**Interdisciplinary doctoral school**

**Field of doctoral studies: Medicine**

UNIVERSITATEA LUCIAN BLAGA DIN SIBIU

# THE MANAGEMENT OF OPEN GLOBE INJURIES – SUMMARY

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**SIBIU 2021**

**Keywords:** *open globe injury, scleral rupture, corneoscleral wound, corneal laceration, prolapsed tissue, lid laceration, management, OTS score, CART model.*

## 1. INTRODUCTION

An open globe injury (OGI) is defined as a full thickness wound of the eyeball and it is the most important cause of permanent visual impairment worldwide. It has a negative psychological impact on the patient and also on the healthcare system. OGI has a global incidence rate of 3.5 per 100,000 persons per year, which corresponds to 203,000 OGI per year worldwide. [1]

Ocular trauma has been categorized by Dr. Ferenc Kuhn into two major types:

- Closed globe
- Open globe [2].

**Birmingham Eye Trauma Terminology ( BETT classification):**

| Term | Definition/interpretation | Explanation |
|---|---|---|
| Eyewall | Sclera and cornea | Though technically the eyewall has three coats posterior to the limbus, for clinical and practical purposes, violation of only the most external structure is taken into consideration. |
| Closed globe injury | No full-thickness wound of eyewall | |
| Open globe injury | Full-thickness wound of the eyewall | |
| Contusion | No wound | The injury results from direct energy delivery by the object (e.g. choroidal rupture) or from the changes in the shape of the globe. |
| Lamellar laceration | Partial-thickness wound of the eyewall | The wound of the eyewall is not “through” but “into”. |
| Rupture | Full-thickness wound of the eyewall caused by a blunt object | Because the eye is filled with incompressible liquid, the impact results in momentary increase of the intraocular pressure. The eyewall yields at its weakest point (at the impact site or elsewhere e.g. an old cataract wound dehisces even though the impact occurred elsewhere). The actual |

| | | |
|---|---|---|
| | | wound is produced by an inside-out mechanism. |
| Laceration | Full-thickness wound of the eyewall caused by a sharp object | The wound occurs at the impact site by an outside-in mechanism |
| Penetrating injury | Entrance wound | If more than one wound is present, each must have been caused by a different agent |
| Intraocular foreign body | Retained foreign object(s) | |
| Perforating injury | Entrance and exit wounds | Both wounds are caused by the same agent |

[4]

The surgical repair of an open globe injury should be performed urgently, ideally within 24 hours of injury. Some recent studies have showed that each day of delay in surgical repair may lead to a reduced visual prognosis. The aim is to restore the normal anatomy with minimal intraoperative manipulation. [6].

An open globe injury has to be considered as a tetanus prone wound. For patients who have been vaccinated previously but who are not up to date, there is little benefit in administering human tetanus immune globuline more than one week after the injury. For patients completely unvaccinated, human tetanus immune globulin should be given up to 21 days after the injury. [7]

Due to the high risk of endophthalmitis, patients with open globe injuries need prophylactic antibiotic treatment with Vancomycin (15 mg/kg, maximum dose 1,5 g) and Ceftazidime ( 50 mg/kg, maximum dose 2g) . For those allergic to penicillin can benefit from fluoroquinolone instead of ceftazidime. The organisms which are frequently associated with posttraumatic endophthalmitis are Bacillus species, coagulase-negative Staphylococcus, Streptococcal species, Staphylococcus aureus and gram negative organisms. [7]

The primary repair has to follow some important steps in order to achieve the best visual outcome:

1. Minimal manipulation of the wound
2. Reposit or remove the exposed intraocular tissues
3. Explore the globe for unrecognized injuries
4. Reduce the risk of endophthtalmitis at minimum. [7], [8]

## 2. HYPOTHESIS:

Open globe injury is a significant cause of permanent visual impairment and blindness worldwide. It is associated with significant morbidity and loss of productivity. A proper evaluation of the injury and a good management strategy are extremely important in order to obtain the best visual outcome.

## 3. THE AIM OF THE STUDY:

The aim of this paper is to highlight the best approach to a patient with an open globe injury and the appropriate management which is necessary to restore the anatomy and best visual function. Also, we studied the prognostic factors for predicting final visual outcome and the factors which have a negative impact on visual outcome in open globe injuries (OGI).

## 4. MATERIAL AND METHOD:

This study is a retrospective study and the patient data was taken from the observational sheets between December 2011 and December 2017. All patients included in this study were admitted at Ophthalmology Department in Sibiu with open globe injuries and lid lacerations. This study included 191 traumatized eyes of 190 patients, only 1 patient was with bilateral open globe injury.

The inclusion criterias for the study were:

- the moment of ocular trauma has to be between December 2011 and December 2017.
- patients to be admitted at Ophthalmology Clinic of the Academic Emergency Hospital of Sibiu with open globe injuries and lid lacerations.
- patient's clinical sheet to have all the parameters followed in this study as age, sex, home address, visual acuity, intraocular pressure, anterior globe examination, posterior globe examination, management, surgical repair of the wound.

The exclusion criterias were:

- patients with closed globe injuries;
- chemical or thermal burns;
- incomplete patient's clinical sheets
- ocular trauma done in any other period than December 2011- December 2017.
- non-surgical eye trauma.

Depending on the affected area, we used a 3-zone classification:

- □ Zone 1: globe opening isolated to cornea or limbus;
- □ Zone 2: globe opening involving anterior 5 mm of sclera;
- □ Zone 3: globe opening posterior to anterior 5 mm of of sclera.

In case of multiple openings, zone is defined as that of the most posterior opening.

In intraocular foreign body, entry site defines the zone.

In case of perforating injuries, zone is defined as the most posterior defect ( mostly the exit site).

Open globe injury was divided into five types:

1. Rupture
2. Penetrating injury
3. Intraocular foreign body
4. Perforating injury
5. Mixed

In order to be able to statistically process the data we categorized the visual acuity in the following groups:

| **Visual acuity** | **Tabel corespondent** |
|---|---|
| ≥0.5 (1/2) | 1 |
| 0.3 – 0.2 (1/3 – 1/5 including) | 2 |
| 0.16 – 0.025 (1/6 – 1/40) | 3 |
| 0.02 (1/50), counting fingers, hand movements, light perception | 4 |
| No light perception | 5 |

For each patient, the intraocular tension was recorded and included in one of the following situations:

- low intraocular pressure  < 9 mmHg
- normal intraocular pressure: 10-21 mmHg
- high intraocular pressure > 22 mmHg

The OTS score was calculated in gross value for every patient according to its visual acuity and slit lamp exam (anterior and posterior pole). Every patient was assigned to its corresponding score class.

| **OTS score** | | |
|---|---|---|
| Variables | | Number of points |
| No light perception | | 60 |
| Light perception or hand movements | | 70 |
| 1/200 – 19/200 | 0,005 – 0,95 | 80 |
| 20/200 – 20/50 | 0,1 - 0,4 | 90 |
| ≥20/40 | ≥ 0,5 | 100 |
| Rupture | | -23 |
| Endophthalmitis | | -17 |

| | |
|---|---|
| Perforating injury | -14 |
| Retinal detachment | -11 |
| RAPD | -10 |

From the obtained value, we substracted the number of points for each lesion in the table. I have recorded the gross number of points for each patient and assigned them to a score class. Then I have compared the visual acuity on discharge with the probability calculated from the table.

| Total number of points | OTS | NPL | LP/HM | 1/200 -19/200 0.005-0,095 | 20/200 -20/50 0,01-0,4 | ≥20/40 |
|---|---|---|---|---|---|---|
| **0-44** | 1 | 74% | 15% | 7% | 3% | 1% |
| **45-65** | 2 | 27% | 26% | 18% | 15% | 15% |
| **66-80** | 3 | 2% | 11% | 15% | 31% | 41% |
| **81-91** | 4 | 1% | 2% | 3% | 22% | 73% |
| **92-100** | 5 | 0% | 1% | 1% | 5% | 94% |

[9].

For preprocessing data and analysis I have used Microsoft Excel and SPSS (IBM).
The descriptive analysis in case of categorical variables (environment, gender, traumatized eye (OT), type of trauma, area, mechanism, visual acuity at admission and discharge (AVI, AVE), intraocular pressure at admission and discharge (IT, TE)) consisted of numerical and percentage determinations, and in the case of the continuous variables median, interquartile interval (IQR).
For the comparative study we used Chi-Square or Fisher tests. To analyse the corelations between initial and final visual acuity and OTS score we used Spearman correlation coefficient. The significance level considered was 0.05.
For CART model we used Chi-squared Automatic Interection Detector.

## 5. RESULTS:

One hundred and ninety patients were studied with an average age of 43.85 years (SD=20.22). There were more male patients (81.58%) than females (18.42%), more patients from rural areas (54.21%) than urban areas ( 45.79%).
Occupational injury was the first cause of injuries (22.26%), followed by home accident (20%), falls (19,47%), violent behavior (7,89%), car accident ( 2.63%).
All patients were not wearing spectacles at the time of the injury.
Left eye was the most affected eye by the injury no matter which area patient comes from ( Chi-square test, p=0.170).

Most patients were admitted with open globe injuries ( 64.74%).

Lid laceration was found at 30.53% of patients.

Penetrating and perforating injuries were found at 22.63% of patients and intraocular foreign body was found at 12.11% of patients. 5.79% presented ocular rupture. Corneal lacerations with prolapsed tissue were found at 10.53% of patients.

34.6% presented VA >= 0.5 at admission, 5.9% had initial VA = 0.3=0.2, 5.4% 0.16-0.025, 47% 0.02 and 7% were admitted with no perception of light . All patients with visual acuity >=0.5 had the same visual acuity at the discharge time without any visual deteriorations. Only few patients with no perception of light (7.7%) at admission got better visual acuity being discharged with 0.02 VA, but more that 90% of them still remained with no perception of light at the discharge time.

More than half of the patients with VA >= 0.5 at admission presented lid lacerations. Most patients with VA less than 0.2 were found with open globe injuries.

More than 90% of patients with conjunctival lacerations had VA >=0.5. Most patients with corneal wounds without prolapsed tissue had an intial VA = 0.16-0.025 ( 19.2%). By contrast, the majority of patients admitted with corneal wound with prolapsed tissue had VA less than 0.02.

Most patients with scleral rupture had VA = 0.02 at the admission.

None of the patients with perforating wounds had a visual acuity better than 0.5 at the admission time.

Most patients with retained intraocular foreign body had VA = 0.02 (28.6%) at the admission time and more the half of them got the best visual outcome ( VA >= 0.5). Half of the patients with RAPD had no perception of light at the admission and most of them were discharged with no perception of light. More than 80% of those with traumatic cataract were admitted with VA= 0.02, but after the surgical removal of the lens they gained perfect vision being discharged with VA>=0.5.

The CART analysis in this study was retrospectively conducted with the information collected from medical records and the prediction was then compared with actual outcome to evaluate the prediction of CART system. The clinical signs were classified in CART form. The initial visual acuity was defined as the visual acuity of the injured eye at presentation to hospital and was divided into 1) 20/20 to hand movement (HM); 2) light perception (LP); 3) no light perception (NLP). The CART prognosis showed a certain agreement to the actual visual outcome (Chi-square test p=0.00) with 59.58% sensitivity to predict visual survival correctly and 80.19% specificity to predict no vision correctly.

According to this study, the manipulation of CART analysis is quite feasible for clinical application. First of all, the signs of CART are all ordinary clinical signs which are generally available from medical records and easy to get in emergency. Secondly, the CART prognosis presented a certain agreement to the actual visual outcome in this study. The prediction of vision survival or no vision may help to indicate different further treatments. However, when assessing the signs respectively, we found that the initial vision of NLP was a strong indication to no vision outcome, whereas the presence of lid laceration made no difference.

Patients with a wound that was smaller than 5 mm had a statistically significant better prognosis than patients with wounds that were larger than 5 mm (p=0.00). Han and Yu established that a larger wound (> 10 mm) was related to a poorer final visual acuity. These findings suggested that the size of the laceration had both therapeutic and prognostic implications, with an increase in the laceration length significantly correlated to a worse visual outcome (p =0.000). Our results also demonstrated that the zone of the injury was associated with the visual outcome. Wounds involving zone III had significantly poorer visual outcomes versus those involving zones I or II. This result is supported by previous studies, which reported a significant association between the posterior extension of the wound and a worse final VA. Madhusudhan et al. reported that subjects with a wound extending posterior to the equator had 20 times the risk of having a final visual acuity less than 3/60 as compared to patients whose wounds were anterior to the recti insertions or restricted to the cornea.

Our study showed that a poor VA at the first visit was an important prognostic factor (p = 0.000). A good initial VA was the strongest prognostic factor of a favorable final VA, similar to that reported by other numerous studies.

Our current study showed that both RD and VH were significantly poor prognostic factors for visual outcomes. These findings are in agreement with previous studies that also reported RD to be a poor prognostic factor for visual outcome.

20 cases of pediatric ocular trauma were reported. Ocular trauma was unilateral in all reported cases. There were more male patients than females (65%). Left eye was the most affected eye (70%). Falls were the first cause of injury ( 65%). More than half of the pediactric patients were admitted with open globe injuries and 40% presented lid lacerations. Regarding open globe injuries, 25% of pediatric patients were reported with corneal lacerations with prolapsed tissue. Most pediatric patients had an initial visual acuity >=0.5.

Almost all patients included in the study presented to hospital eye service within 24 hours of the injury, all of them received antibiotherapy and all of them had the primary repair within 24 hours of the injury.

## 6. CONCLUSIONS

In conclusion, improvements in our knowledge of the pathophysiology of eye trauma and its prognostic factors, as well as advances in diagnostic and therapeutic techniques, have greatly improved the success rates for managing open-globe injuries. A better understanding of these prognostic factors may help provide our patients with better and more realistic expectations of their final VA. This study demonstrated that a poor VA at the first visit, a ruptured globe, zone III injuries, retinal detachment, vitreous haemorrhage, the presence of RAPD and prolapsed tissues are considered to be poor prognostic factors for open-globe injuries. Patients with a wound smaller than 5 mm had a significantly bettter VA than the other groups with wounds larger than 5 mm. When patients with open-globe injuries had posterior segment involvement, vitrectomy proved to be a good prognostic factor.

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