Combat Related Traumatic Brain Injury in High-Intensity Conflict: Epidemiology, Prehospital Assessment, and Outcomes

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Introduction

- Traumatic brain injury (TBI) is a leading cause of combat morbidity and mortality
- Rapid, reliable field recognition of severe TBI is essential for triage, evacuation, and resource allocation
- We characterized the epidemiology, injury patterns, and outcomes of combat-related TBI in recent high-intensity Israel Defense Forces (IDF) operations
- We compared the discriminative performance of two field neurological tools - the AVPU scale and the Glasgow Coma Scale (GCS) - for identifying moderate-to-severe TBI

Methods

- A retrospective analysis of combat-related injuries during ground maneuver operations between October 2023 and December 2025, linking prehospital data from the IDF Trauma Registry with hospital data from the Israeli National Trauma Registry
- Casualties with head or face injury who reached the hospital alive formed the analytic cohort
- Variables included mechanism of injury, injury severity (Abbreviated Injury Scale, AIS), prehospital neurological assessment (AVPU, GCS), evacuation characteristics, and hospital disposition
- Associations were evaluated using logistic regression, reported as odds ratios (OR) and 95% confidence intervals (CI)
- Discrimination was assessed using ROC curves and AUC, with comparisons by DeLong's test

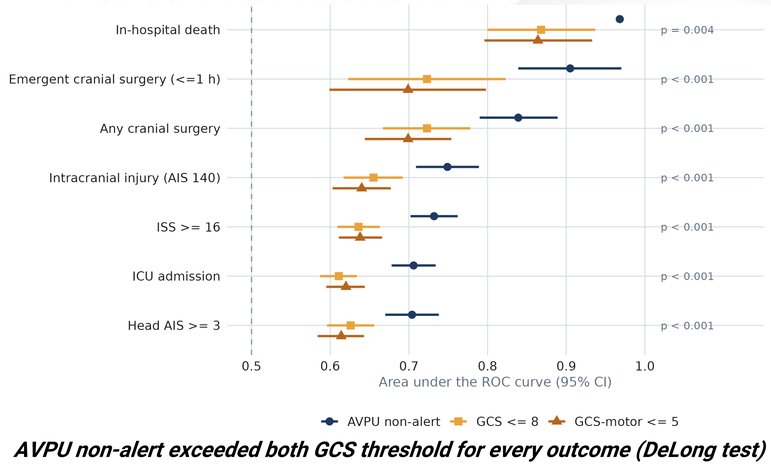
Results

- Among 6,825 casualties in the IDF Trauma Registry, 2,479 (36.3%) were recognized with head or face injury
- Of these, 342 (13.8%) died prehospital and 2,137 reached hospital alive; 927 (37.3%) were hospitalized , and 210 (8.5%) had moderate-to-severe TBI (head AIS ≥3); 111 (53%) had isolated injury and 99 (47%) had polytrauma (additional AIS ≥3 injury)
- Penetrating trauma was the predominant mechanism (84%), driven mainly by explosive fragmentation
- Prehospital neurological assessment showed high documentation (AVPU 98%, GCS 72%).
- Non-alert AVPU was strongly associated with head AIS ≥ 3 (OR 25.6, 95% CI 15.1–44.0, p<0.001), as was GCS ≤ 8 (OR 12.6, 95% CI 7.16–22.3, p<0.001)
- AVPU discriminated moderate-to-severe TBI better than GCS (AUC 0.70 vs 0.63, p<0.001), and outperformed GCS across every outcome examined (see Figure 1)
- In the field, 93% were triaged urgent and 81% evacuated aeromedically
- In-hospital mortality was 13%; among survivors, 50% were discharged to rehabilitation facilities and 35% returned home

Table 1: Baseline characteristics of the study participants

Demographics	Overall (n=927)	Other (n=717)	Head AIS ≥ 3 (n=210)	p-value
Age, years	22 (20-28)	22 (20-28)	22 (20-27)	0.3
Sex: Male	917 (99%)	710 (99%)	207 (99%)	0.7
Penetrating mechanism of injury	736 (79%)	560 (78%)	176 (84%)	0.072
Event type				0.073
Explosion	744 (80%)	582 (81%)	162 (77%)	
Firearm	68 (7.3%)	45 (6.3%)	23 (11%)	
Other	115 (12%)	90 (13%)	25 (12%)	
Field Triage				<0.001
Urgent	699 (77%)	537 (76%)	162 (77%)	
Non urgent	176 (19%)	156 (22%)	20 (9.5%)	
DOW	38 (4.2%)	10 (1.4%)	28 (13%)	

Figure1: Field Neurological Assessment and discrimination across outcomes



AVPU non-alert exceeded both GCS threshold for every outcome (DeLong test)

Conclusion

- Combat-related TBI in high-intensity conflict is a severe, predominantly penetrating injury frequently accompanied by polytrauma, with substantial mortality and rehabilitation needs
- Field neurological assessment is feasible and strongly predicts injury severity, operative need, and death
- Across every clinical outcome, the simpler AVPU scale outperformed GCS for field recognition of moderate-to-severe TBI, supporting AVPU as a high-specificity trigger for triage escalation and expedited neurosurgical evacuation
- These findings favor AVPU-based decision points in forward TBI care pathways and warrant prospective validation and study of long-term outcomes.

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At the moment of truth, IDF MEDICAL CORPS.