

## Research Article

## Evaluation of Traumatic Corneal Rupture Treatment Outcome in dr. Cipto Mangunkusumo Hospital: Two Years Retrospective Study

Brenda Hayatulhaya,\* Syska Widyawati

Department of Ophthalmology Faculty of Medicine Universitas Indonesia –  
RSUPN dr. Cipto Mangunkusumo, Jakarta

\*Corresponding author: brendahayatulhaya@gmail.com

Received 11 October 2021; Accepted 25 January 2022

<https://doi.org/10.23886/ejki.9.84.208>**Abstract**

Open globe injury is an injury that requires prompt treatment which could predict the final outcome. This study evaluates the characteristics and outcome of corneal rupture management in dr. Cipto Mangunkusumo National Hospital's emergency room. We conducted a retrospective study based on the patient's medical record between January 2016 – December 2017. Data regarding patients' demographic, clinical characteristics according to Birmingham Eye Trauma Terminology Score (BETTS) criteria, duration of trauma to surgery, use of early topical steroid, one month visual function result, and risk of endophthalmitis were collected. A repeated ANOVA test with post-hoc Bonferroni was used to compare the mean of a paired numeric variable. A total of 163 patients with corneal rupture were recorded, consisted of mostly male (92%) and median age of 27 years old. We found 36.8% cases occurred in the household, 71% cases in the zone I, 62.6% penetrating cases, and mostly came with 4/200-light perception visual acuity (VA) for all zones, mostly caused by inorganic materials and 50.9% cases involved lens. Endophthalmitis was higher in inorganic causes (69.2% vs 30.8%,  $p=0.33$ ). A total of 95.2% of cases performed surgical treatment in < 24 hours. In post-operative follow up, 53.3% of cases did not need re-operation or proceeding surgery. Several risk factors might affect the treatment outcome of eye injury. Most rupture occurred at zone I. Administration of topical steroids directly post-surgery was not associated with the incidence of endophthalmitis.

**Keywords:** eye trauma, open eye injury, treatment outcome.

## Evaluasi Tata laksana Ruptur Kornea Traumatik di RSUPN dr. Cipto Mangunkusumo: Studi Retrospektif Dua Tahun

**Abstrak**

Trauma mata terbuka merupakan cedera yang membutuhkan tatalaksana segera yang dapat memprediksi untuk hasil akhir. Penelitian ini mengevaluasi karakteristik dan hasil tatalaksana trauma mata terbuka di Unit Gawat Darurat Rumah Sakit Umum Pusat Nasional dr. Cipto Mangunkusumo. Peneliti melakukan studi retrospektif menggunakan rekam medis pasien bulan Januari 2016-Desember 2017. Data yang dianalisis meliputi data demografis, karakteristik klinis pasien berdasarkan kriteria Birmingham Eye Trauma Terminology Score (BETTS), durasi kejadian hingga Tindakan bedah, penggunaan tetes mata steroid setelah operasi, tajam penglihatan 1 bulan setelah operasi serta risiko endoftalmitis. Tes ANOVA dan post-hoc Bonferroni dinilai untuk membandingkan rerata variabel numerik berpasangan. Terdapat total 163 pasien dengan ruptur kornea pada penelitian ini, Sebagian besar subjek laki-laki (92%) dan median usia 27 tahun. Sebanyak 36,8% kasus terjadi di rumah, 71% pada zona I, 62,6% tipe penetrasi; Sebagian besar pasien datang dengan visus awal 4/200 hingga persepsi cahaya pada seluruh zona., sebgain besar disebabkan oleh materi inorganik dan 50.9% subjek terdapat keterlibatan lensa. Insiden endoftalmitis lebih tinggi pada materi inorganik (69,2% dibandingkan 30,8%,  $p=0,33$ ). Sebanyak 95,2% kasus mendapatkan tata laksana bedah dalam waktu <24 jam. Pada follow up pasca-operasi, 53,3% kasus tidak membutuhkan re-operasi atau operasi lanjutan. Beberapa faktor risiko dapat memengaruhi hasil tata laksana trauma mata. Sebagian besar ruptur terjadi pada zona I. Penggunaan steroid topikal setelah operasi tidak berpengaruh dengan insisi endoftalmitis,

**Kata kunci:** trauma mata, trauma mata terbuka, luaran tata laksana.

## Introduction

Eye injury is one of the leading causes of blindness worldwide.<sup>1,2</sup> In 1988, World Health Organization reported 55 million eye injury cases per year that caused 34.5% unilateral blindness; 2.9% bilateral blindness; and 4.2% reduced visual acuity (VA).<sup>1</sup> Current classification of eye injury is *Birmingham Eye Trauma Terminology System* (BETTS)<sup>3</sup> which classified eye trauma as open injury with full thickness wound and closed injury with non-full thickness wound. Open globe injury consists of laceration (penetration, intra-ocular foreign body/IOFB, and perforation) and rupture caused by blunt object. The location of injury affects VA outcome; however, corneal injury has poor prognosis in terms of blindness due to the severity of trauma in visual acuity and the risk of infection.<sup>2-4</sup>

Early surgery after injury is performed to prevent poor prognosis in visual acuity and risk of infection. Ng et al,<sup>5</sup> reported 1.16-folds reduced VA in delayed surgery and Ahmed et al<sup>6</sup> reported 4-folds increase in the incidence of infection if wound closure is delayed over 24 hours.<sup>6-8</sup> Currently, there is no data of corneal rupture or open globe injury treatment outcome and success rate in Indonesia. Objective data and information in the outcome of surgery in corneal rupture or open globe injury CMNH Emergency Unit is expected to be a reference for treatment in future cases. Therefore, this study evaluates the characteristics and outcome of corneal rupture management in CMNH.

## Methods

This study was conducted before the Covid-19 pandemic era in January 2016 - December 2017. A total 163 eyes of 163 patients with corneal rupture were reviewed based on medical records of patients admitted to CMNH Emergency Unit requiring emergency surgery. Retrospective analysis of age, gender, incidence location, materials, zone, type, comorbidity, and visual acuity improvement in relation to zone, duration to surgery, and pre-operative visual acuity data from the medical records were evaluated. Follow-up data including re-surgery, proceeding surgery, steroid used, and endophthalmitis incidence were collected. We used BETTS criteria to evaluate type, grade and zone. Categorical variable was presented in proportion, numeric variable was presented in mean (standard deviation) and median (minimum-maximum). Repeated ANNOVA test with post-hoc Bonferroni was used to compare mean of paired numeric variable. All analyses were performed using SPSS

version 20 (IBM Statistics); p-value less than 0.05 was considered significant.

## Results

Baseline characteristic was presented in Table 1. Proportion of male patient was higher than female. Median age was 27 years old and most patients were referred from private hospital. Inorganic material was higher than organic material and incidence location was mostly at home.

**Table 1. Baseline Characteristic Subjects**

Characteristics	n (%)
Gender	
Male	150 (92)
Female	13 (8)
Age	
< 18 years	55 (33.7)
≥ 18 years	108 (66.3)
Material	
Organic	38 (23.3)
Inorganic	125 (76.7)
Incidence Location	
Working site	55 (33.7)
Home	60 (36.8)
Others	48 (29.4)
Referral Hospital	
Private hospital	76 (46.6)
General hospital	34 (20.9)
Primary care	15 (9.2)
Without referral	38 (23.3)

According to BETTS, open globe injury is classified into type, grade and zone. Based on rupture location, most rupture occurred at zone I (71%) followed by zone II (23 %) and zone III (6%). Most common type of injury was penetrating injury (62.6%) followed by rupture (28.2%) and IOFB (9.2%). About 50.9% patient admitted with lens involvement diagnoses, followed by hyphema or coagulum (19%), infection (26%), extra-ocular disease (6.1%), traumatic optic neuropathy (4.9%) and secondary glaucoma (3.1%).

The use of topical steroid was higher in post-operative surgery of organic materials rather than inorganic materials, though the difference was not significant (61.6% vs 60.5%). In addition, post-operative endophthalmitis occurred in 26 cases with higher percentage of inorganic material causes (69.2%) than organic causes (30.8%).

**Table 2. Early Usage of Topical Steroid and the Incidence of Endophthalmitis Based on Causative Material**

Post operative	Causes		p
	Organic	Inorganic	
Topical Steroid			
Yes	23 (60.5)	77 (61.6)	0.905
No	15 (39.5)	48 (38.4)	
Endophthalmitis			
Yes	8 (30.8)	18 (69.2)	0.327
No	30 (21.9)	107 (78.1)	

According to the zone, most patient with all injury zones came with VA before surgery was highest in 4/200 - light perception for all zones (Table 3). Delayed surgery more than 24 hours was found in 7 of 148 cases, while 95.2% patients underwent

surgery in  $\leq 24$  hours. Improvement of visual acuity was only found significant in zone I. Zone I involve only cornea area, while trauma in zone II and III involving more posterior part of sclera.

**Table 3. Pre- and Post-Visual Acuity Based on Zone Involvement**

Area	Visus, n (%)				
	20/40	20/50 - 20/100	19/100 - 5/200	4/200 – LP	NLP
<b>Zone I</b>					
Pre-op	20 (17.2)	10 (8.6)	7 (6.0)	71 (62.1)	7 (6.0)
Post-op	14 (14.3)	17 (17.3)	15 (15.3)	44 (44.9)	8 (8.2)
<b>Zone II</b>					
Pre-op	3 (7.9)	4 (10.5)	2 (5.3)	22 (57.9)	7 (18.4)
Post-op	2 (6.1)	1 (3.0)	4 (12.1)	17 (51.5)	9 (27.3)
<b>Zone III</b>					
Pre-op	0 (0.0)	0 (0.0)	0 (0.0)	5 (55.6)	4 (44.4)
Post-op	0 (0.0)	0 (0.0)	0 (0.0)	3 (50.0)	3 (50.0)

LP= light perception; NLP= no light perception

## Discussion

Open globe injury is an important cause of visual loss and is frequently preventable. From our findings, high intensity of physical activity is suggested affecting the result of male and median age of 27 years found in this study. Kanoff et al<sup>7</sup> and Beshay et al<sup>8</sup> supported this result with total of 98% and 80% male in comparison to 2% and 20% female. Likewise, personal ability to self-detect and self-protect from the risk itself might also contribute. Several studies in Asia, America, Europe, and Australia reported 60.8-87.4% cases found in young adult, with high intensity activity and accident as the main risk factors.<sup>8-11</sup> According to variable in BETTS criteria, penetration with

inorganic material was found in the largest number of cases. Jovanovic et al<sup>2</sup> and Fujikawa et al<sup>10</sup> reported and supported that inorganic materials (wire) was the most frequent cause of open eye injury. Zone I (cornea limbal) involvement was also found in most cases.

House was the main incidence location found in this study. This distinct result suggested that personal protective equipment might be ignored when doing household activity. However, study from Saini et al<sup>5</sup> supported this study. A work safety education and application was needed to prevent eye injury.

Since penetration was the most frequent type of ocular trauma found in this study, immediate

surgery was the treatment which mostly completed in emergency unit. The result tends to lower when the presented visual acuity was already severe. Visual acuity > 4/200 before surgery resulted in worsened visual acuity at the end of treatment. Study from Puodžiuvienė et al<sup>12</sup> supported that patient with light perception-no light perception had poorer outcome than patient with > 6/60 visual acuity. Regarding type of injury, penetration has the worst post-treatment visual acuity compared to rupture or IOFB.<sup>13</sup> This result was inline by Schorkhuber et al<sup>14</sup> and Hossain et al<sup>15</sup> who reported two patients (1.5%) with  $\geq 20/40$  visual acuity that worsened to 4/200 until light perception due to comorbidity; the first patient came with hypopion but refused vitrectomy and the second patient had aphakia and corneal cicatrices.

The optimal time to treat open eye injury is 24 hours or less.<sup>16</sup> His study reported 54% patients underwent surgery in 12-24 hours after the injury. Prolonged waiting time for surgery increases risk of infection, loss of viability and extended tissue prolapse, and eventually affect VA prognosis. Several factors that influenced duration to surgery were patients, operator, surgery preparation, and availability of surgery room. In this study, seven patients had delayed surgery due to variety of factors, such as funding, operative tolerance, and surgery room availability. We found that patients with waiting times of more than 24 hours did not show any particular tendency towards improvement in visual acuity.

We conducted analysis in the risk of endophthalmitis regarding the material involved in the trauma. Endophthalmitis was found in 15.9% and mostly caused by inorganic material, though not significant compared to organic materials. Prophylaxis antibiotic was recommended to prevent this.<sup>17</sup> All patients in this study were given oral or intravenous systemic antibiotic. Post-operative treatment with topical steroid was still controversial. In this study there was not significant difference of organic and inorganic causes in steroid use. Ahmed et al<sup>7</sup> showed that steroid use was contraindicated if fungal infection suspected.

Proceeding surgery needed in 71 patients in this study, which diagnoses include traumatic cataract extraction in relation to lens involvement. Re-surgery was mostly found in zone I involvement, some of the are caused by the wound that are still not tight or due to high intraocular pressure. In the term of pre- and post-surgery VA changes in relation to duration to surgery, our study showed that there was no specific timing in the optimal time which will

improve visual acuity. However, VA of 4/200 until light perception tends to improve if surgery was done in 6-12 hours and 12-24 hours post-trauma. Zone involvement was profound to affect visual acuity better than duration to surgery. Ng H, et al<sup>5</sup> reported prognostic factors that determine post-operative visual acuity were pre-operative visual acuity, wound area and length, lens involvement, hyphema, and retinal ablation. This is correlated with our finding that initial visual acuity <4/200 to light perception have

## Conclusion

In our study, we found eye injury in Cipto Mangunkusumo National Hospital between January 2016 to December 2017 possesses several risk factors such as male gender, young adult. There were few factors affecting final VA such as zone, grade of injury, initial visual acuity of 4/200-light perception with inorganic materials causes. However, post-operative visual acuity was not associated by duration to surgery. Post-operative topical steroid use was not associated to endophthalmitis, neither caused by organic nor inorganic materials.

## References:

1. Al Mahmoud T, Al Hadhrami S, Elhanan M, Alshamsi HN, Zidan FMA. Epidemiology of eye injuries in a high-income developing country an observational study. *Medicine*. 2019;98. Doi: 10.1097/MD.00000000000016083
2. Jovanovic N, Peek-Asa C, Swanton A, Young T, Alajbegovic-Halimic J, Cavaljuga S, Nisic F. Prevalence and risk factors associated with work-related eye injuries in Bosnia and Herzegovina. *Int J Occup Environ Health*. 2016;22:325-32. doi: 10.1080/10773525.2016.1243081.
3. Aghadoost D. Ocular trauma: an overview. *Arch Trauma Res*. 2014;3:e21639. doi:10.5812/atr.21639.
4. Ng HR, Chee SF, Chai KS, Chong MF, Mustapha M. The Epidemiological Profile of Open Globe Injuries and Prognostic Factors in a Tertiary Care Centre. *Cureus*. 2021;13:e15846. doi:10.7759/cureus.15846.
5. Saini RK, Haryvashi S, Mehra P. Predicting factors in open globe injury. *IOSR journal of dental and medical sciences*. 2020;19:40-4. doi: 10.9790/0853-1903124044
6. Ahmed Y, Schimel AM, Pathengau A. Endophthalmitis following open globe injuries. *Eye*. 2012;26:212-7 doi: 10.1038/eye.2011.313
7. Kanoff JM, Turalba AV, Andreoli MT, Andreoli CM. Characteristics and outcomes of work-related open globe injuries. *Am J Ophthalmol*. 2010;150:265-9.e2. doi:10.1016/j.ajo.2010.02.015

8. Beshay N, Keay L, Dunn H, Kamalden TA, Hoskin AK, Watson SL et al. The epidemiology of open globe injuries presenting to a tertiary referral eye hospital in australia. *Injury Int J Care*. 2017;48:1348–54 doi: 10.1016/j.injury.2017.04.035
9. Fujikawa A, Mohamed YH, Kinoshita H, Matsumoto M, Uematsu M, Tsuki E, et al. Visual outcomes and prognostic factors in open-globe injuries. *BMC Ophthalmol*. 2018;18(1):138. doi:10.1186/s12886-018-0804-4
10. Guven S, Durukan AH, Erdurman C, Kucukevcilioglu M. Prognostic factors for open-globe injuries: variables for poor visual outcome. *Eye*. 2019;33:392–7. doi:10.1038/s41433-018-0218-9
11. Page R, Gupta S, Jenkins T, Karcioglu Z. Risk factors for poor outcomes in patients with open-globe injuries. *Clin Ophthalmol*. 2016;10:1461–6. doi?
12. Puodžiuvienė E, Valeišaitė G, Žemaitienė R. Clinical characteristics, visual outcomes, and prognostic factors of open globe injuries. *Medicina (Lithuania)*. 2021;57. doi:10.3390/medicina57111198.
13. Ho H, Foo J, Li YC. Prognostic factors and epidemiology of adult open globe injuries from Western Sydney: a twelve-year review. *BMC Ophthalmol*. 2021;21:173. <https://doi.org/10.1186/s12886-021-01929->
14. Schorkhuber MM, Wackernagel W, Riedl R, Schneider MR, Wedrich A. Ocular trauma scores in paediatric open globe injuries. *Br J Ophthalmol*. 2014;98:664-8. doi:10.1136/bjophthalmol-2013-304469.
15. Hossain A, Hussain E, Ferdausi N, Sen U, Islam Z. Prognostic value of ocular trauma score in evaluating visual outcome of pediatric (4-16 years) open globe injuries. *Asia Pac J Ophthalmol*; 2014;3;226-9. doi: 10.1097/APO.0000000000000009
16. Durrani AF, Zhao PY, Zhou Y, Huvard M, Azzouz L, Keil JM, et al. Risk factors for endophthalmitis following open globe injuries: a 17-year analysis. *Clin Ophthalmol*. 2021;15:2077-87. doi: 10.2147/OPHTH.S307718.
17. Han Y, Kavoussi S, Adelman R. Visual recovery following open globe injury with initial no light perception. *Clin Ophthalmol*. 2015;9:1443-8. <https://doi.org/10.2147/OPHTH.S87852>.