



Original Research Article

A clinical profile of raised intraocular pressure in closed globe injury and its management

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ABSTRACT

Aims: We studied the clinical profile of patients with raised intraocular pressure (IOP) in closed globe injury and outcome of medical and surgical management.

Methodology: A prospective, interventional study of 32 patients diagnosed with raised IOP following closed globe injury, who presented to a tertiary care centre during the period of November 2018 to May 2020.

Result: Most patients (59%) were young, age group of < 40 years. 71.9% were males. Left eye was involved in 53.1%. Mean duration of presentation after injury was 4.38 days. Most common mode of injury was industrial accidents (28%). Mean IOP at presentation was 29.19 ± 7.342 . Vision at presentation was $\leq 6/60$ in 18.75%. Anterior segment injury was most common. On gonioscopy, 13 eyes (41%) had open angles, 1 eye (3.1%) had closed angle and deferred in rest. Angle recession was present in 2 eyes. 3% of eyes had increased cup-disc ration (CDR) > 0.7 . 68.75% were managed medically and 31.2% surgically. In the medical group, mean initial IOP was 26.18 ± 5.124 mm Hg and at 12 months was 14.83 ± 2.287 mm Hg ($p < 0.0001$). A 44% reduction of IOP seen. The initial and final IOP in surgical group was 35.80 ± 7.330 and 18.60 ± 3.777 respectively with a ($p < 0.0001$). A reduction of 48% IOP was seen at the end of 12 months in surgical group. There was no significant difference between medical and surgical intervention.

Conclusion: There was no significant difference between medical and surgical intervention while treating glaucoma secondary to closed globe injury.

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1. Introduction

Ocular trauma is an important cause of visual morbidity. The prevalence of ocular trauma in India is 2.4%.¹ Blunt trauma occur commonly during games and assault.²

Closed globe injury is an injury where the eyewall doesn't have full thickness wound. It is caused by partial thickness sharp force (lamellar laceration), blunt force (contusion), and superficial foreign body.³ A serious complication of ocular trauma is secondary glaucoma.⁴

This is a major concern because many cases go unnoticed. Without close follow-up, patients are diagnosed years later with irreversible glaucomatous optic nerve damage.

An attempt to recognise the causes of raised intraocular pressure (IOP) following blunt trauma, severity of disease and its management is made in this study.

2. Materials and Methods

This hospital-based, prospective interventional study was conducted at a tertiary care centre in South India, between November 2018 to May 2020. After obtaining ethics

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clearance from Institutional Ethics Committee, 32 patients attending the glaucoma department with closed globe injury followed by raised IOP of > 21 mm Hg willing to give a written, informed consent were included in the study. Patients with pre-existing primary open angle or angle closure glaucoma, secondary glaucoma due to systemic or ocular pathology, penetrating/perforating injury, history of previous ocular surgery or unwilling to give consent for the study were excluded from the study. A detailed medical and ocular history was taken in a pre-structured proforma. Best corrected visual acuity (BCVA) testing was done on Snellen's chart. A careful slit-lamp examination was done to assess anterior and posterior segment. Intraocular pressure (IOP) measurement was done using Goldmann applanation tonometer. Gonioscopy was performed using a Sussman type 4 mirror hand-held gonioscope. Gonioscopy was deferred in patients with hyphaema for 1 month. Stereoscopic evaluation of the fundus and disc was performed using +90D/+78D and 20D. The data was recorded.

The cases were followed up - at one week, at 1 month, at 3 months, at 6 months and at 12 months. At each visit, patient's BCVA was tested by Snellen's, slit lamp examination, IOP measurement by Goldmann's applanation tonometer, gonioscopy using a Sussman type 4-mirror handheld gonioscope, stereoscopic fundus examination using +90D/+78D was undertaken. Visual fields using Humphrey automated perimetry was done at 1-, 3-, 6- and 12-month's interval. Response to treatment was assessed based on IOP reduction to target IOP range, as measured on Goldmann applanation tonometer. Patients who were on anti-glaucoma medications, compliance to treatment was checked at every visit and response to treatment was assessed based on IOP reduction. Medication was chosen based upon IOP control, target pressure, status of optic nerve head, visual fields and compliance of patients to medical treatment.

Patients in whom the hyphaema was non resolving with uncontrolled IOP or blood stained cornea were taken up for paracentesis after obtaining written informed consent. Patients having lens dislocation /subluxation were taken up for lensectomy ± Intraocular lens (IOL) implantation after obtaining written informed consent. Patients with traumatic cataract which was visually significant were taken up for small incision cataract surgery (SICS) with or without IOL implantation after obtaining written informed consent. Trabeculectomy alone or with combined cataract extraction was planned in patients in whom IOP remained uncontrolled despite maximally tolerated medical therapy, progressive glaucomatous damage on maximum medical therapy and with corresponding visual field changes, patient unable to tolerate or adhere to medical regimen after obtaining written informed consent.

The data was entered in MS Excel spread sheet and analysis using IBM SPSS version 24.0 software. Results presented as descriptive statistics in the form of mean/proportion and percentage and possible association was derived by using suitable parametric and non-parametric tests of significance. Results are presented as tables, charts and figures applicable.

3. Results

Maximum patients were in the age group of < 40 years (59%). (Table 1) 7 patients (22%) were ≤ 20 years. 12 patients (37%) belonged to 21-40 years and 13 patients (41%) belonged to 41 to 60 years. Minimum and maximum age being 8 and 60 years respectively. Mean age distribution of study participants. SD 15.02) years.

Table 1: Age distribution of study participants

Age	Number	Percentage (%)
≤ 20 Years	07	22%
21 to 40 Years	12	37%
41 to 60 Years	13	41%
Total	32	100.0
Mean ± SD	34.06 ± 15.020	
Minimum age	08	
Maximum age	60	

23 (71.9%) of study participants were males and 9 (28.1%) were females. (Figure 1)

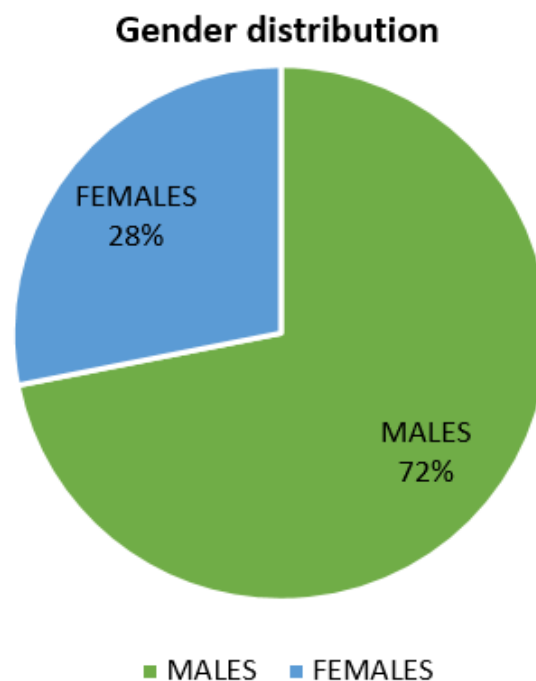


Fig. 1: Gender distribution of study participants

In our study, right eye was involved in 15 (46.9%) subjects and left eye in 17 (53.1%) subjects. (Figure 2)

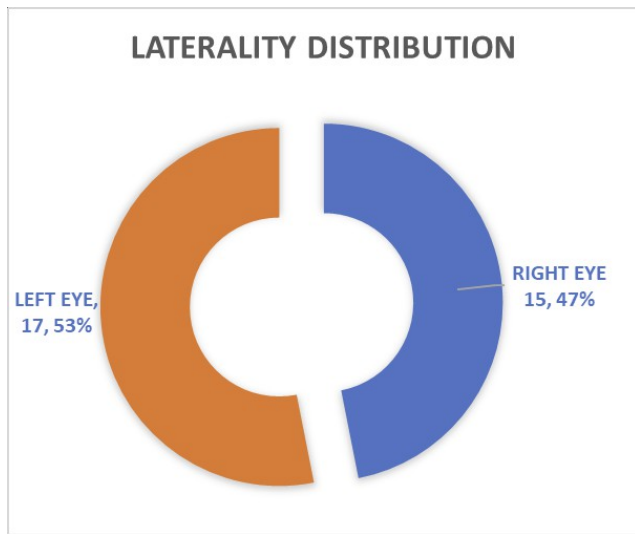


Fig. 2: Laterality distribution of study participants

29 (91%) subjects presented < 10 days of injury while only 3 (9%) subjects presented > 10 days of injury. The mean duration of presentation was 4.38 days. (Table 2)

Table 2: Time of presentation of study participants

Time	Number	Percentage (%)
≤10 Days	29	91.0
>10 Days	03	9.0
Total	32	100.0
Mean ± SD	4.38± 6.328	
Minimum duration	01	
Maximum duration	30	

Most common mode of blunt injury was industrial accidents (28%), followed by injury while playing (25%) and home accidents (25%). Injuries while farming accounted for 9.4% of total injuries. The least common causes being assault (6.3%) and road traffic accident (6.3%). (Table 3)

Table 3: Cause of injury in study participants

Cause	Number	Percentage (%)
Assault	2	6.3
Injuries while farming	3	9.4
Home accident	8	25.0
Industrial accident	9	28.1
Injuries while playing	8	25.0
RTA (road traffic accident)	2	6.3
Total	32	100.0

23 eyes (72%) had IOP between 21-30 mm Hg, 5 eyes (15.5%) had IOP between 31-40 mm Hg and 4 eyes (12.5%) had IOP in the range of 41-50 mm Hg. Mean + SD being 29.19 ± 7.342 mm Hg. Minimum and maximum IOP are 22 mm Hg and 50 mm Hg respectively. (Table 4)

Table 4: Cause of injury in study participants

IOP range	Number of eyes	Percentage (%)
21-30 mm Hg	23	72
31-40 mm Hg	5	15.5
41-50 mm Hg	4	12.5
Total	32	100.0
Mean ± SD	29.19 ± 7.342	
Minimum IOP	22	
Maximum IOP	50	

2 (6%), 2 (6%), 4 (13%), 10 (31%), 5 (16%), 3 (9%), 6 study subjects (19%) had vision of 6/9, 6/12, 6/18, 6/24, 6/36, 6/60 and Hand movements respectively. (Table 5)

Table 5: Initial vision of study participants

Initial vision on snellen's Chart	Number of Patients
6/9	02
6/12	02
6/18	04
6/24	10
6/36	05
6/60	03
Hand movements	06

At presentation, anterior chamber reaction was seen in 15 patients (46.9%). 16 patients (43.8%) did not have anterior chamber reaction while in 3 patients (9.3%) it could not be assessed due to total hyphaema. (Table 6)

Table 6: Inflammation distribution of study participants

Inflammation	Number	Percentage (%)
Present	15	46.9
Not present	14	43.8
Could not be assessed	03	9.3
Total	32	100.0

Corneal injury at presentation was seen only in 3 subjects (9%) with all being lamellar tears while remaining 29 patients (91%) had no corneal injury. (Table 7)

Table 7: Cornea injury distribution of study participants

Corneal Injury	Number	Percentage (%)
Present (Lamellar tear)	3	9.4
No	29	90.6
Total	32	100.0

Hyphaema on presentation was seen in 18 eyes (56.2%) while remaining 14 eyes (43.8%) had no hyphaema. Out of

18 eyes, 10 eyes (55.5%) had grade 1, 5 eyes (27.7%) had grade 2, 0 eyes (0%) had grade 3, 3 eyes (16.6%) had grade 4 hyphaema. (Table 8)

Table 8: Hyphaema distribution of study participants

Hyphema	Number	Percentage (%)
Present	18	56.2
Absent	14	43.8
Total	32	100

6 eyes (19%) had iris injury, 23 eyes (72%) did not have iris injury and in 3 eyes (9%) eyes, details could not be visualised. Out of 6 eyes with iris injury, 5 had sphincter tear (83%) and 1 eye had traumatic mydriasis (17%). (Table 9)

Table 9: Iris injury distribution of study participants

Iris injury	Number	Percentage (%)
Present	06	19
Absent	23	72
No view	03	09
Total	32	100.0

8 eyes (25%) had lens injury, 21 eyes (66%) did not have lens injury and 3 eyes (9%) had no view. Out of 8 eyes, 5 (62.5%) developed traumatic cataract, 2 (25%) had inferior subluxation and 1 (12.5%) had anterior dislocation. (Table 10)

Table 10: Lens injury distribution of study participants

Lens	Number	Percentage (%)
Present	08	25
Absent	21	66
No view	03	09
Total	32	100.0

27 eyes (84.5%) had no vitreous disturbance, 4 eyes (12.5%) had no view at presentation (3- total hyphaema and 1- anterior dislocated lens with hazy cornea) and 1 eye (3%) had mild vitreous haemorrhage which was not significant to hinder disc visualization. (Table 11)

Table 11: Vitreous disturbance of study participants

Vitreous	Number	Percentage (%)
Present	1	3
Absent	27	84.5
No view	4	12.5
Total	32	100.0

27 eyes (84.5%) had no choroidal injury, 4 eyes (12.5%) had no view at presentation (3- total hyphaema and 1- anterior dislocated lens with hazy cornea) and 1 eye (3%) had choroidal rupture. (Table 12)

The disc findings of study subjects at various follow ups are given in the Table 13.

Table 12: Choroidal injury distribution of study participants

Choroidal injury	Number	Percentage (%)
Present	1	3
Absent	27	84.5
No view	3	12.5
Total	32	100.0

The gonioscopy findings of study subjects at various follow ups are given in the Table 14.

The IOP trend of each patient at various follow up periods is shown in the Figure 3.

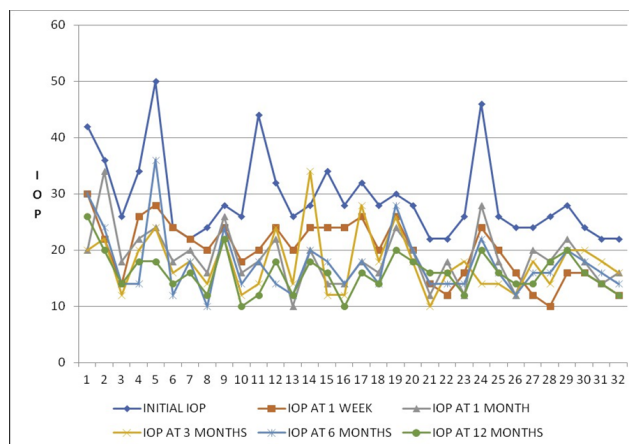


Fig. 3: IOP trend of study participants at various time intervals

Out of 32 eyes, 22 eyes (68.75%) were managed by medical therapy alone. 10 eyes (31.25%) underwent surgical management. Out of these, 6 eye surgeries were attributable to failed medical management. (Table 15)

3.1. Medical therapy

22 eyes (37.6%) were managed by medical therapy alone. Medical therapy failed in 6 eyes (18.75%) which were managed later by surgery. The mean number of antiglaucoma medications at the start of therapy was 2.6 which reduced to 1.6 at 6 months and 1.1 at 12 months. The mean IOP at presentation was 26.18 ± 5.124 mm Hg and at 12 months was 14.83 ± 2.287 mm Hg with a p value of <0.0001 . A reduction of 44% IOP was seen at the end of 12 months in medical group. (Figure 4)

3.2. Surgical therapy

10 eyes (31.2%) underwent surgical procedures. Out of these, 2 eyes had two surgical procedures at some point of their follow-up. The various procedures undertaken are mentioned in the Table 17.

Surgical management at each follow-up is shown in Table 18.

Table 13: Disc distribution of study participants

Disc	Presentation	1 Week	1 st Month	3 Months	6 Months	12 Months
No view	05(15.6%)	01(3.1%)	01(3.1%)	0(0.0)	0(0.0)	0(0.0)
Grossly visible	03(9.4%)	03(9.4%)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
CDR 0.3	24(75%)	28(87.5%)	28(87.5%)	27(84.5%)	24(75%)	24(75%)
CDR 0.5-0.7	0(0.0)	0(0.0)	02(6.3%)	04(12.5%)	07(22%)	07(22%)
CDR >0.7	0(0.0)	0(0.0)	01(3.1%)	01(3%)	01(3%)	01(3%)
Total	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)

Table 14: Gonioscopy finding distribution of study participants

Gonioscopy	Presentation	1 st Week	1 st Month	3 Months	6 Months	12 Months
Deferred	18(56.2%)	18(56.2%)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Open	13(40.7%)	14(43.8%)	29(90.6%)	28(87.6%)	26(81.3%)	26(81.3%)
Closed	1(3.1%)	0(0%)	1(3.1%)	2(6.2%)	04(12.5%)	04(12.5%)
Angle	0(0.0)	0(0.0)	2(6.2%)	2(6.2%)	2(6.2%)	2(6.2%)
Recession						
Total	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)

Table 15: Management modality of study participants

Management	Number of patients	Percentage (%)
Medical therapy	22	68.75
Surgical	10	34.4
Total	32	100.0

Table 16: Management modality of study participants at each follow up

Management	Presentation	1 st Week	1 st Month	3 Months	6 Months	12 Months
Medical	31(96.9%)	29(90.6%)	30(93.7%)	29(90.6%)	29(90.6%)	32(100.0)
Surgical	01(3.1%)	03(9.4%)	02(6.3%)	03(9.4%)	03(9.4%)	0(0.0)
Total	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)	32(100.0)

Table 17: Surgical management of study participants at each visit. IOL – Intraocular lens; MMC –Mitomycin C

Surgical management	Number of eyes	Percentage (%)
Cataract removal + IOL implantation	04	33.33
Paracentesis	01	8.33
Trabeculectomy +MMC	04	33.33
Cataract removal + IOL implantation + Trabeculectomy	03	25

Table 18: Surgical management of study participants at each visit. IOL – Intraocular lens; MMC –Mitomycin C

Surgical management	At presentation	1 Week	1 Month	3 Months	6 Month	12 Month
Cataract removal +IOL implantation	01(8%)	02(17%)	01 (8%)	0(0.0)	0(0.0)	0(0.0)
Paracentesis	0(0.0)	01(8%)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Trabeculectomy +MMC	0(0.0)	0(0.0)	01(8%)	02(17%)	01(8%)	0(0.0)
Cataract removal + IOL implantation + Trabeculectomy	0(0.0)	0(0.0)	0(0.0)	01(8%)	02(17%)	0(0.0)

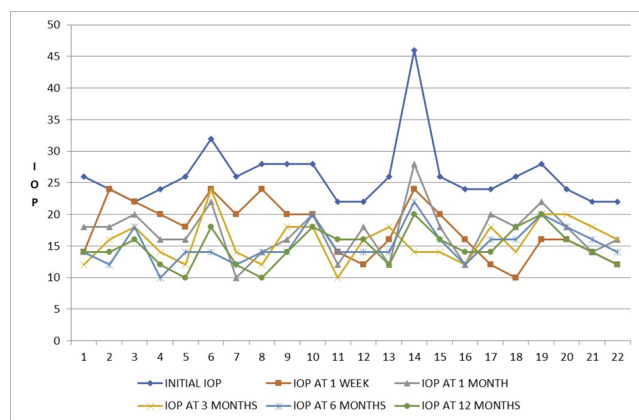


Fig. 4: Graph depicting mean IOP in medical group at each visit

3.3. Medical v/s surgical treatment

The mean difference of IOP with standard deviation in medical and surgical group was 11.364 ± 4.635 and 17.200 ± 8.651 . (Table 19)

Table 19: Mean IOP in medical and surgical group at various visits

Mean IOP at various visits	Medical	Surgical
Initial IOP	26.18	35.8
IOP at 1 week	17.64	25
IOP at 1 month	17.18	22
IOP at 3months	15.82	22.2
IOP at 6months	15.18	23
IOP at 12months	14.82	18.6

3.4. Final vision distribution

24 eyes (75%), 4 eyes (12.5%), 3 eyes (9.4%) and 1 eye (3.1%) had a vision of 6/6, 6/12, 6/18 and 6/24 respectively.

Table 20: Final vision of study participants

Final vision on Snellen’s chart	Number of Patients
6/6	24
6/12	04
6/18	03
6/24	01

The mean of initial vision and final vision was 0.94 ± 0.69 and 0.10 ± 0.19 with a p value of <0.0001 .

4. Discussion

4.1. Age of incidence

Mean age of our study subjects was 34.06 (SD 15.02) years. Studies conducted by Girkin et al⁵ and Ozer et al⁶ reported a mean age of presentation of 35.1(SD 19.9) and 31.78(SD

4.2. Years respectively

Danenberg et al⁷ in their study of 635 patients has reported that 75% of the patients with ocular traumas are <40 years. According to the study conducted by Jain BS, Sony SR, the maximum incidence of ocular injuries were seen in the age group of 16 to 30 years (63%) and in children below 16 years (23.2%) mostly due to unsupervised play by their parents.⁸ Our study and previous studies mentioned above highlights the fact that ocular trauma is quite common in younger age group probably because of outdoor work seen in adults, recreational activities in children, teens.

4.3. Sex predisposition

23 (71.9%) of our study participants were males and 9 (28.1%) patients were females. Studies conducted by Girkin and Ozer et al^{5,6} showed affected males to be 79.9% and 87.1% respectively. A study conducted by Ligget et al⁹ on 931 ocular injury patients consisted of 82% males and 18% females. Our study and a few studies quoted above shows a male preponderance. This can be accounted for more outdoor activities, strenuous physical work in male population across the globe.

4.4. Laterality distribution

In our study, right eye was involved in 15 (46.9%) patients and left eye was involved in 17 (53.1%) patients. In contrast to our study, Girkin et al⁵ reported a right eye predominance of 60.2%. Danenberg et al,⁷ in their study on 635 patients noted 50% involvement of the right eye and 49.6% involvement of the left eye with bilateral involvement in 0.4% patients. Ligget et al⁹ found involvement of the right eye in 43% of the patients and left eye involvement in 41% of the patients with bilateral involvement in 11% of the patients in their study of 931 patients. Most of the studies showed right eye predominance while our study showed left eye predominance. We could not rationalize the same.

4.5. Time of presentation

29 (91%) patients presented to our regional eye institute within ten days of injury while only 3 (9%) patients presented to us ten days after injury. The mean duration of presentation in our study was 4.38 days. According to study conducted by Sihota et al,² it was 9.5 days. Time of clinical presentation after ocular injury depends on various factors like severity of presentation, locality of hospital, transport facilities, education and financial status of patient. Early clinical presentation in our study can be attributed to easily accessible and affordable services of our centre for ophthalmology run by government services (RIO, Bangalore) in this geographical area.

4.6. Cause of injury

In our study, most common mode of blunt injury was industrial accidents (28%), second most common being play injury (25%) and home accidents (25%) followed by farm accidents (9.4%), with least common being assault and road traffic accident (6.3%). Usha vasu et al¹⁰ conducted a retrospective study on occupational globe injury and found that 43 out of the 129 cases (33.3%) to be occupation related. Karaman K et al¹¹ have reported in their study that only 13.8% of the injuries are related to agriculture and our study constituted 9.4% of farm injuries. Patrick Kearns¹² in his retrospective study of 314 cases has reported 17.8% of the injuries to be home accidents, 9.95% to be work accidents and assault 10.8% of injuries. Punnonen et al¹³ found that 40% of the ocular trauma is due to domestic/playing accidents and 36% were occupational. Though agriculture is the main occupation in India, since the study was conducted in a metro city like Bangalore, industrial accidents were predominant compared to farm accidents. However, occupational injury to eye was more common in our study which is in accordance to study conducted by Usha Vasu et al.¹⁰

4.7. Intraocular pressure at presentation

Our study group had a mean IOP of 29.19 ± 7.34 mm Hg at presentation. 23 (72%) of our study participants had an IOP between 21-30mm Hg, 5 (15.5%) patients had an IOP between 31- 40mm Hg and 4 (12.5%) patients had an IOP in the range of 41-50 mm Hg. Study conducted by Ozer et al⁶ had a mean IOP of 21.97 ± 9.81 at presentation which is less than our study.

4.8. Vision at presentation

26 (72%) patients had an initial vision of $\geq 6/60$ while 6 (28%) patients had $\leq 6/60$ on Snellen's chart. Study conducted by Ozer et al⁶ had an initial vision of $\geq 6/60$ in 78% patients and only 22% had $\leq 6/60$ vision.

4.9. Anterior segment findings

Closed globe injury caused by blunt trauma predominantly involves anterior segment. Corneal involvement was seen in 9.4% of our study subjects which were all lamellar tears. A study conducted by Girkin et al⁵ reported corneal injuries in 2% study subjects. In both of our studies, corneal injuries were seen in < 10% of study participants.

Scleral injury was seen in 0% of our study subjects which is in accordance with the study conducted by Ozer et al.⁶

Inflammation in anterior chamber was seen in 46.9% of cases in our study. While study conducted by Girkin et al⁵ revealed inflammation only in 14.7% study participants.

Hyphema was seen in 18 (56.2%) cases, out of which 55.6%, 15.6%, 0%, 9.4% had grade 1,2,3,4 hyphema

respectively. Most of the patients having hyphema were mild degree in our study. Girkin et al⁵ reported hyphema in 58.3% patients⁶ while Ozer et al⁶ reported hyphema in 49.9% of study population. Sihota et al² reported hyphema in 92.5% of cases and showed that traumatic glaucoma occurred in most of the hyphema patients. Angle recession is a frequent complication of traumatic hyphema.

Out of eighteen (56.2%) hyphema eyes in our study, only two (11%) eyes showed angle recession which is in contrast to the study conducted by Blanton et al¹⁴ where angle recession was seen in 71% in traumatic hyphema cases.

Iris injuries were found in 19% of our study subjects, out of which 83% had sphincter tears and 17% traumatic mydriasis. Girkin et al⁵ too reported 19.6% of iris injury in their study. A retrospective study conducted by Canavan et al¹⁵ reported 37.3% iris injuries in blunt trauma, out of which only 27.8% had sphincter tears whereas it was 83% in our study.

Lens injuries were seen in 8 (25%) eyes in our study. Out of which 5 eyes (62.5%) had traumatic cataract (one-anterior capsular cataract, two- posterior capsular cataract, one- typical rosette cataract and one mature cataract). 2 eyes (25%) had inferior Subluxation and one eye (12.5%) had anterior dislocation. A study conducted by Girkin et al⁵ reported 39.2% lens injuries attributable to post traumatic glaucoma after ocular contusion which is more than our study.⁶ Ozer et al reported 16% lens injuries in blunt trauma which is lesser than our study.

4.10. Posterior segment findings

Unlike anterior segment, posterior segment is not commonly involved in closed globe injuries. Our study had posterior segment findings in only two eyes (6.25%). 1 eye (3.1%) had vitreous hemorrhage of grade 2, 1 eye (3.1%) had choroidal rupture. Girkin et al⁵ reported 0.5% vitreous injury and 2% choroidal injury which is similar to our study. Sihota et al⁶ reported 17.5% vitreous hemorrhage and 20% choroidal rupture which is more than our study.

4.11. Gonioscopy findings

Gonioscopy was deferred in all cases of hyphema for one month to prevent re-bleeding. At presentation, gonioscopy was deferred in 18 eyes (56.2%). 13 eyes (41%) had open angles, 1 eye (3.1%) had closed angle, a case of phacotopic glaucoma due to anterior dislocation of lens. At one month, 2 eyes (6.2%) had angle recession of 90° and 180° respectively. At the end of one year, 26 eyes (81.2%) had open angles, 4 eyes (12.5%) had closed angles due to synechiae, and two eyes (6.2%) had angle recession. A study conducted by Canavan et al¹⁵ showed angle recession in 80.5% cases following blunt trauma.

4.12. Disc findings

24 eyes (75%) had normal disc with CDR 0.3 while 7 eyes (22%) had CDR 0.5-0.7 and one eye (3%) had CDR > 0.7.

4.13. Management details

Out of 32 eyes, 22 eyes (68.75%) were managed by medical therapy alone. 10 eyes (31.25%) underwent surgical management either due to failed medical management of glaucoma (six cases), anterior dislocation of lens (one case), inferior subluxation of lens (two cases), 1 mature traumatic cataract.

4.14. Medical management

Medical therapy is usually the first line of treatment. In our study, 22 eyes (68.75%) were managed by medical therapy alone. Medical therapy failed in six eyes (18.75%) which were managed later by surgery. Drug therapy was based upon target IOP to be achieved, cup disc ratio, visual field changes and patient compliance to drugs. Beta blockers, alpha agonist, carbonic anhydrase and prostaglandin analogues were used either singly or in combination based on the clinical condition of the patient. Prostaglandin analogues and miotics were avoided in cases with significant inflammation in the anterior segment. Mean number of antiglaucoma medications at the start of therapy was 2.6 which reduced to 1.6 at 6 months and 1.1 at 12 months. The mean IOP at presentation was 26.18 ± 5.124 mm Hg and at 12 months was 14.83 ± 2.287 mm Hg with a p value of <0.0001. A reduction of 44% IOP was seen at the end of 12 months in medical group. In a study conducted by Ozer et al,⁶ 45.7% study participants were managed medically.

4.15. Surgical management

Surgical procedures were done on 10 eyes (31.2%) in our study. Indications include non-compliance to drug therapy, intolerance to medical therapy, inadequate IOP control despite maximal medical therapy, lens involvement, non-resolving hyphema and blood-stained cornea. 3 eyes (25%) underwent lensectomy + IOL implantation. The IOL implanted was iris claw. These were done in cases with lens subluxation and anterior dislocation. 1 eye (8%) underwent AC wash for total hyphema. one eye (8%) underwent small incision cataract surgery for traumatic mature cataract. Filtration surgeries were done on 7 eyes (59%). Out of these, trabeculectomy + mitomycin C (MMC) was done on 4 eyes (34%) and triple procedure (Trabeculectomy with Small incision Cataract Surgery with Rigid PCIOL was done on three eyes (25%). Trabeculectomy remains the gold standard in surgical management of glaucoma. Studies show that success rate of trabeculectomy in secondary glaucoma (48%) was low compared to primary glaucoma (74%). 2 cases in our study underwent two surgical procedures at

some point of time during their follow up, out of which one underwent anterior chamber wash for total hyphema at one week followed by trabeculectomy with MMC six months later. Another case underwent lensectomy + IOL implantation at one week followed by trabeculectomy with MMC at six months. The initial IOP and final IOP in surgical group was 35.80 ± 7.330 mm Hg and 18.60 ± 3.777 mm Hg respectively with a p value of <0.0001. A reduction of 48% IOP was seen at the end of 12 months in surgical group.

4.16. Medical v/s surgical treatment

The mean difference of IOP in medical and surgical group was 11.364 ± 4.635 and 17.200 ± 8.651 . This shows that medical and surgical therapy did reduce final IOP of the patient but there was no significant difference between medical and surgical intervention.

4.17. Final vision distribution

24 eyes (75%) had 6/6 vision, 4 eyes (12.5%) had 6/12, 3 eyes (9.4%) had 6/18, 1 eye (3.1%) had vision of 6/24 on Snellen's chart. Best vision being 6/6 and worst 6/24. The mean of initial vision and final vision was 0.94 ± 0.69 and 0.10 ± 0.19 with a p value of <0.0001. There was significant improvement in vision in most of our patients at the end of one year follow up. But these patients need lifelong follow up in injured eye and also normal eye as few studies have shown that development of glaucoma is not uncommon in the normal eye later in life. Filtration surgeries may fail at a later date necessitating drug therapy or addition of drugs, thus mandating follow up of such patients.

5. Conclusion

Ocular trauma is one of the potential causes of visual morbidity which is preventable. One of the most visual threatening complications of ocular trauma is secondary glaucoma. Closed globe injury following blunt injury is quite common in young adults and children with play and accidental injuries. It is not uncommon to neglect such injuries. Glaucoma that follows trauma is a major concern because many cases may go unnoticed and without close follow-up are diagnosed many years later as having irreversible glaucomatous optic nerve damage. Prompt diagnosis and early treatment is the key to prevent blindness occurring due to traumatic glaucoma.

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7. Conflict of Interest

The authors declare no conflict of interest.

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