·Clinical Research·

Pediatric traumatic cataract and surgery outcomes in eastern China: a hospital-based study

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Abstract

• **AIM: To evaluate the etiologies, management, and outcomes of pediatric traumatic cataract in eastern China.**

• **METHODS: Pediatric traumatic cataract were reviewed for demographic information, type of injury, mode of injury, time of injury, interval between injury and first visiting doctors, hospital of first visiting, surgeries, complications and prognosis.**

• **RESULTS: A total of 117 eyes of 117 patients (96 boys and 21 girls) with unilateral injuries (66 right and 51 left eyes) were included in the study. The mean (SEM) age at diagnosis was (6.6±3.2) years (range, 1.3-13.8 years). Each cataract was categorized according to the type of trauma: closed-globe (n=26) or open-globe (n=91) injuries. The most common injuring objects were sharp metal objects (37.61%). The most common complication in open-globe injuries was corneal laceration, whereas traumatic mydriasis was most common in closed-globe injuries. Of 68 eyes in patients with open-globe injuries who received cataract extraction, intraocular lens (IOLs) were primarily implanted in 47 eyes (68.12%), whereas 18 eyes with closed-globe injuries received cataract extraction, and IOLs were primarily implanted in 17 eyes (94.4%). The surgical procedures included reconstruction of the anterior segment, synechiolysis, excision of the membrane, lensectomy, vitrectomy and related techniques. Postoperative vision was significantly improved compared with preoperative vision.**

• **CONCLUSION: Pediatric traumatic cataract should be treated in time to attenuate the complications, and education on pediatric traumatic cataract and improvements in pediatric health care are needed for the early detection of cataract in children.**

• **KEYWORDS:** children; trauma; cataract

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INTRODUCTION

Pediatric traumatic cataract is one of the leading causes of monocular blindness in children, accounting for 29%-57% of pediatric cataract cases [1]. Pediatric eye is in development, and trauma will lead to more severe complications, such as vitreous proliferation diseases. Without effective and prompt treatments, pediatric cataract will deteriorate vision, including of loss of binocular vision, amblyopia, strabismus, low vision in life, even blind [2]. In certain regions with well-established childhood blindness programs, the average Childhood Cataract Surgical Rate (CCSR) ranges from 29.2 to 39.8 children per million population[3], whereas in other poorly established regions, the CCSR is only 1.1 [4]. A study from Uganda estimated that cataract was responsible for over 30% of all cases of blindness and visual impairment in children [5]. Evidence-based information is crucial for improving eye care in children. We could not find such information on pediatric traumatic cataract in China, so a retrospective review of pediatric traumatic cataract in our ophthalmology center was performed to explore the treatment of traumatic cataract in children, with the goal of providing scientific evidence surrounding the prevention and treatment of pediatric traumatic cataract in China.

SUBJECTS AND METHODS

This retrospective review was approved by the Shandong Eye Institute Review Board. A retrospective review was conducted of the records of all children 14 years old or younger that had a diagnosis of traumatic cataract and presented at the Qingdao Eye Hospital between January 2005 and January 2012. All of the included patients were divided into two groups based on the type of injury: closed-globe injuries were designated as group A, and open-globe injuries as group B. The foldable intraocular lens was implanted (Akroes, hydrophilic acrylic, Bausch & Lomb Surgical), according to the formula SRK-T. The patients' medical records were reviewed for demographic information, mode of

injury, time of injury, interval between injury and first visiting doctors, hospital of first visiting, surgeries, and preoperative and postoperative best-corrected visual acuity (BCVA). Visual acuity was graded according to the classification proposed by Pieramici *et al*[6]: grade 1, ≥20/40; grade 2, ≥20/100 but <20/40; grade 3, ≥20/400 but <20/100; grade 4, ≥LP but <20/400; and grade 5, NLP. The Institutional Review Board (IRB)/Ethics Committee approved the study, and the research adhered to the tenets of the Declaration of Helsinki.

Statistical Analysis The statistical analysis was conducted using an SPSS 13.0 database program; a Chi-squared test was used to determine dependency, and descriptive tests were used for the analysis. A P value of less than 0.05 was considered to be statistically significant.

RESULTS

A total of 117 eyes of 117 consecutive patients (96 boys and 21 girls) were included in the study. The age range was 1.3-13.8 years (mean age, 6.6±3.2 years), and 58.97% of the patients were from 4 to 9 years old (Figure 1). The follow-up period was a mean of (10.64±6.81) months (range, 1 month-29 months). All of the patients had unilateral cataracts, and 66 of them had injured their right eyes, whereas the remaining 51 had injured their left eyes. The numbers of cases of closed-globe injury and open-globe damage were 26 and 91 (1:3.50), respectively. The most common mode of injury was sharp objects (44 eyes, 37.61%), including scissors, iron wire, syringe needles, and nails, followed by botanical materials (22 eyes, 18.80%), toy guns (14 eyes, 11.97%), and firecrackers (12 eyes, 10.26%, Table 1).

There were no seasonal differences in morbidity throughout the year (χ^2=4.904, P=0.936), although 83.33% of the injuries due to firecrackers occurred in the first quarter of the year. A total of 97 patients (82.91%) visited a doctor within 24 hours after injury [22 (84.62%) from group A and 75 (82.42%) from group B]. Only 29 of the patients (24.79%) visited our hospital first; the other 88 (75.21%) were referrals from other hospitals. All of the 24 patients in group B who visited our hospital first received emergency debridement, sutures, or combinations of other surgeries, such as cataract extraction and implantation of an IOL. However, 16 (23.88%) of the other patients in group B, who were referrals, did not receive the emergency surgeries, which was a significant difference (χ^2=6.594, P=0.008). Although the 24 patients who visited our hospital first received the emergency surgeries, the interval between injury and emergency surgery exceeded 24 hours in 8 patients (33.33%) because they did not visit a doctor promptly.

Of 91 eyes with open-globe injuries, the most common complications were corneal laceration, anterior capsule violation, and iris synechia, whereas in eyes with closed-globe injuries, the most common complications were traumatic mydriasis, secondary glaucoma, and anterior chamber hyphema (Figure 2).

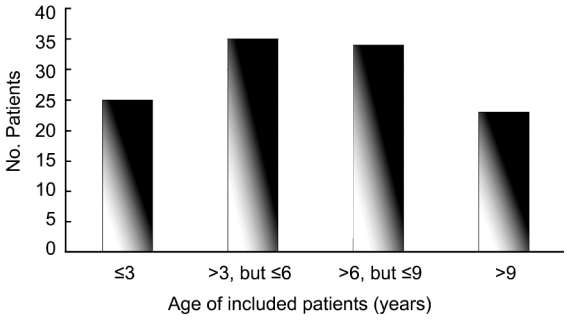

Figure 1 The numbers of pediatric traumatic cataracts at different ages.

Table 1 The mode of injury in pediatric traumatic cataract *n*

Mode of injury	Closed-globe	Open-globe	Total
Sharp metal	0	44	44
Botanic	3	20	22
Toy gun	12	2	14
Firecracker	5	7	12
Glass	0	6	6
Pen	0	6	6
Cobble	2	2	4
Slingshot	1	0	1
Key	1	0	1
Electric shock	1	0	1
Not clear	1	4	5
Total	26	91	117

Of 68 eyes in patients with open-globe injuries who received cataract extraction, IOLs were primarily implanted in 47 eyes (68.12%), whereas of 18 eyes with closed-globe injuries, IOLs were primarily implanted in 17 eyes (94.4%). Of 21 eyes receiving secondary IOL implantation in group B, 16 suffered with intraocular foreign body and/or endophthalmitis, and the one receiving secondary implantation in group A suffered with hyphema and retinal lesion. The interval between the secondary implantation and the cataract extraction was (4.07±2.54) months (range, 0.47-8.67 months), and there was a trend toward better visual acuity in eyes with more recent surgery, but this did not reach statistical significance since P=0.053 is almost significant.

In group A, additional procedures were performed, including pupilloplasty (3 eyes, 11.54%), trabeculectomy (3 eyes, 11.54%), and enucleation (1 eye, 3.85% because of retinal detachment). In group B, vitrectomy and retinal detachment surgery in 19 eyes (20.88%) were the most common additional procedures, followed by posterior capsulotomy in 9 eyes (13.24% of 68 eyes with IOL implantation, with Nd: YAG laser treatment in 5 eyes), trabeculectomy in 5 eyes (5.49%) and enucleation (1 eye, 1.10% because of endophthalmitis) (Figure 3).

Table 2 The IOL implantation in different types of injuries *n* (%)

Type of injuries	In capsular bag	In ciliary sulcus	Suture scleral fixation	Without implantation
Closed-globe	16 (80.0)	2 (10.0)	0	2 (10.0)
Open-globe	39 (47.6)	24 (29.3)	5（6.1）	14 (17.1)

Table 3 The comparison of preoperative and postoperative BCVA between types of injuries [*n* (%), $\bar{x} \pm s$]

BCVA	Preoperative			Postoperative		
	Open-globe	Closed-globe	*P*	Open-globe	Closed-globe	*P*
≥20/40	3 (3.4)	0		36 (41.4)	14 (58.3)	
≥20/100 but <20/40	5 (5.7)	1 (4.2)		16 (18.4)	4 (16.7)	
≥20/400 but <20/100	14 (16.1)	8 (33.3)	0.274	11 (12.6)	3 (12.5)	0.228
≥LP but <20/400	55 (63.2)	13 (54.2)		13 (16.9)	0	
NLP	0	0		1 (1.1)	1 (4.2)	

LP: light perception; NLP: no light perception.

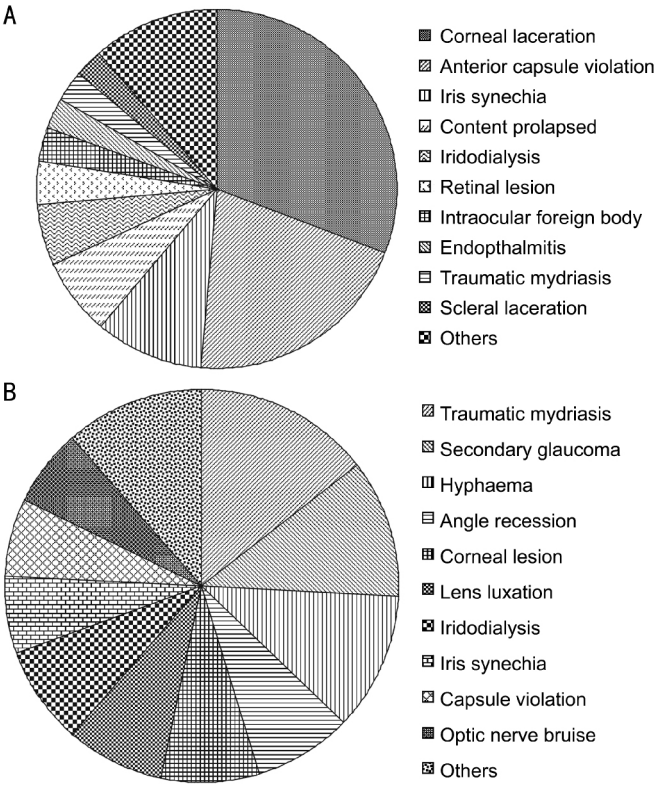

Figure 2 The associated complications of pediatric traumatic cataract A: Open-globe injuries; B: Closed-globe injuries.

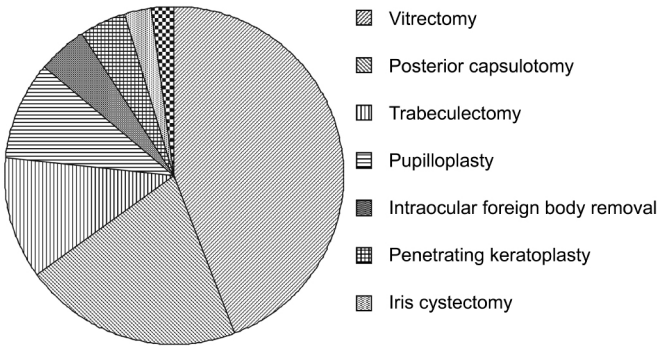

Figure 3 The subsequent procedures in open-globe injuries.

Cataract surgeries were not performed in 4 eyes of group A and 3 eyes of group B because of mild opacity. Enucleation was performed in 1 eye in group A and 1 eye in group B. Cataract extractions were performed in 102 eyes, between groups such that IOLs were implanted more frequently in closed globe injuries (χ^2=7.054, P=0.029, Table 2). The remaining 6 patients' information were lost about their treatment to cataract, due to no follow-up in our hospital.

The preoperative and final BCVA were examined in 99 patients, and the others were not (12 eyes belonged to non-cooperative patients, and 6 eyes' information were missed). There was no significant difference in the pre-operation BCVA between open-global and closed-global injuries (χ^2=3.889, P=0.274, Table 3), there also was not significant differences in post-operation BCVA (χ^2=5.635, P =0.228, Table 3), but the postoperative BCVA was significantly improved compared with the preoperative value in open-global (χ^2=60.986, P<0.001) and closed-global injuries(χ^2=32.073, P<0.001). Of the eyes with closed-globe injuries, 4 eyes had a final visual acuity poorer than 20/100, 3 of whom suffered retinal lesions and the remaining one of whom received an enucleation due to eyeball atrophy secondary to retinal detachment. Moreover, in the open-globe injuries, 25 eyes had a final visual acuity poorer than 20/100, of which 17 had notable corneal scarring, 5 had retinal lesions, 2 had secondary glaucoma, and 1 received an enucleation.

DISCUSSION

Since February 1999, when WHO launched a global initiative for the elimination of avoidable blindness, "VISION 2020", blindness prevention and ophthalmic epidemiology studies in China have obtained considerable progress. The Cataract Surgical Rate (CSR) has ascended from 318.3 in 1999 to 796.2 in 2009 [7]. There were an estimated 210,000 blind children in China in 1999, with a prevalence of per 1 000 children of 0.50, according to WHO [8]. The most common cause of childhood blindness is heredity, followed by trauma

and high fever encephalitis sequelae. Although the incidence of retinopathy of prematurity (ROP) and the consequent blindness rate has dropped due to many effective prophylaxis and treatment measurements [9], pediatric traumatic cataract should receive greater attention because of the complexity of the condition and the consequent amblyopia.

In our study, the rate of traumatic cataract was higher in boys than in girls in coincidence with other studies [10,11]. Higher rates of trauma in males compared with females could be due to higher risks of trauma during outdoor activities and being much more inclined to come in contact with dangerous articles, such as firecrackers [12]. Most children with traumatic cataract were preschool age, when children are full of curiosity about the world and exploring everything they can touch without enough recognition of dangerous materials. Sharp metal is the most common mode of injury, followed by botanical materials, toy guns and firecrackers, which is different from Reddy's study [13]. Traumatic cataract from firecrackers is prevalent in January and February, which may be associated with the Chinese tradition of setting off fireworks in the Spring Festival. Avoiding touching dangerous material and increasing warnings would likely reduce the prevalence of trauma. In traumatic cataract in children, closed-globe injury occurs considerably less frequent than open-globe injury, which may be because the rate of lens opacity in closed-globe injury is less than that in open.

Overall, 82.91% of all of the patients visited an ophthalmology service within 24 hours after injury, but a portion of the patients with open-globe injuries did not receive emergency surgery, partially because of the lack of knowledge about pediatric penetrating injuries by certain ophthalmologists, the children's poor cooperation and less reliable historical information. In addition, due to the shortcomings of the medical system in China, certain patients with open-globe injuries were not introduced to the pediatric ophthalmologists or eye center in time. In our study, enucleation was performed in 2 children because of retinal detachment and endophthalmitis as a result of delayed visiting a doctor. Several children with open-globe injury did not visit ophthalmologists within 24 hours after penetrating injuries, likely because the parents did not pay enough attention to their injuries. Therefore, the education about public health should be augmented [14]. It may, perhaps, be helpful to strengthen primary eye care and adopt the community eye care approach in early detection, proper counseling and timely management. Pediatricians and ophthalmologists should pay more attention to certain symptoms, such as chronic red eye, decreased vision and pain, which should increase clinic suspicion for penetrating injuries [2]. A careful examination should be conducted in children with the abovementioned symptoms, even without an identified traumatic history, to avoid a missed diagnosis that may bring about irreparable results.

There were no significant differences in preoperative and postoperative vision between closed- and open-globe injuries, which suggested that the effect of closed-globe injuries on vision was comparable with that of open. The postoperative vision was better than the preoperative vision. It is necessary that traumatic cataract should be managed as soon as possible to avoid other complications, such as amblyopia[1,11,13,15,16].

In our study, 68.12% of the patients with open-globe injuries received primary IOL implantation. In addition, almost all of the eyes with closed-globe injuries received primary IOL implantation, as they lacked corneal laceration or infection. The interval between secondary implantation and cataract extraction had an insignificant effect on the postoperative visual acuity. Although simultaneous repair of the penetrating wound and IOL implantation after cataract extraction was advocated by certain articles[17-20], inaccurate prediction of the power of the IOL occurred when the biometry of the fellow eye was used [21]. Because of the variable extent of a corneal or scleral wound and the possibility of infection, primary implantation of IOL might not be practical [22], and secondary implantation could achieve the same effect [23]. Therefore, the decisions regarding the surgery should consider the traumatic condition, child's age, and other factors.

The most commonly associated ophthalmic injuries in pediatric patients are cornea laceration and anterior capsule violation, similar to those found in Reddy's study [13], which will increase the surgical complexity; others, such as vitreous prolapse, endophthalmitis, and serious capsule violation, will change the mode of implantation of the IOL (Table 2). Due to injuries to the capsule and ciliary zonule, the IOL cannot be implanted in the capsular bag; instead, it is placed in the ciliary sulcus or by scleral fixation in open-globe injuries. Although the latter methods can increase the rate of retinal detachment, they are effective and reliable in patients with pediatric traumatic cataract who had insufficient posterior capsule support[24,25].

The associated ophthalmic injuries need additional managements other than cataract extraction and IOL implantation. The most common is vitrectomy and retinal detachment surgery because of vitreous hemorrhage, hernia or retinal injuries, and these associated injuries will degrade postoperative vision[26,27]. Posterior capsule opacity (PCO) in pediatric patients with cataract is prevalence [28], which needs to be managed by Nd: YAG laser or surgical capsulotomy combined with anterior vitrectomy, as this condition will degrade vision and lead to amblyopia. In our series, 13.24% of eyes with IOL implantation received surgical capsulotomy in eyes with open injuries. Therefore, traumatic cataract in

pediatric patients is complex, and certain other surgeries are necessary.

In conclusion, the management of traumatic cataract in pediatric patients should be varied according to the age, mode of injury, traumatic type and associated injuries [29]. Careful preoperative examination is necessary, and certain symptoms should receive more attention. This study suggests that dangerous material should be stored out of the reach of children, especially those of preschool age. Improving strategies for preventing blindness in children of developing countries is necessary.

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