PEDIATRIC OCULAR TRAUMA

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Abstract- Ocular trauma is an important cause of ocular morbidity in children. At present only limited studies regarding distribution of ocular trauma exist in Iran. This study was performed to define epidemiologic characteristics and clinical profile of ocular trauma in children and to discuss management and final outcomes of such injuries. The files of 60 patients aged 16 years or younger who had been admitted for eye trauma at Shahid Sadoughi Hospital from April 2003 to March 2004 were analyzed. Sixty cases were studied. Majority of injuries occurred in the age group of 8-12 years (58.3%). There were 40 (66.6%) boys and 20 (33.3%) girls. The highest proportion of injuries occurred in streets-roads (41.6%), followed by home (25%). Open globe injuries accounted for 51.7% of injuries, closed globe for 35% and chemical injuries for 13.3%. The most common causes were pointed objects, stones, bow-arrow and accidental blows and falls. Best corrected visual acuity of 20/40 or better was achieved in 10 patients (47.9%) in closed globe group. However, only 5 eyes (16.1%) in open globe group could achieve this vision. Seventeen patients (28.3%) achieved visual acuity of 20/200 or less. In conclusion, most ocular injuries are preventable and occur due to unsupervised use of objects like pointed things and bow–arrow. Initial visual acuity is statistically an important predictor of final visual acuity.

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Key words: Ocular trauma, penetrating injuries, visual acuity

INTRODUCTION

Eye injury is an important cause of ocular morbidity in children, being a leading cause of non–congenital unilateral blindness in this age group (1). Ocular trauma has significant impact on the patient's future quality of life and patients are exposed to a major risk of amblyopia. Approximately 18% of people who have visual disorders due to trauma are blind in one eye (2). Approximately 1.6 million people are blind owing to ocular trauma and 2.3 million are bilaterally visually impaired. The public health importance of such ocular trauma is undeniable. Out of 20 people who are examined by an ophthalmologist, one has an eye injury (3).

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Ocular injury occurs in three forms: open globe, closed globe and chemical injuries. Open globe injuries are one of the common emergencies in ophthalmologic clinics and require immediate operation (4). By identifying any underlying factors in the etiology of serious injuries, it may be possible to design effective methods for reducing the incidence of visually damaging trauma (5). Nearly 90% of eye injuries can be prevented by relatively simple measures (6-7).

The incidence of ocular injuries in children aged 16 years or younger varies in studies conducted in different parts of the world (8-11). Several societies and international data banks such as National Eye Trauma Registry (NETS) are established for recording the demography of eye injuries (12). At present only limited studies regarding distribution of ocular trauma exist in Iran. This study was carried out to identify epidemiologic causes and factors related to final visual outcome of ocular trauma in children.

MATERIALS AND METHODS

Analysis of cases of ocular trauma in children aged 16 years or younger admitted to Shahid Sadoughi Hospital, Yazd, Iran, over a year from April 2003 to March 2004 was carried out.

Data regarding demographic characteristics of patients, the cause, nature and place of injury, duration between injury and presentation, duration of hospital stay and initial and final visual acuity were recorded. On the basis of Birmingham eye trauma terminology system by Kuhn *et al.* ocular trauma was classified as open-globe, closed-globe and chemical injuries (13-15).

Main outcome measure was final visual acuity. The patients were examined each day during hospitalization and every week during the first month, and every month until three months consequently. The patients were followed up for at least 6 months when the final visual acuity was determined. Only the patients who needed hospital treatment were included in the study.

Patients were divided into four groups according to their final visual acuity:

Group 1: final visual acuity 20/40 or better

Group 2: 20/50 – 20/200

Group 3: 20/400 or worse

Group 4: no light perception (NLP)

The final visual acuity of each group was compared to initial visual acuity by Chi Square test. Statistical analysis performed using SPSS version 13 and *t* test for paired and unpaired samples by Chi Square test for grouped variables.

We obtained informed consent from all patients or their parents.

RESULTS

A total number of 60 children were admitted to the hospital with ocular injury during the study period. Forty (66.6%) were male and 20 (33.3%) were female with male-female ratio of 2:1. The highest male–female ratio was found in higher age groups (12-16 years) with a male-female ratio of 2.3:1. The youngest group (2-7 years) showed a low ratio of 1.6:1. Mean age of patients was 8.45 years for girls and 7.3 years for boys, and the median age was 7 years. Age of our patients ranged from 2 to 16 years. 60% resided in the urban areas. Seventeen (28.3%) children were in the 2-6 age group, 35 (58.3%) in the 7-11 and eight (13.2%) in 12-16 age groups. The injury involved the left eye in 33 (55%) cases and the right eye in 27 (45%). The most frequent finding was hyphema in closed globe injury, corneal laceration in open globe injuries and corneal abrasion in chemical injuries. Fourteen (23.3%) of the children who were admitted had a hyphema.

The mechanisms of injury are shown in table 1. The commonest type of injury was open globe injury, accounting for 51.7%. Blunt traumas (35%) and chemical injuries were the next (13.3%). The most frequent cause of injury was stone and ball in blunt trauma and stick, glass and air-gun in penetrating trauma. Thirty nine patients (65%) were below 10 years and the most common type of trauma in this age group was open globe. The causes of injury are shown in table 2. Pointed objects accounted for 45% of the injuries (27 cases); stick was the most common cause in this group. The second leading cause of injury was air-gun/bow-arrow injuries (16.6%). In this group 7 eyes (6.6%) were injured by air-gun during playing in street that

Table 1. Mechanism of injury according to age group*

	Age group (years)†			
Mechanism of injury	**2-6**	**7-11**	**12-16**	**Total**
Penetrating	5 (29.4%)	21 (60%)	5 (62.5%)	31 (51.7%)
Blunt	7 (41.2)	11 (1.4%)	3 (37.5)	21 (35%)
Chemical	5 (29.4%)	3 (8.5%)	0 (0%)	8 (13.3%)
Total	17 (100%)	35 (100%)	8 (100%)	60 (100%)

* Data are given as number (percent).

† *P* Value= 0.028, $\gamma 2$= 7.13 (comparison between < 6 years and 6 years or more).

Table 2. Causes of eye injury

Cause	Number (%)
Pointed objects	
Stick	11 (18.3%)
Airgun/Bow-arrow	10 (16.6%)
Pencil, Glass	5 (9%)
Chemicals	8 (13.3%)
Road traffic accident	8 (13.3%)
Fire-Works	5 (8.3%)
Stone	5 (8.3%)
Metal Wire	3 (5%)
Ball	3 (5%)
Fall	2 (3.3%)

resulted in our 4 cases of enucleation. For boys, fireworks and metallic particles whereas for girls the chemical materials were the next frequent causes.

The places where injury occurred are shown in table 3. Most injuries occurred during playing in the streets and roads (41.67%), followed by home (23.33%) and school or child care facilities (16.67%). Differences of eye injuries by place of the event in different age groups were significant at P value < 0.002 (Table 3). In the group aged 12-16 years, 3 children were working when the ocular trauma occurred.

Highest number of eye injuries especially in boys occurred during spring and summer. More than half of the children were alone or without supervision when the ocular trauma occurred (56.6%).

Patients were admitted to hospital for a mean of 5.8 days (range 2-16). Thirty–one cases presented within 0-6 hours of injury, 20 between 6-12 hours while 9 presented beyond 12 hours from the trauma. Examination was performed within the first 24 hour of their injury in 88.3% of children (69.4% with closed–globe and 30.6% with open globe). Thirty five children (58.3%) required surgical management, 23 (38.3%) were treated medically and two (3.3%) were simply observed. There were 3 cases of endophthalmitis (5%). Bow and arrow injury (P < 0.05) and eyes in which primary repair was delayed beyond 24 hours of injury (P < 0.01) had a higher risk of endophthalmitis and enucleation.

The final visual acuity was recorded at the end of three months. Of the 60 patients, only 25% achieved final visual acuity of 20/40 or better. The initial visual acuity and final visual acuity are shown in table 4. Best corrected visual acuity of 20/40 or better achieved in 10 patients (47.9%) in closed globe group. However, only 5 eyes (16.1%) in open globe group achieved this vision. Four patients had NLP vision and were enucleated.

Analysis of relation between duration from the onset of injury to operation and final visual acuity showed that when this period was shorter, the predictive visual outcome was better and visa versa (Table 5). The type of injury, its severity, and the initial visual acuity are known prognostic factors of the final visual outcome. In general visual outcome appears worse for children under 9 years due to amblyopia. Open globe injuries registered the most severe cases, with more than half causing blindness at the initial examination, whereas 30% of injuries caused severe visual impairment or blindness (visual acuity < 20/200). The factors associated with visual outcome included, type of injury, initial visual acuity and time between onset of injury and operation. As expected in accordance with the severity of the injuries, severe visual impairment and blindness were caused mainly by open globe injuries.

Table 3. Place of injury by age*

	Age group (years)			
Place of injury	**2-6**	**7-11**	**12-16**	**Total**
Work	0 (0.0%)	2 (5.7%)	2 (25%)	4 (6.7%)
School/Child care	2 (11.77%)	10 (28.5%)	1 (12.5%)	11 (18.33%)
Home	10 (58.82%)	5 (14.3%)	1 (12.5%)	23 (38.33)
Roads/ Streets	4 (23.53%)	10 (28.5%)	3 (37.5%)	13 (21.77%)
Sport	1 (5.88%)	8 (22.9%)	1 (12.5%)	9 (15%)
Total	17 (100%)	35 (100%)	8 (100%)	60 (100%)

* Data are given as number (percent).

Table 4. Distribution of initial and final visual acuity*

Visual acuity	Group I (20/40 or better)	Group II (20/50-20/200)	Group III (20/400 or worse)	Group IV (NLP)
IVA	12	14	31	3
FVA	15	28	13	4

Abbreviations: IVA, initial visual acuity; FVA, final visual acuity; NLP, no light perception.
*Data are given as number.

DISCUSSION

More than one third of eye injuries occur in pediatric age group. In general children are more susceptible to eye injuries because of their immature motor skills, and their tendency to imitate adult behavior without evaluating risks (9). Many children suffer visual impairment from eye trauma that can seriously hamper their psychosocial development. Also children are often allowed to observe adult activities that may pose a risk to them (*e.g.* working with dangerous tools). As reported by others (16-19) in the present study, boys outnumbered girls in the frequency of eye trauma with a ratio of 2:1. In our society boys are generally granted more liberty than girls and tend to spend more time outside with their friends with less adult supervision (20). They are allowed and even encouraged to exhibit more aggressive behavior as part of their normal characteristic. In this study school-aged children were more susceptible than the younger age group.

The present study showed that a higher frequency of ocular trauma occurred in roads and streets (41.6%); the second frequent place was at home, in contrast to the study of Juan *et al.* which showed highest frequency at home (21). This underscores the great need for primary programs targeting parents and outside environment.

A majority of the population in our series belong to a poor socioeconomic class. In our study, majority (58.3%) of injuries were seen in the 7-11 year age group; this is different from a study in India (22) which identifies 45.51% of injuries in this age group. This may be due to social and cultural differences between two populations. The preponderance of left eye is consistent with findings of other authors (23). Pointed objects particularly stick, pencil and air gun was the most common causative agent in this study as well as Shoja's (24), and this contrast somewhat with types of injuries encountered in adults in whom blunt injuries are more frequent than in children (25). Children commonly play with hazardous objects such as knife, pencil, needle and glass that were left within their reach by parents. Sports objects like balls are also a potential hazard. Fire-works injuries show a peak in the last Wednesday of the year (Charshanbah Soori) ceremony, indicating a great need for supervision in this ceremony. This is in contrast with similar studies in which fireworks caused no injuries due to control of selling fireworks to those younger than 14 years.

In pediatric trauma, 23.3% of those with serious eye injuries were in the 1-14 age group (11). Sport associated eye trauma is largely preventable (16). Protective eye wear is available for a number of sports. In this study penetrating injuries (open–

Table 5. Duration between the onset of injury, operation and final visual acuity*

Final visual acuity	Duration between the onset of injury (hour) † < 6	6-12	> 12	Total
20/40 or better	12 (38.71%)	0 (0%)	3(33.33%)	15(25%)
20/50-20/200	15 (48.38%)	10 (50%)	3(33.33)	28(46.66%)
20/400 or worse	3 (9.68%)	8 (40%)	2 (22.23%)	13(21.67%)
NLP	1 (3.23%)	2 (10%)	1 (11.11%)	4(6.67%)
Total	31 (100%)	20 (100%)	9 (100%)	60 (100%)

Abbreviations: NLP, no light perception.
*Data are given as number (percent).
†*P* Value= 0.016, $\gamma^2 = 10.26$ (comparison between < 6 hour and 6 hour or more).

globe, 51.7%) predominate in comparison to blunt injuries (closed–globe, 33%). This finding is not in keeping with other series in which blunt injuries predominate (26, 27) and this can be due to the fact that we did not include patients with trauma treated as outpatients. In Caroline's study, blunt trauma accounts for 65% of total injuries (28). This difference represents further evidence that there is not a trend of decreased incidence of open globe injury in children in our country compared with others societies (29-30). Penetrating injuries, in general, carry a poorer prognosis and they are more likely to require surgery and subsequently to suffer from long term visual impairment (31). In our study visual prognosis was poor in open-globe injury. One third of patients had final visual acuity of 20/200 or worse and 4 eyes were enucleated. The poor results in this type of trauma agree with Niirran and Raivio who claim despite therapeutic advances, visual prognosis in children is still worse than adults due to nature of the injury and amblyopia problems (32). The mild trauma was excluded from study and this was among the limitations

It is necessary to implement programs regarding effects of ocular trauma, recognition of specific hazards and their prevention. Prevention of injury depends firstly on identifying the cause and, secondly targeting this by education and legislation. There were no injuries due to road traffic accidents in McEwen study (28), but in this study, the highest portion of injuries occurred in streets-roads. This difference is due to elimination of this cause of eye injury in the young (and in adults) owing to successful implantation of legislation regarding the use of seat belts in the front and back seats of cars (33, 34) and protective device for motorcycle. Unfortunately this legislation does not carry out in our country. Air gun injuries have a poor prognosis owing to the extensive damage caused by the high velocity pellets and often result in loss of vision or even enucleation. Our 4 enucleation case was due to air gun shut. Occupational open globe injuries are usually severe and are associated with a poor visual outcome. Visual outcome is better in eyes that require only primary repair. We have identified several factors that may aid the clinician in deciding on the prognostic value of primary repair.

In conclusion, trauma is an important cause of ocular morbidity in Yazd. Legislation alone is not always successful and education is necessary. General safety precautions and behavior modifications are indicated.

Conflicts of Interests

We have no conflicts of interest.

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