



Incidence of ocular blast injuries in modern conflict

David McMaster¹  · Gerry Clare²

Received: 26 November 2020 / Revised: 26 November 2020 / Accepted: 27 November 2020 / Published online: 11 December 2020

© The Author(s), under exclusive licence to Springer Nature Limited part of Springer Nature 2020

To the Editor:

There is an increasing trend of ocular injury in modern conflict. This is compounded by the development of weapons with higher explosive and fragmentation power, resulting in increased severity and morbidity of injury. Explosions cause unique patterns of injury, with the majority a combination of primary and secondary blast mechanisms that are not often seen outside of combat or terror-related attacks [1]. In modern conflict zones up to 15.8% of all medical evacuations have sustained eye injuries [2], and the incidence of ocular trauma is also increased in terror attacks where explosive devices are used (Table 1). In 2019, following a vehicle-borne improvised explosive device detonation in Mogadishu, Somalia ocular injuries were found in 24.6% of survivors [3].

Given the difficulty in managing complex blast injuries and the visual outcomes associated, we aimed to determine the incidence of blast-related ocular injury in modern conflict. We searched PubMed, Web-of-Science and Google Scholar for original studies reporting ocular injury in armed conflict. Key words included ocular, eye, trauma, injury, explosive, conflict, war, armed and combat. A total of 170 titles were identified and 30 were selected for full-text review. Additional relevant articles were identified from the reference lists of articles reviewed and a secondary search of grey literature. We identified 16 studies of ocular injury in modern conflict (Table 2). A total of 13,777 patients with ocular injuries were included in these studies, with a pooled incidence of 78.1% of ocular injuries caused by explosive munitions.

We show that the majority of eye injury in modern conflict is blast related. Eye protection significantly reduces the incidence and severity of injury and should be encouraged as early as possible in military training and deployments. Enforced use of eye protection in US military convoys in Iraq was shown to reduce eye injuries from a conflict wide incidence of 6–0.5% [4]. Eye protection does not however eliminate risk, nor is there a guarantee troops will be wearing protection; only 11% of British Armed Forces in Iraq or Afghanistan between 2004 and 2008 with eye injuries reported wearing combat eye protection [5]. It is also unlikely that civilians caught in areas of conflict or terror bombings will be suitably protected. It is reported that in Iraq and Afghanistan between 2003 and 2011, eye injuries managed at UK-led military treatment facilities were much less likely to be treated definitively than their US counterparts, reflecting an absence of ophthalmologists [6]. Instead, patients were dependent on rapid aeromedical evacuation taking on average two days. For time-critical injuries delays outside of this window and time to specialist ophthalmic care is likely to affect visual outcomes [7].

Conflict and terror are unpredictable, and it is essential that healthcare professionals are aware of the disproportionate incidence of eye injury, the most common mechanisms and unique patterns of injury that require specialist management. Due to the severity of injury and impact that loss of vision has on quality of life, there must be comprehensive treatment pathways in place, including ensuring availability of specialist surgeons (e.g. ophthalmologists). In many areas rapid evacuation is not possible and there is a need for ophthalmologists, both military and civilian, to be forward deployed to manage patients quickly and effectively. This may involve integration of specialist surgeons into emergency medical teams who are deployed in the aftermath of disaster, outbreak and/or other emergencies [8].

✉ David McMaster
david.mcmaster@doctors.org.uk

¹ University of Nottingham School of Medicine, Nottingham, UK

² Moorfields Eye Hospital, London, UK

Table 1 Ocular injuries sustained by survivors of terror attacks.

Study first author	Location	Year	Injured survivors (n)	Ocular injuries (n)	Incidence of ocular injury
Kalayci	Mogadishu, Somalia	2019	114	28	24.6%
Yonekawa	Boston, USA	2013	164	22	13.4%
Turégano-Fuentes	Madrid, Spain	2004	512	95	18.6%
CDC	New York, USA	2001	790	204	25.8%
Odhiambo	Nairobi, Kenya	1998	290	80	27.6%

CDC Centres for Disease Control and Prevention.

Table 2 Incidence of explosive blast injury in patients presenting with ocular injury during modern conflict.

Study first author	Year	Details of conflict	Date of conflict	Patients with eye injuries (n)	Incidence of blast injury
Mader	1993	US forces injured during Operation Desert Storm	1991	160	78%
Lashkari	1995	Iran–Iraq war	1980–1988	4622	83%
Berger	2002	South Lebanese conflict	1992–1997	41	87%
Mader	2006	Iraqi insurgency	2004	207	82%
Weichel	2008	US forces injured during Operations Iraqi & Enduring Freedom	2003–2006	523	79%
Mansour	2009	Lebanon civil war	1975–1991	544	82%
Thomas	2010	Iraq and Afghanistan conflict	2001–2003	1246	92%
Blanch	2011	British forces injured in Iraq and Afghanistan conflicts	2004–2008	63	86%
Barak	2011	Second Lebanon war	2006	69	80–90% ^a
Gendler	2015	Israeli Defence Force	1997–2013	129	67%
Ozal	2015	Syrian civil war	2012–2013	39	60%
Gundogan	2015	Turkish armed forces injured during insurgent attacks	2003–2013	48	96%
Islam	2016	Pakistani armed forces	2010 – 2014	120	83%
Naqvi	2017	Pakistani armed forces	2012–2016	210	54%
Seck	2017	Senegalese armed forces	1991–2005	37	86%
Breeze	2019	Iraq and Afghanistan conflicts	2003–2011	5719	71%

^aExcluded from pooled analysis due to inaccuracy.

Author contributions DM and GC contributed to the writing and review of this article.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Scott R. The injured eye. *Philos Trans R Soc Lond B Biol Sci.* 2011;366:251–60.
2. Ari AB. Eye injuries on the battlefields of Iraq and Afghanistan: public health implications. *Optometry.* 2006;77:329–39.
3. Kalayci M, Er S, Tahtabasi M. Bomb explosion: ocular effects of primary, secondary and tertiary mechanisms. *Clin Ophthalmol.* 2020;14:1145–51.
4. Gondusky JS, Reiter MP. Protecting military convoys in Iraq: an examination of battle injuries sustained by a mechanized battalion during Operation Iraqi Freedom II. *Mil Med.* 2005;170:546–9.
5. Blanch RJ, Bindra MS, Jacks AS, Scott RAH. Ophthalmic injuries in British Armed Forces in Iraq and Afghanistan. *Eye.* 2011;25:218–23.
6. Breeze J, Blanch RJ, Mazzoli R, DuBose J, Bowley DM, Powers DB. Comparing the management of eye injuries by coalition military surgeons during the Iraq and Afghanistan conflicts. *Ophthalmology.* 2020;127:458–66.
7. Dhillon A, Ahmad MSZ, Breeze J, Blanch RJ. Prolonged deployed hospital care in the management of military eye injuries. *Eye.* 2020;34:2106–11.
8. McMaster D, Clare G. Integrating specialist ophthalmic services into emergency medical teams. *Bull World Health Organ.* 2020;98:722–4.