea. He had no complaints about the right eye. He had no known chronic illnesses.

On examination, the right eye was found to be normal with visual acuity of 6/6. In the left eye the visual acuity was light perception (PL), he had a Relative Afferent Papillary Defect (RAPD), and fundoscopy revealed a swollen optic disc and a pale edematous retina in the posterior pole with a cherry red spot at the macula. There was also an area adjacent to the optic disc, which maintained the normal retina colour, though this did not extend to the fovea. Fundus Fluorescent Angiogram (FFA) showed delayed arterial filling and an enlarged foveal avascular zone. The Optical Coherent Tomogram (OCT) showed hyper-reflective and swollen inner layers of the retina with shadowing of the outer layers and cystic space within the fovea.

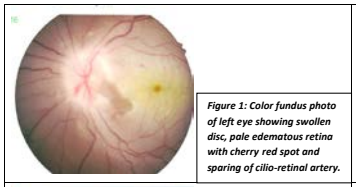

Figure 1: Color fundus photo of left eye showing swollen disc, pale edematous retina with cherry red spot and sparing of cilio-retinal artery.

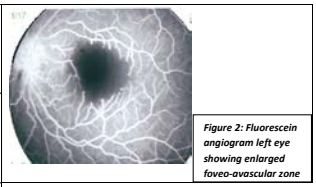

Figure 2: Fluorescein angiogram left eye showing enlarged foveo-avascular zone

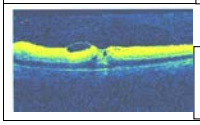

Figure 3: OCT left eye showing thickened hypereflective inner retinal layers with shadowing of the

Systemic examination showed normal blood counts, normal blood sugar, normal kidney function tests and normal total cholesterol levels at 187mg/dl (reference: <200mg/dl). However, he had elevated serum Low Density Lipoprotein (LDL) at 148mg/dl (reference: <130mg/dl) and Low High Density Lipoprotein (HDL) of 19mg/dl (reference:>35mg/dl). The blood pressure was normal at 100/60mmHg, Electro-Cardiogram (ECG) revealed sinus tachycardia and the echocardiogram was normal. CT scan of the brain and orbit revealed tissues swelling of the canalicula portion of the optic nerve but no fractures.

The patient was diagnosed with TON and CRAO with cilioretinal artery sparing. He was subsequently put on oral prednisolone 20mg once per day in the morning for 2 weeks and then tapered off over a period of one week. On subsequent follow up three months later the visual acuity was still PL, the optic disc showed signs of atrophy and the retina remained opalescent.

DISCUSSION

CRAO occurs mostly in the elderly patients with cardiovascular risk factors leading to artheromatous

emboli. In children the condition is rare and when it occurs an underlying systemic cause is often present[3]. Blunt trauma is a very rare cause of CRAO with TON. Our patient had suffered blunt trauma to the forehead and investigations also revealed a deranged lipid profile with high LDL levels and low HDL.

The mechanism of CRAO in blunt trauma is not fully understood. Some of the mechanisms hypothesized include direct compression of the optic nerve, the central retinal artery and vascular supply to the optic nerve[10]. This could be due to edema of orbital tissues, haematomas or direct impingement by bony spicules. Compression forces transmitted to the orbital apex cause a compartment syndrome whereby compression leads to a vicious cycle of swelling and ischemia.

The role of endothelial disruption due to sudden stretching of the vessels with subsequent clot formation has also been ascribed[9]. This is augmented by vaso-spastic response which is part of the normal clotting cascade[7]. The end result is ischemia to the retina and optic nerve with resultant profound loss of vision.

Few reports have been published of TON with CRAO. Cumurcu[10] wrote of a 10 year old child with blunt trauma to the left eye with subsequent total loss of vision in that eye. He was diagnosed with TON and CRAO and received bolus high dose steroids for 72 hours followed by oral steroids without improvement in visual acuity.

Vianna[6] reported a case of traumatic parafoveal arteriolar obstruction and TON in a 32 year old male who also suffered from systemic lupus erythematosus. The patient had suffered blunt trauma to the right eye and developed poor vision within hours. In that patient too, the visual acuity remained poor (HM) despite treatment with oral prednisolone 60mg per day. Karna *et al*[9] also reported a case which had poor outcomes in visual acuity.

In spite of being treated with oral steroids the visual acuity remained PL in our patient. There's generally no consensus on the management of optic neuropathy due to trauma[11] and the few case reports on CRAO with TON point to disappointing outcomes irrespective of the treatment regimen employed[6,10]. The international optic nerve trauma study[12] concluded that neither corticosteroids nor optic canal surgery should be considered the standard of care for patients with traumatic optic neuropathy. It is therefore clinically reasonable to decide to treat or not treat on an individual patient basis.

As far as we know, ours is the first case with TON and CRAO in which the cilioretinal artery remained patent. However the vision was still poor, likely because the area supplied by the cilioretinal artery in this patient did not include the foveal area and also because of the optic neuropathy.

In conclusion, though rare, CRAO can occur in blunt trauma and should be watched out for by clinicians as they manage patients with trauma. Even so, a search for underlying systemic conditions must be carried out to rule out other covert risk factors.

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