Eye Injuries: Surgical Management and Outcomes

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Disclaimer: The views expressed in this poster are those of the authors and do not reflect the official policy of the Department of the Army/ Navy/ Air Force, Department of Defense or the U.S. Government
Background

- IRB approved retrospective consecutive case series of all eye trauma cases evaluated at Walter Reed Army Medical Center between 2001-August 2011
- Does not include National Naval Medical Center or Walter Reed National Military Medical Center cases UNLESS patient was evaluated to WRAMC at some point after injury (NNMC has ~350 eye casualties during same interval)
- Does not include “TBI-related Vision loss” or “TBI-related visual dysfunction”. Includes eye injury and/or neurologic injury
- Eye injuries classified according to the Birmingham Eye Trauma terminology
### B. OPEN-GLOBE INJURY CLASSIFICATION

<table>
<thead>
<tr>
<th>Type</th>
<th>Pupil</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Rupture</td>
<td>Positive: relative afferent pupillary defect present in affected eye</td>
<td>I. Isolated to cornea (including the corneoscleral limbus)</td>
</tr>
<tr>
<td>B. Penetrating</td>
<td>Negative: relative afferent pupillary defect absent in affected eye</td>
<td>II. Corneoscleral limbus to a point 5 mm posterior into the sclera</td>
</tr>
<tr>
<td>C. Intraocular foreign body</td>
<td></td>
<td>III. Posterior to the anterior 5 mm of sclera</td>
</tr>
<tr>
<td>D. Perforating</td>
<td></td>
<td></td>
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<tr>
<td>E. Mixed</td>
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</tbody>
</table>

**Grade**

- Visual acuity:
  1. $\geq 20/40$
  2. 20/50 to 20/100
  3. 19/100 to 5/200
  4. 4/200 to light perception
  5. No light perception

*Measured at distance (20 ft or 6 m) using Snellen chart or Rosenbaum near card; with correction and pinhole when appropriate.

†Confirmed with bright light source and fellow eye well occluded.
Open Globe Injuries

Penetrating

Perforating

Enucleation

IOFB

Rupture
### Closed-Globe Injury Classification

**Type**  
A. Contusion  
B. Lamellar laceration  
C. Superficial foreign body  
D. Mixed

**Grade**  
Visual acuity  
1. $\geq 20/40$  
2. 20/50 to 20/100  
3. 19/100 to 5/200  
4. 4/200 to light perception*  
5. No light perception†

**Pupil**  
Positive: relative afferent pupillary defect present in affected eye  
Negative: relative afferent pupillary defect absent in affected eye

**Zone†**  
I. External (limited to bulbar conjunctiva, sclera, cornea)  
II. Anterior segment (involving structures in anterior segment internal to the cornea and including the posterior lens capsule; also includes pars plicata but not pars plana)  
III. Posterior segment (all internal structures posterior to the posterior lens capsule)

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*Measured at distance (20 ft or 6 m) using Snellen chart or Rosenbaum near card, with correction and pinhole when appropriate.  
†Confirmed with bright light source and fellow eye well occluded.  
‡Requires B-scan ultrasonography when media opacity precludes assessment of more posterior structures.
# Demographics

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>651</td>
</tr>
<tr>
<td>Number of patients with bilateral eye injury</td>
<td>240</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>27.14 ± 7.24 (18-53)</td>
</tr>
<tr>
<td>Gender</td>
<td>96.5 % male/3.5% female</td>
</tr>
<tr>
<td>Eye protection</td>
<td>28.9 % yes/23.7 % no/ 47.4 % unknown</td>
</tr>
<tr>
<td>Location of injury</td>
<td>Iraq 83.4%/ Afghanistan 16.6%*</td>
</tr>
</tbody>
</table>

### Mechanism of injury

- IED: 62.3%
- RPG: 13.7%
- MVA: 4.8%
- GSW: 11.5%
- Other: 7.7%
General injury pattern

Closed-Globe (n=391)
- Zone 1 or 2 Anterior Segment (n=176)
  - Adnexal (n=111)
  - Neuro (n=52)
- Zone 3 Posterior Segment (n=215)
  - Intraocular foreign body (n=149)

Open-Globe (n=337)
- Laceration
- Rupture / 1° enucleation (n=64)
- Perforating (n=72)
- Penetrating (n=52)
Ocular Trauma Score (OTS)

Range 0 to 100 for **prognosis** of final visual acuity—initial exam

- Only used for globe trauma (NOT oculoplastics/neuro)

**Initial Vision**

- NLP 60 pts
- LP/HM 70 pts
- 1/200-19/200 80 pts
- 20/200-20/50 90 pts
- >20/40 100 pts

**Rupture** -23 pts
**Endophthalmitis** -17 pts
**Perforating** -14 pts
**Retinal Detachment** -11 pts
**APD** -10 pts

Incidence of Blindness

• Different ways of assessing:
  1. Per Eye
     a) Worse than 20/200
        • 264/891 (29.6% of eyes injured)
     b) NLP or enucleated
        • 162/891 (18.2% of eyes)
  2. Per Patient
     a) 20/200 or worse OU
        • 50/651 patients (7.7%)
     b) NLP or enucleated OU
        • 16/651 patients (2.5%)
  3. DoD Retention standards
     • 20/800 in poorer seeing eye
     • 20/20 in better eye

▪ Important metric to layperson
Total number of surgeries performed

- Initial vision 20/200 or better: 64.6%
- Initial vision worse than 20/200: 35.1%

Bar chart showing the distribution of initial vision outcomes post-surgery.
Interventions in the subset of eyes with final vision worse than 20/200*

Systemic Factors Affecting Ophthalmic Care
Associated Injuries

• Patients may be intubated and sedated with an inability to assess visual acuity upon arrival

• Traumatic brain injury (38.2%) affects patient compliance with use of eye medications and follow up appointments
  – Did not screen for TBI until August 2004
  – 51% TBI rate in soldiers injury Aug 04-Oct 06

• Injuries may prevent post-operative positioning [extremity injury (45.8%) and traumatic limb amputation (13.7%)]

Assessing Visual Function in Intubated / Brain Injured Patients

- **Pre-2006**
  - Deferred intervention until patient awake enough to cooperate with exam

- **2006-Present**
  - Recognized the chronicity of TBI
  - Surgical intervention can be considered in severely traumatized eyes sooner for high risk cases
  - Still no ideal means of quantifying subjective visual symptoms of TBI patients
Traumatic Brain Injury (38.2-51%)
Postoperative Positioning for Retinal Procedures

- Necessary for macular hole repair, retinal detachment repair
- May be limited by systemic issues
Unable to Position following Vitrectomy

Groin Flap

IOFB
Eye and Extremity Injuries
Associated Injuries

- Face: 355/651 = 54.5%
- Traumatic Brain Injury: 249/651 = 38.2%
- Abdomen: 48/651 = 7.4%
- Thorax: 53/651 = 8.1%
- Pelvis: 34/651 = 5.2%
- Neck: 29/651 = 4.5%
- Amputee: 89/651 = 13.7%
Extremity Injuries (45.8%)

- Long recovery period with physical therapy and occupational therapy
- External fixation ring: bone growth at 1 mm per day
Abdominal Injury (7.4%)
• Original Patient Database at Walter Reed was a Spreadsheet

• Follow up data recorded on spreadsheet

• No capability to document outcomes over time
Current Status

• Working to compile data from National Naval Medical Center Records
• Extend follow-up interval of previously reviewed cases
• Enroll and follow up on patients in a long-term prospective tracking study at Walter Reed
• Continuing to actively treat 46 wounded warriors at Walter Reed Bethesda
Efforts to enhance patient outcomes

- Wireless retinal prosthesis
- Development of artificial corneal graft
- 3-D bioprinting: Development of ophthalmic tissue for surgical training
- Implementation of ocular injury simulator surgical systems in training military ophthalmologists
- Assessing the effects of concomitant traumatic brain injury and vision loss on wounded warriors
- Amniotic membrane and umbilical cord matrix therapy for better controlled corneal wound healing
- Topical IL-1 to inhibit corneal scarring
QUESTIONS?