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Poor final visual outcome after traumatic hyphema: A retrospective study of associated factors

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ABSTRACT

Objectives: To determine the factors associated with a poor final visual outcome following a non-perforating traumatic hyphema.

Methods: The in-patient records of all traumatic hyphema patients admitted to the Department of Ophthalmology of the Hamad Medical Centre (HMC) in Doha, Qatar, were retrospectively reviewed for a four-year period from January 2004 to March 2008. One hundred and seventeen patients who did not meet the exclusion criteria were divided into two groups based on their final visual outcome post-treatment. Group 1 (good outcome) consisted of 100 patients with a visual acuity (VA) of 6/18 or better and group 2 (worse outcome) consisted of 17 patients with a VA of less than 6/18. The two groups were compared to determine the factors associated with a poor final visual outcome.

Results: Group 2 patients had an 82.3% incidence of complications after a traumatic hyphema compared with a 21% incidence in group 1. Of these complications, secondary glaucoma and rebleeding were significantly associated with a worse final visual outcome. Trauma from projectiles or blows did not differ significantly in their effect on the final visual outcome, although blow injuries had a greater impact on the final visual outcome. Posterior segment injuries were associated with a worse visual outcome.

Conclusion: It was concluded that secondary glaucoma, rebleeding, and posterior segment injuries are factors associated with a poor final visual outcome.

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INTRODUCTION

Hyphema is the accumulation of blood in the anterior chamber (AC) of the eye and can occur after a blunt or lacerative trauma. The vast majority of hyphema cases result from a significant blunt trauma to the eye, but some hyphema cases result from a seemingly trivial injury.[1] Balls, stones, projectile toys, air gun pellets, bungee cords, paint balls, household objects (e.g., clothes hangers), fists, and airbags (when deployed during a vehicular accident) are some common causes of blunt or lacerative trauma to the eye.[1,2] The accumulation of blood in the AC after a trauma may set in motion various pathological processes that threaten the vision of a hyphema patient.

The symptoms of a hyphema vary depending on the severity of the trauma as well as the volume of blood that fills the AC. The most common presentations are blurred vision, pain, photophobia, or lacrimation.

The prognoses for visual recovery and vision loss are directly related to the degree of damage to the globe; whether there is secondary haemorrhage or bleeding; and whether glaucoma or glaucoma-related sequelae (e.g., corneal blood staining and optic atrophy) develops.[3,4] Lens opacity, choroidal rupture, angle recession, and retinal detachment are commonly associated with traumatic hyphema and can compromise the level of final vision.[5] Anterior segment injuries may cause an initial decrease in VA. However, permanent visual loss has been directly linked to posterior segment injury such as macular oedema, retinal detachment (RD), retinal haemorrhage, or choroidal rupture.[6]

A small hyphema usually disappears within 4 to 5 days. However, a large amount of blood can obstruct the outflow of the aqueous resulting in glaucoma, blood staining of the cornea, rebleeding and poor visual recovery.[1]

An epidemiological study performed in an urban medical centre found that approximately two-thirds of traumatic hyphema cases result from blunt trauma and the remaining one-third, from a lacerative injury.[7,8] Males are involved in three-fourths of all hyphema cases.[2] Approximately 75% to 78% of traumatic hyphema patients are males with a median age of 15.5 to 18.2 years.[4,6,9] The mean annual incidence of hyphema is approximately 17 per 100,000 in the population.[6,7] The mean annual incidence of hyphema by gender is 20 per 100,000 for males and 4 per 100,000 for females.[2,6,7] The peak incidence for trauma-induced hyphema occurs between the ages of 10 and 20 years.

One study indicates that 44% of traumatic hyphema cases result from a street assault and 12% occur either at work or during athletic activities.[7] Projectile injuries tend to be more common among children, while blow injuries are more common among adults.[7,10] The incidence of rebleeding is reportedly between 2.4% and 38%.[7,11] African-American patients are more at risk than Caucasian patients for rebleeding and ocular damage.[4,12]

From these statistics, it is clear that the prevalence of traumatic hyphema and associated complications (such as glaucoma or rebleeding), and the severity of injury varies among different populations. The relation of these factors to the final visual outcome after a traumatic hyphema has not been well established. Although some factors are not amenable to treatment, other factors such as secondary bleeding may respond to treatment. Accurately determining which factors are associated with a poor final visual outcome and establishing early interventions (e.g., surgery, medication) may help in preserving the vision of traumatic hyphema patients. The relative importance of patient characteristics, severity of injury, and complications such as rebleeding were retrospectively studied in relation to the final visual outcome of patients treated for traumatic hyphema. The incidence of rebleeding and its affect on the final VA was also investigated.

METHODS

This retrospective study was conducted in the Department of Ophthalmology at the Hamad Medical Centre in Doha, Qatar. Hamad Medical Centre (HMC) admits all patients with traumatic hyphema and receives the majority of emergency ophthalmic cases in the State of Qatar, whose current population is approximately 1.4 million. The 200 records of traumatic hyphema patients who were treated at HMC from January 2004 to March 2008 were retrospectively reviewed for factors associated with a poor final visual outcome. Cases that lacked the necessary information or where certain documentation was missing resulted in exclusion of these cases from the study, including patients who met the exclusion criteria. The exclusion criteria included: open-globe injury, pre-existing eye pathology, post-operative complications, or secondary bleeding due to iris neovascularization, or a bleeding disorder. After the review of all cases of traumatic hyphema, 117 were considered to meet the inclusion criteria of the study.

The following information was obtained from the primary data collection process: name of the patient; file number; date of admission; age; sex; cause of trauma; results of initial examination; complete medical history; type of injury; and date of discharge. The department charge nurse assisted in obtaining this information from the ophthalmology records and the patient's records were obtained from the Medical Records Department according to the file number.

An ophthalmologist resident provided the clinical data at the time of admission from the emergency department. An initial examination included testing the patient's corrected VA (using the Snellen chart) and grading the size of the hyphema as follows:

- Microscopic hyphema: red blood cells circulate but there is no collection of blood within the AC;
- Grade 1: one-third or less of the AC is filled with a gross clot;
- Grade 2: more than one-third and up to one-half of the AC is filled with a clot;
- Grade 3: more than one-half and up to three-fourths of the AC is filled with a clot; and
- Grade 4: total hyphema, the AC is more than three-fourths filled with either a red or black clot.

All patients that were admitted to the Department of Ophthalmology were treated with activity restriction (e.g., limited ambulation) and were placed in a semi-seated position and administered a topical steroid. After admittance, patients were examined once daily with funduscopy and with a slit lamp examination. The intraocular pressure (IOP) was checked by applanation tonometer. VA (with correction) was checked by glass or pinhole examination. Secondary bleeding was diagnosed if the size of hyphema increased or, if fresh blood was present in the AC. Topical aqueous suppressants (e.g., Timoptol 0.5%) or an oral carbonic anyhrase inhibitor were added to the treatment regimen if the IOP was greater than 28 mm Hg. Follow-up examinations included VA check, (defined as the best VA with spectacles or pinhole in the traumatized eye), IOP testing, and gonioscopy. The final VA was defined as the corrected VA recorded at the last patient visit.

The data collection forms that were designed to gather the necessary information from the patient files for analysis were trialed initially to overcome any issues with the design of the questions. Based on the data collected, the sample was divided into two groups according to a patient's final visual outcome. The first group was categorized according to a final visual outcome of 6/18 or better and the second group categorized for a final visual outcome of less than 6/18. Cases of group 1 and group 2 were compared to determine the factors that were related to a poor final visual outcome.

The Statistical Package for Social Science (SPSS) software was used for data analysis. Chi-squared analysis was performed to test for differences in proportions of categorical variables between two or more groups. In 2 x 2 tables, the chi-squared test was replaced with the Fisher's exact test (two-tailed) when the assumptions underlying chi-squared were violated. Namely, in case the expected frequency was less than 5 in any of the cells. A P value of < 0.05 was considered the cut-off value for significance.

RESULTS

Patient characteristics

On analysis it was found that 100 of the 117 patients in the sample had normal vision (VA $\geq$ 6/18) at discharge (this constituted group 1), and 17 patients (group 2) had a worse visual outcome (VA $<$ 6/18). Table 1 lists the characteristics of the 117 patients.

Age and sex distribution

The age of the patients ranged from 0 to 59 years with a mean age of 25.1 $\pm$ 13.0 years. Although 64.9% patients were under the age of 50 years, the highest incidence of hyphema (35%) occurred in subjects who were 10–19 years old. Furthermore, there was a much greater prevalence of male hyphema patients (96.6%) than female hyphema patients (3.4%).[4] Fig. 1 shows the distribution of patients according to age.

Grade of hyphema

Table 1 shows that 64.7% of the patients had a grade 1 hyphema. Of the remainder, 19.8% of patients had a grade 2 hyphema; 0.9% of the patients had a grade 3 hyphema; and 7.8% of the patients had a total hyphema (grade 4). A significant statistical difference was found between the grade of the hyphema and the visual outcome. Virtually most of the patients who presented with a large clot appeared to have a worse final visual outcome (18.2%). However, no statistical significance was

Table 1. Characteristics of traumatic hyphema in 117 patients.

VA On Admission	Outcome group		*p*-value
	Good (≥ 6/18) N = 100 n(%)	Worse (< 6/18) N = 17 n(%)	
Age group			
0–9	9(100.0)	0(0.0)	
10–19	35(85.4)	6(14.6)	
20–29	21(87.5)	3(12.5)	0.305
30–39	23(88.5)	3(11.5)	
40–49	12(70.6)	5(29.4)	
Sex			
Male	96(85.0)	17(15.0)	0.999
Female	4(100.0)	0(0.0)	
Affected eye			
Right	52(94.5)	3(5.5)	0.009
Left	48(77.4)	14(22.6)	
Grade of hyphema			
Microhyphemia (Circulating RBC)	7(87.5)	1(12.5)	
Grade 1 (< 1/3)	68(90.7)	7(9.3)	0.009
Grade 2 (1/3–1/2)	16(69.6)	7(30.4)	
Grade 3 (> 1/2)	1(100.0)	0(0.0)	
Total	8(80.0)	2(20.0)	
Associated with clot			
Yes	72(81.8)	16(18.2)	0.071
No	26(96.3)	1(3.7)	

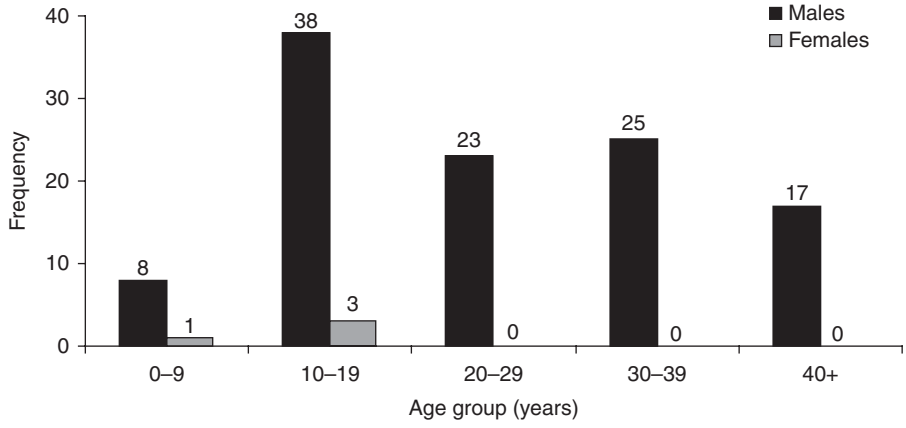

Figure 1. Distribution of patients with traumatic hyphema by age and sex.

identified as only one case (3.7%) without a clot did not have a favorable outcome ($p = 0.071$). Although the prevalence of left eye injury cases were similar to that of right eye injuries (53.0% vs. 47.0%, respectively), right eye injuries were more commonly associated with a good visual outcome (94.5%) when compared to the left eye (77.4%) ($p = 0.009$).

Visual Acuity

Table 2 compares the pre-treatment and post-treatment VA of the patients. A total of 63 patients had a VA of < 6/18 on admission. Of these patients, 77.8% had a good outcome post-treatment (VA ≥ 6/18). The association between a patient's initial and final VA was found to be significant ($p = 0.011$). Post-treatment it was found that a total of only 17 patients (14.5%) remained in the worse outcome group.

Complications

Table 2 shows that 21 patients in the good outcome group had one or more complications, compared with 14 patients in the worse outcome group. Rebleeding was associated with the worst outcome as out of the eight patients with this complication, only 50% were discharged with a good VA outcome.

Table 2. Final visual acuity (VA) outcome compared to VA on admission, complications and type of treatment.

	Outcome group		*p*-value
	Good (≥6/18) N = 100 n(%)	Worse (<6/18) N = 17 n(%)	
VA On Admission			
Good (≥6/18)	51(94.4)	3(5.6)	0.011
Worse (<6/18)	49(77.8)	14(22.4)	
Complications			
Rebleeding	4(50.0)	4(50.0)	0.015
Transient High IOP	3(75.0)	1(25.0)	0.471
Secondary Glaucoma	9(52.9)	8(47.1)	<0.001
Corneal blood straining	2(100.0)	0(0.0)	0.999
Posterior Synechiae	2(66.7)	1(33.3)	0.378
Anterior Synechiae	1(100.0)	0(0.0)	0.999
Type of treatment			
Conservative	88(91.7)	8(8.3)	
Antiglaucoma	9(52.9)	8(47.1)	0.001
Surgical intervention	3(75.0)	1(25.0)	

Poor visual outcome was associated with the presence of secondary glaucoma, which after rebleeding affected 47.1% of patients. Transient high IOP, corneal blood staining, and anterior and posterior synechiae did not significantly contribute to a worse outcome in this study sample.

Type of treatment

Table 2 categorizes a patient's visual outcome in relation to treatment approaches. Most patients 96(82.1%) received conservative treatment, while 17(14.5%) of the patients were treated with anti-glaucoma drops and 4(3.4%) of the patients had surgical intervention. Of the patients treated with surgical intervention, two patients had an AC washout, one had exploratory surgery, and one had trabeculectomy and lens aspiration.

Place of trauma

Table 3 reveals that most eye trauma takes place at worksites (n = 66; 56.4%), followed by in school (n = 26, 22.2%), and then in the home (n = 16, 13.7%). At a worksite, a projected nail was found to be the most common mechanism of trauma (n = 39, VA < 6/18 = 12.8%), followed by projected stones (n = 11, VA < 6/18 = 21.4%). In a school setting, common causes of eye trauma are related to sports (n = 9, VA < 6/18 = 22.2%). All cases of eye trauma whether occurring at home or in school (except for school sports trauma) had a 100% recovery rate. Assault trauma and road traffic accidents were the least common causes of eye trauma but were more likely to have poor VA outcome.

Types of trauma

Table 3 distinguishes the types of trauma in terms of blow or projectile. Projectile trauma constituted 65.8% of cases and blow traumas constituted 27.4%. No statistically significant difference was identified between the type of trauma and the final visual outcome.

Ocular injuries associated with traumatic hyphema

Table 4 shows the various ocular injuries that were associated with hyphema. Corneal abrasion, traumatic mydriasis, cataract, and commotio retinae were the most common injuries. These injuries, however, were not significantly associated with the final visual outcome at the time of discharge and follow-up. Twenty-seven patients from the good visual outcome group and 21 patients from the worse outcome group had posterior segment injuries. A poor visual outcome was significantly associated with macular oedema ($p < 0.001$) and macular scarring ($p = 0.009$). Recovery from these particular posterior segment injuries was poor.

Table 3. Sites and causes (mechanisms) where ocular trauma occur.

Mechanism of trauma	Outcome group		Total
	Good (≥6/18) N = 100 n(%)	Worse (<6/18) N = 17 n(%)	
At work	**54**	**12**	**66**
Nail[Δ]	34(87.2)	5(12.8)	39
Stone[Δ]	11(78.6)	3(21.4)	14
Wood[Δ]	0(0.0)	1(100.0)	1
Rope[‡]	2(100)	0(0.0)	2
Plastic Stick[‡]	4(66.7)	2(33.3)	6
Explosion	3(75.0)	1(25.0)	4
At school	**24**	**2**	**26**
Sport[Δ]	7(77.8)	2(22.2)	9
Stone[Δ]	2(100.0)	0(0.0)	2
Pencil[‡]	4(100.0)	0(0.0)	4
Shoes[Δ]	4(100.0)	0(0.0)	4
Others	7(100.0)	0(0.0)	7
At home	**16**	**0**	**16**
Plastic bullet[Δ]	4(100.0)	0(0.0)	4
Plastic stick[‡]	2(100.0)	0(0.0)	2
Cloth hanger[‡]	3(100.0)	0(0.0)	3
Toys[Δ]	2(100.0)	0(0.0)	2
Others	5(100.0)	0(0.0)	5
Outside home and school	**6**	**3**	**9**
Assault[‡]	3(60.0)	2(40.0)	5
RTA	3(75.0)	1(25.0)	4

Type of trauma [Δ]Projectile, [‡]Blow

Table 4. Ocular injuries associated with traumatic hyphema.

	Outcome group				*p*-value
	Good (≥6/18)		Worse (<6/18)		
	N = 100	%	N = 17	%	
Eye lid					
Lid laceration	7	7.0%	3	17.6%	0.160
Lid swelling	2	2.0%	2	11.8%	0.100
Cornea					
Corneal Odema	1	1.0%	2	11.8%	0.056
Corneal abrasion	50	50.0%	11	64.7%	0.262
Partial Corneal laceration	1	1.0%	1	5.9%	0.270
Angle					
Recession	11	11.0%	1	5.9%	0.999
Iris					
Traumatic mydriasis	64	64.0%	13	76.5%	0.318
Iridodialysis	17	17.0%	3	17.6%	0.999
Lens					
Dislocated lens	5	5.0%	2	11.8%	0.269
Cataract	25	25.0%	8	47.1%	0.080
Vitreous					
Vitreous Hemorrhage	0	.0%	0	.0%	–
Retina					
Commotio retina	21	21.0%	7	41.2%	0.119
Choroidal rupture	3	3.0%	2	11.8%	0.153
Macular edema	1	.1%	8	47.1%	<0.001
Retinal Hemorrhage	1	1%	0	.0%	–
Retinal detachment	0	.0%	0	.0%	–
Macular Hemorrhage	0	.0%	1	5.9%	–
Macular scar	1	1.0%	3	17.6%	0.009

DISCUSSION

Previous studies have noted that traumatic hyphema is an injury of youth, with males being at greater risk than females.[5,8,11–21] The data collected was similar to results of previously reported studies. The majority of patients in this study were 20 years old or younger.

Although some studies indicate an association between hyphema size and a poor final visual outcome, there remains some uncertainty to what extent the poor outcome is the result of the hyphema itself or to what extent it is related to complications such as rebleeding.[5,7] Read and Goldberg suggest that a poor visual outcome could be directly linked to the hyphema in approximately 10% of patients.[22] On the other hand, many researchers have reported a significant correlation between the size of a hyphema and the final visual outcome.[7,8,11,20,21,23–25] Ng et al., in their review of several studies involving 425 traumatic hyphema patients, found that the final visual outcome of patients who had a large hyphema was significantly poorer ($p < 0.001$).[14] In contrast, Rahmani et al.[26] were unable to show an association between the final visual outcome and the size of a hyphema. We similarly found that neither a poor final visual outcome nor complications were associated with the size of the hyphema. However, in our study the number of patients who had grade 3 or grade 4 hyphemas was too small to be of any statistical significance. Most of the patients in our study who had a small hyphema did not suffer rebleeding, develop glaucoma, or have corneal blood staining. The majority recovered with good vision. A similar finding has been reported by other researchers.[27,28]

Some researchers have found that the final VA in traumatic hyphema patients improves from the initial VA. For example, Shiuey and Lucarelli[25], and Kearns[15], report that 96% and 75% of patients, respectively, have a good visual outcome (VA $\geq$ 6/18). In our study, the final visual outcome was 6/18 or better in 85.5% of patients who presented with traumatic hyphema. Our results are similar to that obtained by Wilson et al.[18] and Cho et al.[5].

Our study indicates that traumatic hyphema cases are more prevalent in the left eye than in the right eye. Left eye hyphemas have a worse final visual outcome than right eye hyphemas. This difference is statistically significant ($p < 0.001$). The preponderance of left eye hyphemas may be explained by the fact that there are usually more right-handed people in a population. A projectile thrown with the right hand is more likely to hit the opposite eye (i.e., left eye) of the victim.[3,21,24]

We found that work-related ocular traumas were more common than traumas occurring at school, home, or as a result of an assault.[8,29,30] Other researchers have had contrasting results. For example, Kearns[15] found that sports-related injuries are four times more common than work-related injuries along with others,[10,19] and various researchers report the home as the most common location where all types of trauma occur.[13,18]

Although projectile injuries to the eye accounted for 65.8% of traumatic hyphema cases and blow injuries accounted for 27.4% of cases in our study, we found that the type of injury (projectile vs. blow) had no significant effect in the final visual outcome. This result is similar to that obtained by Cho et al.[5].

Some research indicates that the final visual outcome may depend on the severity of associated intraocular injuries.[5,7,31,32] Ng et al.[14] and Rahmani et al.[26] showed that retinal damage is a significant contributor to a worse final visual outcome. Kearns[15] and Talmon et al.[33] showed that choroidal rupture, and retinal detachment or retinal tear are the most frequent injuries responsible for poor visual outcome. In our study, a poor final visual outcome was associated with posterior segment injuries. Macular oedema, macular haemorrhage, and macular scarring were significant factors for a poor final visual outcome in our study.

Although permanent visual loss has been directly linked to posterior injuries,[6] anterior segment injuries may cause an initial decrease in VA. Anterior segment injuries such as traumatic mydriasis or iridodialysis may not significantly compromise the visual function. However, these injuries are likely to reflect the severity of the initial trauma. On the other hand, corneal oedema and cataracts significantly affect the vision. Nearly 33 patients out of the 117 patients in this study with traumatic hyphema developed some lens changes, and 9 of the patients required cataract extraction. The majority of contusional cataracts remained localized to the anterior and posterior subcapsular and cortical regions and were typically non-progressive. Eyes that showed progressive lens changes usually required surgery within 18 months after injury.[34]

Two problematic complications associated with hyphema are rebleeding and secondary glaucoma. Both are associated with a worse visual outcome. Intervening early when symptoms of these complications appear may help a hyphema patient maintain their vision.

We observed the recurrence of bleeding between the third and fifth day after the trauma. Only one patient had rebleeding on the seventh day after an AC washout. A study by Papaconstantinou et al., showed a similar range of days for the onset of rebleeding.[9] Our patients had a 6.8% incidence rate of rebleeding. This rate is in keeping with the range of incidence rates (5% to 10%) found in various European studies involving a large number of hyphema patients who underwent conservative

treatment.[4,5,24,25] (These incidence rates, however, are considerably lower than the incidence rates (ranging from 3.5% to 38%) found in most American studies. This contrast may be related to the racial makeup of the subjects used in the studies.[4,5,7,11,12,18,19,26,27] For example, Spoor et al., found that rebleeding is significantly more frequent in African-American patients than in Caucasians.[12] Some researchers suspect that this outcome may be due to racial differences in the melanin content of the iris.[7] This speculation is based on the results of an animal study in which researchers injected melanin into the eyes of rabbits that had a hyphema.[4] The administration of melanin prolonged the resorption of the blood and affected the rate of rebleeding in the rabbits' eyes.[6,7]

Rahmani et al., demonstrated that the final vision of patients who have rebleeding is worse than the final vision in patients who do not have rebleeding.[26] Our study results corroborate previous studies indicating that rebleeding is associated with a poorer visual outcome.[6,7,13,24,25] By contrast, Kearns et al.[15] and Ng et al.[11,14], found that rebleeding is not associated with a poor visual prognosis, even in those patients who had a total hyphema that required an AC washout. Results of a study by Cho et al.[5] indicate that rebleeding is an uncommon complication and is not associated with a poor visual prognosis.

About 25% of hyphema patients will have a transient (i.e., acute) elevation in IOP greater than 25 mm Hg.[5,9] Increased IOP is a frequent complication of traumatic hyphema that may result in secondary glaucoma and impaired vision. This elevation may be due to trabecular meshwork obstruction by red blood cells, platelets, and fibrin, or may be due to direct damage to the trabecular meshwork. The transient elevation of IOP was not associated with a poor final visual outcome in our study. This result is similar to the findings obtained by Cho et al.[5] Secondary glaucoma, developing weeks to years after a hyphema may result from posterior synechiae formation with iris bombi, peripheral anterior synechiae, ghost cell, or angle recession. In our study, secondary glaucoma occurred in 14.5% of patients and was significantly associated with a poor final visual outcome. This finding is similar to the results obtained by Cho et al.[5] and Warid et al.[21] By contrast, Kearns[15] found that secondary glaucoma is a rare complication.

It has been reported that 6% to 10% of patients with traumatic hyphema develop late glaucoma in association with angle deformity.[5,6,17] Despite examination by gonioscopy, we could not reach a conclusion concerning the prevalence of angle recession in our patients. However, it is recognised that glaucoma due to angle recession is rare. Secondary glaucoma reportedly occurs only when the angle recession is between 180 and 240 degrees.[15,34] The follow-up period in our study was too short to assess the true incidence of glaucoma.

Corneal blood staining was seen in only one patient resulting in a incidence of 1.25%. This incidence is lower than the 2% to 11% incidence reported by Wilson et al.[18]

CONCLUSION

We conclude that hyphema resulting from a blow trauma has no greater influence on the final visual outcome than does a hyphema resulting from a projectile trauma. We failed to find a significant association between a large-sized hyphema and a poor final visual outcome. We found that high risks for a poor final visual outcome are rebleeding and posterior segment injuries. In addition, glaucoma is significantly associated with a poor final visual outcome after a traumatic hyphema. We therefore recommend long-term follow-up examinations for hyphema patients in order to detect the late onset of secondary glaucoma.

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