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OCULAR INJURIES IN CHILDREN
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ABSTRACT

Objectives: **To describe the epidemiology, referral system and visual outcomes of eye injuries in children.**
Design: **Retrospective case series.**
Setting: **Kenyatta National Hospital (KNH) Nairobi, Kenya.**
Subjects: **Children aged upto 15 years with eye injuries hospitalised between January 1st, 2000 and December 31st, 2004.**
Results: **There were 182 cases. Male: female ratio was 2: 1. Median age was seven years (IQR 4-10) with bimodal peaks at four and seven years. The most common cause (35%) was sticks. One hundred and twenty seven cases (70%) were open- globe injuries. One hundred and fourty one (77%) presented with visual acuity worse than 6/60 seven eyes were badly damaged and were removed (evisceration enucleation). Ninety five children (52%) were referred from Central and Eastern provinces while 87 (48%) were from Nairobi province. Most [26 (31%)] cases in Nairobi were from Kibera, Dandora and Kariobangi. Median duration between injury and arrival at first medical facility was one day but three days from injury to KNH after referral. Only 29% got tetanus toxoid, antibiotics, analgesics or eyepads at the referring facility. Median hospitalisation was seven days with a median bill of KSh 5,275/= (US$ 70.00). Fourty four children (24%) had their bills waived for inability to pay. At the last recorded follow-up 81 (57%) children had better visual acuity, 16.9% had light perception (PL). Corneal scar was the most common complication.**
Conclusions: **Eye injuries in KNH are severe, mostly affecting pre-school children from low-income settings. There is delay in arriving at KNH and inadequate care at the referring centres. Outcomes were poor although better than on admission. This may affect education, careers and quality-of-life. Injury-prevention programmes are recommended.**

INTRODUCTION

Trauma to the eye among children in both developed and developing countries occurs most commonly at play in the home environment (1-4). Ocular trauma is the most common cause of monocular blindness in children (5). The impact of trauma has been difficult to capture in public health since the WHO definition of blindness takes into account vision in both eyes yet most trauma is monocular. The economic burden of ocular trauma in children is also difficult to appreciate and measure as children are not at an economically productive age (6, 7). The disability-adjusted life-years of an injured child are more than an adult since the child lives longer with the disability caused by the injury (8,9).

Ocular injuries in children are particularly challenging. Children are prone to amblyopia if there is delay in visual rehabilitation and this can affect future education and career choices. Affected children may be unable to pursue careers that require stereopsis such as aviation or ophthalmic surgery. Visual outcomes and physical disfigurement may severely affect future psychosocial and cognitive

development (10). Anaesthesia for children with penetrating eye injuries is particularly complicated requiring special skill (11).

Legislation and various prevention programmes exist for eye injuries especially those related to adults and occupations. There is inadequate routine data on the epidemiology of ocular trauma in children in developing countries. Such data may be useful for research, planning clinical care and for advocacy. International initiatives like the World Eye Injury Registry (WEIR) developed by the International Society for Ocular Trauma (ISOT) are now collecting data and have proposed a common platform for classification of eye injuries called the Birmingham Eye Trauma Terminology System (BETTS) (12).

This study was conducted in order to (i) describe the epidemiology of eye injuries seen in children referred to the national referral hospital in Kenya (ii) audit the visual outcomes and (iii) describe elements of the existing referral system that may influence visual outcomes.

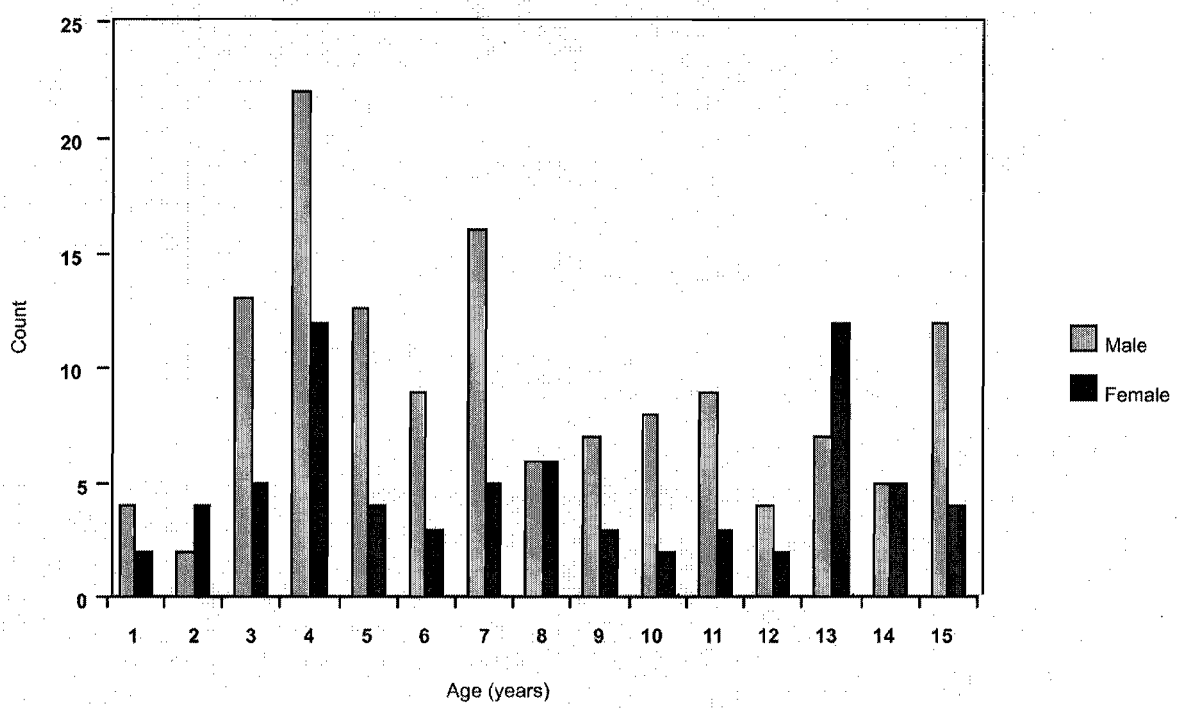
MATERIALS AND METHODS

A retrospective case series was undertaken for children aged up to 15 years, who were hospitalised with globe injuries at Kenyatta National Hospital (KNH) between January 1st, 2000 and December 31st, 2004. Records of cases were retrieved from the computerised hospital registry by entering the ICD-10 code S.05 representing injury of eye and orbit, age ≤15 years and year of reference (13). A File Tracer Card that tracks the movement of medical record charts within the hospital system was used to obtain the files that were not present in the records room at the time. Data were entered into a structured questionnaire. The names of patients and clinicians were not revealed in the data forms. Descriptive statistics were obtained. Visual acuity in this report refers to best corrected visual acuity (BCVA). The Institutional Ethics Committee of KNH approved the study.

RESULTS

Demographics: During the period January 1st , 2000 to December 31st, 2004, 182 children were hospitalised at the Kenyatta National Hospital (KNH) ophthalmology department with eye injuries. One hundred and twenty nine (71%) were boys and 53 (29%) girls giving a male:female ratio of 2.4: 1. The median age of affected children was seven years (IQR 4-10). There was a bimodal age distribution with peaks at four and seven years for both boys and girls (Figure 1).

Figure 1
Age and sex distribution of children with eye injuries



Referral through the health system: Eighty seven children (48%) were referred from within Nairobi province while the other 95 (52%) were from surrounding provinces mainly Central and Eastern. Most (30%) referrals came from Central Province followed by the Ukambani area in Eastern Province (Machakos, Makueni, Kangundo, Kitui, Mtito andei, Mwala and Mwingi districts) with 15%. In Nairobi the highest frequency of eye injuries came from Kibera with 11 children (13.1 %), Dandora eight (9.5%) and Kariobangi seven (8.3%). Together, these three residential areas constituted 31 % of the injuries from Nairobi.

One hundred and two children (56%) presented to the nearest medical facility within a day of injury while 123 (67.5%) had presented within two days. The time taken to the first health facility ranged from one to fourteen days. The median duration between injury and arrival to KNH for all children was three days (IQR 1-5.5). Children from Nairobi arrived sooner (median two days, IQR 1-6) compared to those from outside Nairobi (median three days, IQR 2-5). Only 63 (34.6%) children arrived at KNH within 24 hours of referral from the first medical facility. 40% presented more than three days later (Table 1).

Twenty one (12%) children had tetanus toxoid injection administered at the referring centre. Only 52 (29%) children got antibiotics at the referring centre. Only 24 (13%) children received analgesics at the referring centre. Twenty (11 %) children arrived with an eyepad at KNH.

Types of injury and causes: One hundred and twenty seven (70%) children had open globe injuries. One hundred and one injuries (55.5%) involved the right eye. The most common cause of injury was a stick, responsible for 64 (35%) injuries followed by stones accounting for 19 (10%) injuries. The causes of injury are shown in Table 2. There was a large heterogeneous group classified as others in which were included hot oil, tyre bursts, falls, umbrellas, belt, door, road traffic accidents, arrows, the thorn-like tip of a sisal plant etc. This group of causes was responsible for 40 cases (22%).

Table 1
Times taken through the referral system to KNH

Time (days)	From injury to first health facility			From injury to KNH		
	No.	(%)	Cumulative %	No.	(%)	Cumulative %
1	102	56.0	56.0	63	34.6	34.6
2	21	11.5	67.5	22	12.1	46.7
3	3	1.6	69.1	24	13.2	59.9
4	3	1.6	70.7	15	8.2	68.1
5	1	0.5	71.2	11	6.0	74.1
6	-		71.2	8	4.4	78.5
7	-		71.2	11	6.0	84.5
8	-		71.2	5	2.7	87.2
10	-		71.2	8	4.4	91.6
14	1	0.5	71.7	7	3.8	95.4
19	-		71.7	1	0.5	95.9
21	-		71.7	2	1.1	97.0
28	-		71.7	1	0.5	97.5
45	-		71.7	1	0.5	98.0
58	-		71.7	1	0.5	98.5
Missing data	51	28.0	100	2	1.1	100
Total	182	100		182	100	

Table 2
Causes of eye injuries

Object	Frequency	(%)
Stick	64	35.2
Stone	19	10.4
Knife	14	7.7
Wire	10	5.5
Nail	9	4.9
Pen	9	4.9
Glass	7	3.8
Fist/slap/whip	3	1.6
Metal	3	1.6
Others (hot oil, tyre bursts, falls, umbrellas, belt, door, road traffic accidents, arrows, the thorn-like tip of a sisal plant etc.)	40	22.0
Total	182	100

The most common clinical manifestations were corneal perforation (64%) and iris prolapse (46%) (Table 3). Fifty three (29%) children had cataract on presentation. three (1.6%) children had significant systemic pathology on admission, one (0.5%) had anaemia and two (1.1%) had head injury. Some children had multiple findings.

Table 3
Clinical features of the eye injuries

Clinical feature	Frequency	(%)
Corneal perforation	116	63.7
Iris prolapse	84	46.2
Cataract	53	29.1
Fibrin in the anterior chamber	48	26.4
Vitreous in anterior chamber	44	24.2
Scleral perforation	38	20.9
Vitreous haemorrhage	34	18.7
Hyphaema	33	18.1
Lens matter in anterior chamber	13	7.1
Lid laceration	11	6.0
Conjunctival laceration	9	5.0
Retinal detachment	8	4.4

In 101 children visual acuity could be assessed by Snellen chart, in three children a Lea chart was used. Assessment for the remaining 78 (43%) was difficult as they were either too young or too severely injured to respond to objective measurements. The most common presenting visual acuity was perception of light (PL) (Table 4). These were 44 children (26%). One hundred and fourty one (77%) had vision worse than 6/60. Seven (4%) had visual impairment (worse than 6/18 upto 6/60). Twenty (12%) children had no perception of light.

Visual outcome: All surgery was done under general anaesthesia. Six children (3.3%) needed primary evisceration and one (0.5%) had a primary enucleation. Thirty two (18%) children had subsequent surgeries for removal of sutures or management of complications. The visual outcomes are shown in Table 5. We defined final visual acuity as the last recorded visual acuity after discharge from hospital available in the follow up record. Fourty (22%) children did not have complete data. Twenty (11%) were missing a presenting visual acuity and twenty (11%) did not return for follow up after discharge from hospital. Of the 142 who had both baseline and follow up data, 81 (57%) had a better final visual acuity at the last recorded visit while 44 (31%) remained the same and 17 (12%) had a worse visual outcome.

Table 4
Visual acuity on presentation to KNH

Snellen visual acuity	Frequency	(%)
6/6	1	0.5
6/9	4	2.2
6/12	5	2.7
6/18	4	2.2
6/24	1	0.5
6/36	3	1.6
6/60	3	1.6
CF	10	5.5
HM	19	10.4
PL	47	25.8
FL	32	17.6
NPL	21	11.5
Difficult to assess	12	6.6
Not recorded	20	11.0
Total	182	100

CF-Counting Fingers, HM=Hand Movements, PL=Perception of Light, FL=Follows Light, NPL=No Perception of Light

Table 5

Visual acuity at presentation and at outcome measured at the last recorded follow up. The shaded grid represents the line of equivalence. Those to the left of this line improved while those to the right ended up worse compared to baseline

		Final visual acuity													
		6/6	6/9	6/12	6/18	6/24	6/36	6/60	CF	HM	PL	FL	NPL	Diff	Total
Visual acuity at presentation	6/6														0
	6/9		3				1								4
	6/12	2	2								1				5
	6/18		2	1											3
	6/24			1											1
	6/36		1		1				1						3
	6/60			1	1										2
	CF		1		2		1		4				1		9
	HM	2	2	2				1	2	4	5				18
	PL	2	1	1	2	4	4		7	6	12		5		44
	FL	1	4	1	1	1		1	1	1		12	2	1	26
	NPL				1				2	4	3		8		18
	Diff		1			1					3	2	1	1	9
	Total	7	17	7	8	6	6	2	17	15	24	14	17	2	142

CF=Counting Fingers, HM=Hand Movements, PL=Perception of Light, FL=Follows Light, NPL=No Perception of Light, Diff=Difficult to Assess

The intermediate and late complications seen are shown in Table 6. The most common complication was corneal opacity (n=63, 35%) which was seen at a median duration of 42 days after treatment. Phthisis bulbi occurred in 20 children (11 %) and developed 60 days after treatment. Fifteen (8.2%) children developed cataract seen about 19 days later. Posterior capsule opacification (PCO) was seen in 11 (6%) of children 50 days (IQR 21-120) after initial hospitalisation.

Table 6

Complications seen and the time when they occurred

Complication	No. (%)	No. of days after treatment when recognised Median (IQR)
Corneal opacity	63 34.6	42 21-83
Phthisis bulbi	20 11.0	60 26-105
Amblyopia during hospitalisation	8 4.4	-
Amblyopia after hospitalisation	18 9.9	-
Cataract	15 8.2	19 7-30
PCO	11 6.0	50 21-120
Seclusio pupillae	8 4.4	45 25-75
Glaucoma	4 2.2	75 23-120
Secondary hyphaema	7 3.8	3 0-24
Uveitis	7 3.8	28 21-28
Endophthalmitis	3 1.6	42 42-42

Cost of hospitalisation: The median duration of hospitalisation at KNH was seven days. The hospitalisation bill charged to the patients ranged from Kshs. 300.00 (US$. 4.00) to Kshs. 35,880.00 (US$ 497.00). The median hospitalisation bill was Ksh 5,275.00 (US$ 70.00) (IQR 2,000.00 - 8,210.00). Forty four (24%) children were unable to pay and the bill had to be waived.

DISCUSSION

The male preponderance observed in this study is consistent with what has long been observed in other studies on ocular trauma (2,14,15). Boys may be more explorative and adventurous but a scientific explanation for this is unclear. The peak age affected was four and seven years. At four years most children gain more independence walking and playing away from parents. In Kenya most children from rural areas and low socio-economic status start school at age seven years. Injuries may then occur at play to and from school where there is no parental or teacher supervision. Rural children at this age commonly take responsibility for looking after livestock in the fields when not in school. In this environment, they are prone to injury from sticks.

KNH in Nairobi is close to Central and Eastern Provinces. There are no district hospitals in Nairobi with capacity to handle severe ocular injuries or general anaesthesia for children. Most children presented promptly to the first medical facility but there was a three day delay going to KNH. This suggests that geographical distance may not be the most important limiting factor but perhaps cost or other factors. Majority of referrals from Nairobi came from Kibera, Dandora and Kariobangi residential areas that generally have low-income and high population density or slums.

The care given at the first medical centre was sub-optimal with respect to administration of tetanus toxoid, antibiotics, analgesics and protection of the eye from further injury with an eyepad. The proportion of children where this was done was no more than 29%. This may be related to limitations of capacity at these facilities in human resource capability and infrastructure to support diagnosis and treatment of severe ocular injury.

The circumstances around the injury were not described in this study. Sticks and stones were the most common cause of injury in this study which is similar to other studies in African countries (16). It is unclear whether this occurred at play or work as children in rural areas tend to look after livestock. The study period included a two-year period when the universal free primary school education policy was re-instituted in Kenya. It is plausible that these injuries may have occurred at play in the home or to and from school. Assault and child labour were difficult to delineate.

Most injuries involved the anterior segment. These are usually injuries that can be handled by a general ophthalmologist with adequate surgical equipment. Retinal detachments and posterior segment injuries that need a highly trained sub specialist vitreoretinal surgeon were fortunately few. The surgical equipment needed for such repair is usually expensive and in short supply in developing countries.

Majority of injuries seen were very severe with poor visual acuity on presentation (Table 4). A poor initial visual acuity has been described as a poor prognostic factor for eye injuries (17, 18). The visual outcome of open globe injuries is also markedly compromised if it takes more than 24 hours to repair them (19).

Various factors may have contributed to the visual outcomes observed. Children referred to KNH came with severe injuries as 70% had open globe injuries and 77% had visual acuity worse than 6/60. There was also a long delay of three days between injury and arrival to KNH. Also treatment given at the first medical centre was generally inadequate.

Corneal opacities were the most common complication. These contribute to amblyopia and need optimal care. Time delays in presentation to KNH, in starting amblyopia therapy and delays in removal of sutures may have worsened the prognosis of corneal injuries. There is no functional corneal tissue bank in Kenya from which corneal grafts can be obtained. Secondary cataracts and posterior capsule opacification seem to occur rather early at three to six weeks after discharge from hospital increasing the need for further intraocular or laser surgery. Most cases of endophthalmitis had late onset (42 days) suggesting low virulence organisms such as Proprionebacterium acnes or fungi. The latter is commonly associated with injuries caused by vegetative matter such as sticks.

In this study we have described the pattern of occurrence of ocular trauma in children and aspects of the health care system that may affect outcomes. Our study is limited by not using the international classification of eye injuries used in the World Eye Injury Register (WEIR) to standardise reporting and serve as a platform for clinical audit (12,20).

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