



Vision Center of Excellence (VCE)

Characteristics of Ocular Injury in the Military Environment: Current Clinical Profiles and Future Predictions

Dr. Mariia Viswanathan

Vision Care Readiness Section Chief

April 7, 2023

Topics

- VCE Establishment and Capabilities
- Trauma Observed in Recent U.S. Military Conflicts
- Trauma Profiles Anticipated in Future Conflicts
- Trauma Care in Current and Anticipated Military Environments

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



VCE Establishment

- **Establishment of a Center of Excellence**
 - Prevention, diagnosis, mitigation, treatment, and rehabilitation of military eye and vision injuries
- **Implementation of a Vision Registry**
 - Collect longitudinal data on eye injuries to guide
 - Clinical education
 - Promote best practices
 - Inform policy
- **Collaboration/Interaction**
 - Secretary of Veterans Affairs
 - Residency Research Partnership Program (RRPP)
 - Institutions of higher education
 - Public and private entities (including international)

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



VCE Capabilities

- **Education** – RRPP, JKO courses, CPGs, PRs, collaborative manuscript development
- **Data Analysis** – M2, DVEIVR
- **Vision Care SMEs Expertise**
- **Augment the Voice of the Vision Communities** – DoD and VA consultants, ophthalmologists, optometrists, data scientists, ethics communities, CDC, FDA
- **Collaboration/Interaction** between sensory portfolios for the DoD and VA and other DHA R&E CoEs
- **Social Media Platforms in Vision Care**

VCE does not provide direct funding for research projects

- Work is intended to be collaborative with VCE SME and data analysis support

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Steps of Trauma Management (from DHA Sensory Portfolio)

- Identify and Understand
- Protect and Prevent
- Diagnose, Assess, and Surveil
- Stabilize in Transit
- Treat and Rehabilitate
- Improve and Augment

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Relevant Conditions in Eye Trauma

- Open globe injury
- Retrobulbar hemorrhage/orbital compartment syndrome
- Closed globe injury
- Eyelid laceration
- Orbital fracture
- Chemical injuries
- Orbital cellulitis
- Infectious keratitis
- Angle-closure glaucoma
- Eye care in multi-trauma/thermal burn patient
- Directed energy threats to the visual system
- Visual dysfunction due to traumatic brain injury

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Trauma Observed in Recent U.S. Military Conflicts

- **Low-level counterinsurgency and counter-terrorism conflicts**, with some large-scale combat operations interspersed: weaponry and tactics that were very low-tech, improvised explosive devices (IEDs), explosively formed penetrators and suicide vehicles
- **Repetitive exposure to low-level blasts** that produces acute and cumulative damage to the ocular tissues or visual system, binocular and visual function impairment
 - Lower quality of life in affected Service members
- **30% of patients left legally blind in their injured eye**

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Reported Data on Military Eye Injuries

- Eye injuries in the U.S. Armed Forces:
 - Orbital floor fractures, contusions, and open wounds to the ocular adnexa and orbit accounted for 85% of eye injuries resulting in hospitalization
 - 80% of ambulatory visits were for superficial wounds and foreign bodies
 - Motor vehicle crashes and fights caused nearly half of the hospitalizations
 - **Combat-related eye injuries continue to increase in frequency and are generally secondary to Improvised Explosive Devices (IEDs)**

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!

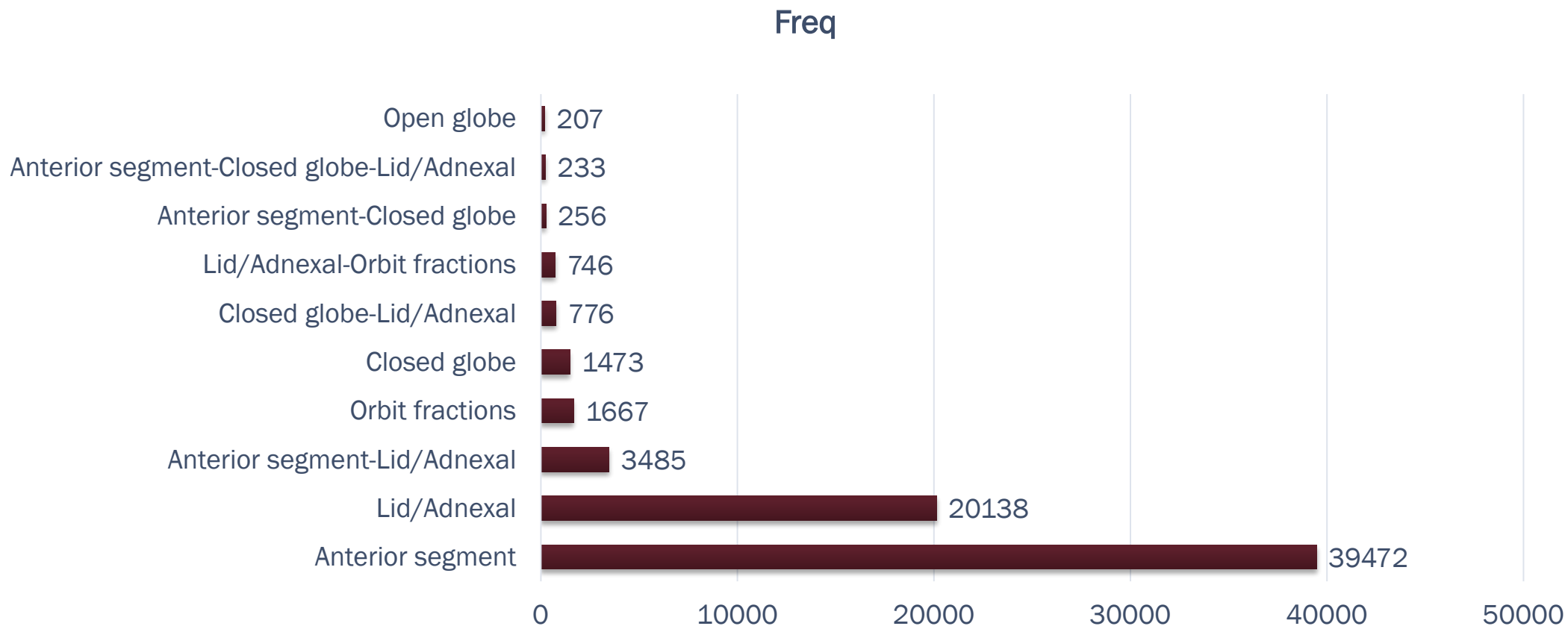


Reported Data on Military Eye Injuries (Cont.)

- Operation Iraqi Freedom and Operation Enduring Freedom eye injuries:
 - 15.8% of all medical evacuations were a result of battle eye injuries
 - Most common eye injuries were open-globe injury without intraocular foreign body 56% (adnexal injuries - 22%)
 - Time to initial retina surgery ranged from 3 to 87 days
 - Service members wearing eye protection were 9 times less likely to sustain an eye injury than those without
 - 38% of soldiers were not wearing eye protection at the time of injury
 - **Only 25% of warfighters with severe ocular trauma return to duty**



VCE Analysis of M2 Database Eye Injury Diagnoses Sustained by Active Duty Service Members (Including National Guard) from 2017-2021



UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



M2 Reported Data on Ocular-Related Medical Encounters

- Myopia, astigmatism, and acute conjunctivitis accounted for almost one-half (47.7%) of all ocular and vision-related medical encounters in the M2 database
- Walter Reed National Medical Center Ophthalmology Service Report- eye diseases and non-battle injuries:
 - Uveitis (13.1%)
 - Retinal detachment (11.2%)
 - Infectious keratitis (4.7%)
 - Choroidal neovascularization (4.7%)
- The analysis of training subjects:
 - 49.2% of injuries occurred during skill training (e.g., parachuting, operating firearms, etc.)
 - 29.5% occurred during physical exercise

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Trauma Profile Anticipated in Future Conflicts - High Intensity Urban Warfare Experience – Chechnya, Georgia, Ukraine

- Peer and/or near peer adversaries – large-scale combat operations (LSCO)
 - Extensive urban combat
- Sizeable military forces
- Erratic communications
- High-casualty volume
- Complex and potentially prolonged evacuation pathways
- Basic public health issues

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Trauma Profiles Anticipated in Future Wars

- Wide variety of weapons systems:
 - High-explosive weaponry: thermobaric, cluster bombs
 - Directed Energy weapons: lasers, high-powered microwave weapons
 - Chemical weapons such as sarin, chlorine, and phosphorus
 - Biological weapons
 - Nuclear and radiologic weapons
 - Cyber warfare as indirect effect on patient care

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Trauma Care in Current and Anticipated Military Environments

- The war in Ukraine



Analysis of Military Medical Care During the War in Ukraine

- Long frontline up to 1300 km
- High-intensity attacks from a near-peer adversary with high explosive, precision and non-precision weapons



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.lemonde.fr%2Fen%2Fles-decodeurs%2Farticle%2F2022%2F11%2F25%2Fne-months-of-war-in-ukraine-in-one-map-how-much-territory-did-russia-invade-and-then-cede_6005655_8.html&psig=AOvVaw1Pi34vfRUjWT60VNxiahJn&ust=1675438821778000&source=images&cd=vfe&ved=2ahUKEwiCheWPivf8AhUc3ckDHUmVawUqr4kDegUIARCOAQ

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Analysis of Military Medical Care During the War in Ukraine (cont.)

- About 400 – 600 medical hospitals along front line were targeted and destroyed
- Patient overload for remaining hospitals increased 3 times – military and relocated civilians
- Evacuation by land through railway, emergency, military and volunteer civilian vehicles



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.sph.umn.edu%2Fnews%2Fschools-and-programs-of-public-health-join-together-to-demand-the-protection-of-health-care-workers-in-ukraine-and-beyond%2F&psig=AOvVaw3kS1yII5VRFXVAwe8c_OT0&ust=1675437009299000&source=images&cd=vfe&ved=2ahUKEwiNisSvj_f8AhUdxckDHZ_BDdsQr4kDegUIARCbAQ



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.npr.org%2F2022%2F03%2F09%2F1085450946%2Fmaternity-hospital-mariupol-russian-strike&psig=AOvVaw3kS1yII5VRFXVAwe8c_OT0&ust=1675437009299000&source=images&cd=vfe&ved=2ahUKEwiNisSvj_f8AhUdxckDHZ_BDdsQr4kDegUIARDNAQ

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Analysis of Military Medical Care During the War in Ukraine (cont.)

- Example of prolonged care timeframe – Azovstal stood for 80 days under siege with military and civilian patients. Afterwards they were detained in the Russian-controlled penal colony for 6+ months without professional medical care.



<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.foxnews.com%2Fworld%2Frussia-n-forces-reach-azovstal-steel-plant-ukraine-soldier&psig=AOvVaw3cbJM-tyQNani4VaShetww&ust=1675436732985000&source=images&cd=vfe&ved=2ahUKEwiso00rjvf8AhU6Pd4AHTSRDGsQr4kDegUIARDJAQ>



https://www.google.com/url?sa=i&url=https%3A%2F%2Fnews.sky.com%2Fstory%2Fleased-ukrainian-prisoner-of-war-reveals-torment-at-the-hands-of-russians-12709279&psig=AOvVaw0JiVer1cpHYvwPNLVqj39H&ust=1675438025546000&source=images&cd=vfe&ved=2ahUKEwiJ846Uk_f8AhWUMN4AHSQQAVsQr4kDegQIARBR

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Analysis of Military Medical Care During the War in Ukraine (cont.)

- Initial surgical intervention– up to 24 hours
 - Time to Role III for further treatment and rehabilitation: 3 – 14 days
- Visiting ophthalmologists:
 - Integrating visiting ophthalmologists, with 2/3 from the civilian sector for ophthalmic surgery care
 - Had to sleep 2-3 hours due to traveling between points of care at night
 - Up to 50 surgical patients in one day – requiring a large volume of surgical and medical supplies
 - Less time per surgery due to curfew time
 - Surgeries can be mixed including treating clean and dirty trauma all at once



Analysis of Military Medical Care During the War in Ukraine (cont.)

- Most frequent eye injury type:
 - Mine explosive, blast wave injury – closed globe injury combined with polytrauma and TBI, with high incidence of secondary optic nerve atrophy
 - Open globe injury with predominance of corneoscleral entry
 - Intraocular foreign body injury
 - Chemical burns – phosphorus (and unknown substance) that required corneal transplantation



<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.thetimes.co.uk%2Farticle%2Fwar-in-ukraine-kharkivs-hospitals-reveal-the-hideous-cost-of-putins-invasion-8f1858dhd&psig=AOvVaw3SkcfAjikV0ligrWzZxFH&ust=1675437312499000&source=images&cd=vfe&ved=2ahUKEwiv-o3AkPf8AhVP2ckDHUbPBIQr4kDegUIARCGAQ>



Future Vision Care: Is it Still Sci-Fi or Already the Reality?

- Acceleration of biological revolution - robotics, artificial intelligence, and synthetic biology
- Big data analysis and public education within evidence-based medicine and real-world analysis
- Collaborative programs for data consistency, collection, recording, storage and sharing
- Promote infectious agent data sharing for early communication worldwide (e.g., potential pandemic pathogens)

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Future Vision Care: Is it Still Sci-Fi or Already the Reality? (Cont.)

- Commercial introduction of bio-engineered living cells that are animate, programmable, interactive, and can sustain themselves to various degrees
- AI clinical trials and individualizing approach with avatar DNA clone for treatment testing
- Alternative treatment to antibiotic therapy to lower antibiotic resistance
- Synthetic biosensors to catalyze reactions, including the neutralization of chemical agents
- Eye drops that permeate to the retina as anti-inflammatory and antioxidant inductors of reversible changes to sensitive neural structures
 - Reduce scarring and neuronal damage
 - Promote photoreceptor rescue
- 3D-printed tissues

UNCLASSIFIED

Improving Health and Building Readiness...Anytime, Anywhere – Always!



Future Vision Care: Is it Still Sci-Fi or Already the Reality? (Cont.)

- Education of Combatant Commands on the use of personal protective equipment
- Guidance of medical teams on the proper assessment, initial treatment, and rapid evacuation of casualties
- Real-time detection of possible ambient threats near the warfighter, such as chemical, biological, radiological, nuclear, or explosive threats
- Directed Energy (DE) detection and protection



Questions?

