

Lateral Canthotomy in Orbital Compartment Syndrome: Special Operations Medics on the Battlefield Can Save the Eye

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ABSTRACT

The primary medical role of the Special Operations Forces (SOF) Medic is to stabilize the patient and prevent loss of life, limb, and eyesight on the battlefield. Significant time and resources are invested to ensure that SOF Medics are the best trained and most proficient combat Medics in the world. While considerable focus is placed on teaching the intricacies of saving life and limb, it seems as though only tacit emphasis is placed on the preservation of eyesight.

Loss of vision can mean not only decrement of lifestyle for the patient, but could also mean loss to the military of a highly trained operator with years of irreplaceable experience. It is the conclusion of the authors that in addition to the current approach of medical management for orbital compartment syndrome, the skills to perform a lateral canthotomy and cantholysis could easily be introduced into the SOF medical training curriculum. This is a relatively straightforward procedure which could significantly reduce the morbidity from a potentially blinding injury.

INTRODUCTION

Orbital compartment syndrome, although rare, is a significant complication of acute facial trauma. It can readily lead to permanent loss of vision if not diagnosed early and treated appropriately and aggressively. The current mainstay of treatment taught to Special Operations Forces (SOF) Medics and contained in the Special Operations Forces Medical Handbook has been medical management with rapid (48 hour) referral to an eye specialist. This is largely due to the simple fact that penetrating injury to the globe has been the major injury pattern seen.

With the significant increase in operational tempo seen by these Medics over the past several years, ophthalmologic injury patterns have increased multi-fold in incidence and have lead to another look at the need for additional training in this area. Furthermore, a review of the Joint Theater Trauma Registry (JTTR) located in Iraq revealed a number of cases resulting in preventable loss of eyesight. Further record review revealed that where a SOF Medic provided initial care and resuscitation, this was the only individual available to provide definitive care for this type of injury. Without exception, the procedures outlined in this article, namely the lateral canthotomy and cantholysis were not performed. It is the intent of this article to recommend an easy, practical addition to the current training regime of the SOF Medic.

MATERIALS/METHODS

An exhaustive review of the JTTR was conducted, reviewing all injuries designated as “eye trauma.” We found and evaluated 146 records dating back to the beginning of combat operations in Operation Iraqi Freedom and Operation Enduring Freedom. Cases were reviewed for specific mention or implication of retrobulbar compartment syndrome, retrobulbar hematoma, post-traumatic vision loss, or post-traumatic glaucoma in the diagnosis; also evaluated were cases in which an emergent lateral canthotomy and/or cantholysis was performed by an ophthalmologist or other care provider (OR trauma specialist). Of these, sixteen were noted to imply in the record that lateral canthotomy would have improved outcomes if performed earlier in the course of treatment. Four cases directly involved SOF Medics, though this was not reflected in the medical record.

The core curriculum for SOF Medics at the Special Operations Combat Medic (SOCM) Course, the Special Forces Medical Sergeants (SFMS) Course, and the Special Operations Combat Medical Skills Sustainment Course was reviewed. Furthermore, the main field resource available for SOF Medics, namely the Special Operations Medical Handbook, was reviewed for the management of eye trauma. Also, course material experts for the education of the SOF Medics were polled to verify what was taught during formal training in the above-mentioned evolutions.

A literature search was performed in an attempt to determine the minimum level of training necessary to establish a baseline for para-professionals to be able to perform this procedure; no information was found. Additionally, a search was conducted to determine standardized education of lateral canthotomy and cantholysis; no source outside of dedicated residencies in ophthalmology or emergency medicine was found. A survey was performed of the ophthalmologists and ophthalmology residents at two U.S. Army and one U.S. Navy hospital, as well as deployed ophthalmologic surgeons and emergency physicians at the 332nd Expeditionary Medical Group. The survey revealed a high degree of comfort with the concept of teaching this procedure to SOF Medics. There was universal concurrence that this procedure should be performed in the field due to a very low complication rate and high potential for significantly improved outcomes.

DISCUSSION

Classically, orbital compartment syndrome has been associated with blunt trauma, or as an iatrogenic post procedure complication. A review of even the most current text books, including Will's Eye Manual, does little to comment on orbital compartment syndrome as a complication of penetrating injury. However, combat actions over the last several years have lead to an obvious shift in the paradigm, as it is now more routinely seen in theater accompanying penetrating injury.¹ Presumably, this is due to the fact that unique injury patterns are occurring as a result of blast injuries from improvised explosive devices (IEDs) and the subsequent multi-system complications, which are contributing to the new types of morbidity from the modern battlefield.

With the advent of improved personal protective devices (PPD), such as improved body armor, better helmets, torso and limb protection, etc., Soldiers are surviving what were previously considered lethal attacks. Unfortunately, PPD does not protect the entire body. Therefore, Soldiers tend to survive IED attacks, only to suffer the sequelae of blast pressure and injuries from secondary projectiles. The eyes are particularly vulnerable. While modern ballistic eyewear protects the eyes from frontal insult, the periphery of the orbit, specifically the lateral aspect, remains vulnerable.

Acute facial trauma, either blunt or penetrating, may lead to retrobulbar hemorrhage from either venous or arteriolar sources into the retrobulbar space. This area of the skull is more a potential space than an actual cavity as it is occupied by the globe anteriorly with seven immobile bones of the eye socket on the periphery and a

relatively immobile interconnecting fascial layer.² Even trace amounts of venous or arterial bleeding can lead to an increase in retrobulbar pressure and rapidly overfill this potential space.

Retrobulbar hemorrhage is followed by displacement of the globe anteriorly to the extent allowable by the canthal tendons (and to a lesser degree the prolapse of bulbar fat). Anterior displacement squeezes the globe between the immobile eyelids and the now expanding hematoma. When anterior displacement of the globe reaches the limits of its anatomical restraints, intra-orbital and intraocular pressures can go up precipitously, leading to permanent damage to the optic nerve.³ Penetrating trauma may produce direct injury to the eye or any of the periocular structures.⁴

Vessels that provide watershed blood flow to the sensitive structures of the eye, namely the postciliary, prelaminar, and choroid capillaries – are at risk. These structures lie within the musculature of the eye and as such are compressed with minimal expansion of the retrobulbar space; they are especially vulnerable to anatomic disruption, even at relatively low pressures. Finally, with increasing pressures, the ophthalmic artery itself may become compromised resulting in true orbital compartment syndrome. The end result of orbital compartment syndrome may be central retinal artery occlusion, anterior ischemic neuropathy, and blindness if not reversed emergently.⁵

The diagnosis of orbital compartment syndrome has traditionally been made at the tertiary care level with the use of intraocular pressure devices such the Medtronic TonoPen™, with little emphasis being placed on its diagnosis and management by personnel in the field. Current SOF medical guidelines for treatment of increasing intraocular pressure (IOP) merely call for pharmacologic management and referral within 48 hours.⁶ Traditional teaching has emphasized saving of life and limb, with only tacit emphasis on the rescue of eyesight. Loss of vision can mean not only loss of lifestyle for the patient, but also loss to the military of a highly trained operator with years of irreplaceable experience. This medical management of acute eye trauma has been considered the acceptable pattern in the past as it was consistent with the injury pattern previously seen by SOF Medics. However, as the type of injury has evolved, so has the need for more rapid diagnosis and definitive battlefield care.

The surgical expertise necessary for the SOF Medic to perform these procedures is already present, as they are already both familiar and comfortable with such aggressive interventions as cricothyrotomies and tube

thoracostomy. While only a cursory ophthalmologic exam is possible on the battlefield, it is sufficient to evaluate for orbital compartment syndrome and the need for lateral canthotomy and cantholysis.

Signs and symptoms suggestive of orbital compartment syndrome are: decreased ocular motility, proptosis, nausea and vomiting associated with eye pain, afferent pupillary defect, a hard globe on palpation, and significantly decreasing visual acuity over a course of time.^{4,5} Decreasing visual acuity (for all practical purposes, the vital sign of the eye) over time should be considered one of the most alarming factors in the SOF Medic's exam, though the presence of any or all of the aforementioned signs or symptoms should cause the SOF Medic to consider orbital compartment syndrome. Serial examinations, especially with delays to more definitive care, are paramount as signs and symptoms of retrobulbar compartment syndrome may not be present, or obvious, on initial presentation. Once ischemic retinopathy from retrobulbar hemorrhage manifests, time is of the essence to salvage the eye – and the 48 hours currently taught to SOF Medics⁶ is beyond what some authors have recommended as a more effective goal of six hours.⁷

Procedural risk to the globe while performing the lateral canthotomy and cantholysis can be minimized with a basic review of anatomy and cautious application of the procedure. While hemorrhage, infection, and injury to the other structures of the eye (such as lateral canthal ligament) can occur when performing this procedure, they are typically much more amenable to reconstructive or pharmacologic therapy than any retinal injury resulting from ischemia. Incisions made during the performance of the lateral canthotomy, even by relatively inexperienced providers, have been shown to generally heal without suturing or significant scarring.⁸ It could be stated that compared to the risks associated with *not* performing this procedure, those associated with completing it are minimal.

The goal of this procedure, as with any procedure performed on the battlefield, is to save the eye until more definitive treatment may be obtained. The hands-on training to gain competency has been shown to require minimal resources and time when experienced providers with a basic understanding of simple procedures are involved. Furthermore, it has been shown that didactic models are an effective, easy, and inexpensive means of supplementing hands-on training. An instructional video outlining this procedure can be found on the world wide web at http://www.brown.edu/Administration/Emergency_Medicine/eye.htm⁹ (must capitalize exactly as shown here).

Of special note: It is generally stated that palpation of the globe of the eye after trauma is relatively contraindicated, especially by the mid-level provider. In this case however, with an index of suspicion and in the absence of more advance methods of ophthalmologic exam, cautious palpation can be performed prior to proceeding in an effort to assess for orbital compartment syndrome on the battlefield. The risk/benefit of such a course of action significantly supports cautious exam.¹⁰ However, it is notable that this recommendation is controversial and should ONLY be performed by an experienced provider who has made every reasonable effort to assure there is no penetration of the globe itself. Under most circumstances, the presence of proptosis alone would be a clinical indication for performing the procedure, and as such, no palpation would be necessary.

Traditionally, even rural first-responders could realistically expect to transport their patients to an established treatment facility within the “golden hour,” but the same is not true for the SOF Medic in the field. Definitive care for the SOF patient may be many hours or even days away; as such, special consideration for this patient population and SOF medical protocol must be made.

Careful consideration should be given to increasing intraocular pressure (IOP) in the face of globe rupture. Mixed opinions have been elicited through conversation with various ophthalmologic consultants. It appears to be the majority opinion that little harm would be done by performing lateral canthotomy and cantholysis if accomplished without placing additional stress on the globe. It would be tragic if the globe could be salvaged from penetrating trauma or rupture, only to discover that vision was lost due to increased IOP.

CONCLUSION

SOF Medics receive extensive training in anatomy and physiology, pharmacology, trauma management, and surgical technique. Our SOF Medics confidently and competently perform invasive surgical procedures as a cricothyrotomy or tube thoracostomy. Nevertheless, a review of battlefield eye trauma outcomes, as well as the SOF medical curriculum, suggests a need for broader thinking in the arena of eye trauma management.

A simple review of the anatomy of the eye and its surrounding structures, medications typically used for anesthesia and intraocular pressure reduction, as well as a review of the surgical techniques via live tissue models, should be sufficient to provide these exceptionally well-prepared Medics to perform this procedure in the field. Additionally, the Special Operations Forces Medical Handbook (01 June 2001) reviews common eye prob-

lems and eye injuries, but it does not cover loss of vision due to increased IOP. Introducing the concept of the lateral canthotomy and cantholysis into continuing education forums within the SOF community (Special Operations Combat Medical Sustainment Course) would cost little in terms of time, manpower, and money, but could prove invaluable to the trauma patient in need.

Fortunately, the practice of assessing, treating, and reassessing is ingrained into the SOF Medic mindset throughout training. SOF Medics perform in a stellar fashion when dealing with insults to the head, neck, thorax, abdomen, and limbs. They confidently assess, treat, and monitor the most challenging of trauma patients with little more than an aid bag of rudimentary supplies. The tools to salvage eyesight, threatened by increasing IOP from retrobulbar hemorrhage, exist in that aid bag. Educating SOF Medics tools to salvage the threatened eyesight could prove to be an invaluable investment.

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REFERENCES

1. Department of Defense. (2003 – 2006) *Combat Trauma Registry*.
2. Vaughn D, Asbury T, Tabbara K (eds). (1989). *General Ophthalmology*, 12th ed. East Norwalk CT Appleton & Lange; p166.
3. Love JN, Bertram-Love JE: (1993). Luxation of the globe. *Am J Emerg Med*; 11:61.
4. Gossman MD, Roberts DM, Rarr CC. (1992). Ophthalmic aspects of orbital injury. *Clin Plast Surg*; 19:71.
5. Emmanuella J, et al. (1992). Predictors of blinding or serious eye injury in blunt trauma. *J Trauma*; 33:19.
6. Lovas T, Butler F. (2001). Eye Injury. *Special Operations Forces Medical Handbook*. Jackson: Teton NewMedia. 3-27.
7. Kilroy DA. (2003). Emergency ophthalmology: A rapid treatment guide. *Emerg Med J*; 20:396.
8. Knoop K, Trott A. (1994). Ophthalmologic procedures in the emergency department: I. Immediate sight-saving procedures. *Acad Emerg Med*; 1:408.
9. Suner S, Simmons W, Savitt DL. (2000). A porcine model for instruction of the lateral canthotomy. *Acad Emerg Med* 2000; 7:837.
10. Kylstra JA, Lamkin JC, Runyan DK. (1993). Clinical predictors of scleral rupture after blunt ocular trauma. *Am J Ophthalmol*; 115:530.



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