

OPERATIONAL MORTALITY OF UK SERVICE PERSONNEL IN IRAQ AND AFGHANISTAN: A ONE YEAR ANALYSIS 2006-7

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Introduction

Details of all UK military deaths on operations are collected from clinical notes, post mortem reports and incident reports and are held on the UK Joint Theatre Trauma Registry, maintained by the Academic Department of Military Emergency Medicine (ADMED) at the Royal Centre for Defence Medicine (RCDM). Analysis of these deaths is used to determine emerging injury patterns, to monitor clinical effectiveness, and to inform personal and vehicular protective systems.

This paper evaluates UK Service deaths in the first year of operations in Helmand Province, Afghanistan, comparing hostile action wounding mechanisms, patterns, salvageability and preventability with UK Service deaths in Iraq for the same period.

Methods

All UK Service operational deaths due to trauma in Afghanistan and Iraq between 01 Apr 06 to 31 Mar 07 were included in the study.

Deaths were divided into hostile action (HA) or non-hostile action (NHA) and casualties were categorised as either killed in action (KIA; death prior to reaching a medical facility) or died of wounds (DOW; death after reaching a medical facility). Information from the clinical notes and/or military police statements was used to corroborate both the mechanism and exact location of death: these findings were used to validate the initial notifications to the Defence Analytical Services Agency (DASA). Where there were no recorded vital signs following injury and there was no return of spontaneous circulation (ROSC) during cardiopulmonary resuscitation (CPR) the death was listed as KIA, even if the casualty was evacuated to a medical treatment facility with CPR in progress.

Injuries were coded using the Abbreviated Injury Scale (AIS) and classified as minor (AIS1), moderate (AIS2), serious (AIS3), severe (AIS4), critical (AIS5) or maximal (AIS6). The UK Joint Theatre Trauma Registry (UK JTTR) records AIS 1998, AIS 2005 and AIS 2005 (US Military) codes in parallel. This is to facilitate direct comparison with other trauma system performance dependent on the version of AIS that an alternate

system uses. For simplicity this paper derives all wounding patterns, injury severity scores and probabilities of survival from AIS 2005 (US Military) [1].

Wounds scoring AIS \geq 3 were mapped diagrammatically to explore the effectiveness of helmet and body armour personal protective systems.

Injury severity was assessed using the Injury Severity Score (ISS) [2] and New Injury Severity Score (NISS) [3]. Probability of survival was determined mathematically using TRISS methodology [4] and probability of death was determined by the Severity Characterisation of Trauma methodology (ASCOT [5]); unexpected deaths were peer reviewed.

An independent peer review of all deaths was undertaken to determine salvageability and preventability from the combined perspectives of surgical intervention and tactical constraints. The panel consisted of clinical experts (surgery, emergency medicine), a Home Office pathologist, a specialist in ballistics and protective clothing, and a specialist in vehicle armour protection.

The definitions used were:

- (i) **Salvageability:** the likelihood that surgical intervention would be attempted for given injuries and the predicted influence on survival:
 - Salvageable: intervention would probably have influenced survival.
 - Potentially salvageable: intervention would have been attempted and may have influenced survival (probability of survival >5%).
 - Possibly salvageable: intervention would have been attempted but with a high probability of mortality (probability of death >95%).
 - Non-salvageable: intervention would not have led to survival.
- (ii) **Preventability:** the likelihood that intervention was possible given the tactical circumstances and resources.
 - Preventable: Tactical situation did not preclude intervention within existing resources.
 - Possibly preventable: Tactical situation did not prevent intervention, but significant extra resources required.
 - Unpreventable: Tactical situation precluded intervention irrespective of resources.

Specific analysis was undertaken to compare prevalence of so called "signature injuries" (burns, head injuries, amputations) with contemporary US military experience.

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Results

Between 01 Apr 06 and 31 Mar 07 there were 76 trauma related fatalities, 45 on Op HERRICK (Afghanistan) and 31 on Op TELIC (Iraq). The Army accounted for 47 (62%), Royal Marines 14 (18.5%), Royal Air Force 14 (18.5%), and Royal Navy 1 (1%). 5 of 76 (7%) were Special Forces. 74 (97%) were male Service personnel.

57 deaths (75%) were the result of hostile action (HA), with 48 KIA and 9 DOW; 19 (25%) were non-hostile action (NHA), with 18/19 NHA deaths occurring before entering a medical facility (14/19 were from a Nimrod crash; 5/19 were motor vehicle incidents, including 2 soldiers crushed by vehicles and 1 soldier drowned in a rolled vehicle). There were no deaths attributed to "friendly fire" in this period (these would have been classified within HA and appropriately suffixed). Overall the ratio of KIA:DOW was 5.3:1 (TELIC 3.1:1, HERRICK 8.3:1).

Hostile action mechanisms of injury were 38/57 (67%) blast or fragmentation and 19/57 (33%) gunshot wounds. Blast or fragmentation was further characterised as improvised explosive device or explosively formed projectile (IED/EFP) 17/38; rocket propelled grenade (RPG) 13/38; mortar 5/38; mine 3/38. 5 cases from a Lynx helicopter crash are included in the 'blast/fragmentation' category as the aircraft was brought down by RPG.

For injuries coded AIS ≥ 3 , head injuries were the most prevalent in the HA deaths, present in 24 (42%); thorax injuries were present in 23 (40%); neck injuries in 14 (24%); abdominal injuries in 9 (16%); limb & pelvis injuries in 9 (16%); whole body disruption in 8 (14%) and facial injuries in 1 (2%).

Of the Hostile Action deaths, 41 (72%) had ISS 60-75 (near-maximal or maximal injury severity, indicating that death was expected); 46 (81%) had NISS 60-75. NISS therefore identified 9% more cases as "expected deaths" by anatomical injury alone. 7/9 (78%) DOW from hostile action had a maximal ISS of 75.

Plain chest radiography was used to image the thorax of casualties immediately prior to post mortem. 1 KIA fatality (2% hostile action deaths; 1/57) had a tension pneumothorax on this radiograph (Figure 1). This death followed behind armour trauma that generated a large, complex posterior chest wound: ISS 21, NISS 48, Probability of Survival 1.1% (TRISS), Probability of Death 95.2% (ASCOT).



Figure 1: Post mortem radiograph demonstrating tension pneumothorax

In comparison, an analysis of 978 fatalities (post mortem radiography) within the Vietnam Wound Data and Munitions Effectiveness Team study identified tension pneumothorax as the cause of death in 3-4% of fatally wounded combat casualties [6].

Signature injuries

Burns. Excluding those with whole body disruption, burns of any severity (AIS 1-6) were present in just 2 cases (1x AIS 1, 1x AIS 6).

Head Injuries. 20/24 (83%) deaths with head injuries AIS ≥ 3 had one or more head injuries coded AIS 6 (maximal, currently untreatable). In comparison, 11/23 (48%) deaths with thoracic injuries had one or more injuries coded AIS 6. All injuries AIS ≥ 3 for the head face and neck have been superimposed onto human figures wearing contemporary body armour to evaluate opportunities to enhance personal protection: the results are deliberately withheld from the public domain.

Amputations and Decapitations. Excluding those with whole body disruption there were 2 decapitations and 8 amputations (2 were partial) in 8 HA deaths (8/49, 16% all HA deaths). The decapitations were from explosively formed projectiles; 1 death followed mine strike of a dismounted soldier; the remainder were related to improvised explosive devices.

Sepsis

It has been cited that a major cause of preventable death in war is infection [7]. There were no cases of death from sepsis in this period.

Salvageability and Preventability

From probability of survival (Ps) statistics there were 2 mathematically unexpected deaths (Ps >50%, TRISS methodology). Peer review reclassified one of these as a clinically expected death and validated the other as potentially clinically salvageable although tactically unpreventable.

Independent peer review of all deaths identified 69/76 (91%) as unsalvageable.

2 deaths were identified as potentially salvageable (drowning, trapped in rolled armoured vehicle; limb injuries, trapped in minefield) and 5 possibly survivable. 6 of these 7 cases were declared tactically unpreventable (Table 1); the remaining case (Case 494) still carried a maximal injury severity score (ISS 75).

Case	ISS	MOI	Resource Issue	Salvageability & Preventability
072	75	MVC	Vehicle rolled in ditch: no patient access	Potentially salvageable Unpreventable
494	75	IED	Immediate definitive airway required	Possibly salvageable Possibly preventable
511	29	IED	Surgical control required within 30 minutes of injury	Possibly salvageable Unpreventable
516	75	GSW	Immediate definitive airway required + surgical control within 30 minutes of injury	Possibly salvageable Unpreventable
636	26	Recoilless rifle	Surgical control within 30 minutes	Possibly salvageable Unpreventable
702	41	Mine	Trapped in minefield (rescuers injured)	Potentially salvageable Unpreventable
874	34	IED	Surgical control within 30 minutes. Massive transfusion	Possibly salvageable Unpreventable

Table 1: Preventability of possibly and potentially salvageable patients (injury details removed to maintain anonymity)

Discussion

The different principal mechanism of injury between the two operational theatres was apparent with a higher incidence of hostile action death due to blast and fragmentation on TELIC (76% v 57%) and more GSW deaths on HERRICK (43% v 24%); this may reflect different threats as well as a different mission.

The mechanism, patterns and severity of injury are significantly influenced by two mass casualty aircraft incidents where no survivors would be expected, specifically a Nimrod crash in Afghanistan that accounted for 14 of the NHA deaths, and a Lynx helicopter brought down by a rocket propelled grenade (RPG) during which five fatalities were sustained.

The ratio of killed in action (KIA) to died of wounds has been used historically as an indicator of trauma system performance, but this is a very crude tool. Almost 80% of those who are recorded as DOW had a maximal injury severity score (ISS = 75) where there is an unequivocal expectation of death. Survival to reach a medical treatment facility may be influenced by the quality of pre-hospital care, but transient survival of an inevitable death is a poor measure of system performance. It is the unexpected outcomes that identify system strengths or failures.

The Injury Severity Score (ISS) is an internationally accepted tool to assist in predicting probability of survival and to identify unexpected outcomes, with a score of 60 or more taken as one measure to identify an expected death. However, the ISS cannot be used in isolation as it is recognised that it underestimates multiple injuries in the same body region (for example, only one amputated limb will be scored in the event of multiple amputations): equally importantly it takes no account of the tactical military situation. In these circumstances, peer review of cases clarifies whether or not a death has been clinically preventable or tactically unavoidable. Peer review of these 76 deaths confirmed that none of the 76 deaths was avoidable when both the clinical severity of injury and the tactical situation were taken into consideration.

The attendance of a clinician (emergency physician, senior emergency nurse or paramedic) at every military post mortem allows the identification of whether clinical skills have been performed optimally. This information is used to feedback to clinicians individually (via telephone or email) or collectively (via weekly clinical case conferences) to reassure clinicians that every appropriate measure was taken during a resuscitation; or to establish an explanation for any deviation from standardised procedures (that may be a result of a rectifiable training gap); or to correct through education any clinical approach that is considered to fall below optimal practice within the constraints of the operational environment.

Conclusions

The head and chest account for the majority of lethal injuries. Body mapping of ballistic injuries AIS \geq 3 shows the vulnerability of the face and neck. Burns are an uncommon component of contemporary HA deaths on TELIC and HERRICK. TRISS will identify unexpected deaths, but holistic peer review of all deaths will identify additional cases where opportunities may lie for intervention. Clinical salvageability cannot be viewed in isolation from tactical constraints and overall preventability.

References

1. Association for the Advancement of Automotive Medicine. The Abbreviated Injury Scale 2005. Des Plaines, Illinois. Association for the Advancement of Automotive Medicine. 2005.
2. Baker SP, O'Neill B, Haddon W, Long WB. The Injury Severity Score: A method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974; 14: 187-196.
3. Osler T, Baker SP, Long WB. A modification of the Injury Severity Score that both improves accuracy and simplifies scoring. *J Trauma* 1997; 43: 922-926.
4. Boyd CR, Tolson MA, Copes WS. Evaluating Trauma Care: The TRISS Method. *J Trauma* 1987; 27: 370-378.
5. Champion HR, Copes WS, Sacco WJ et al. A New Characterisation of Injury Severity. *J Trauma* 1990; 30: 539-546.
6. McPherson J, Feigin D, Bellamy R. Prevalence of Tension Pneumothorax in Fatally Wounded Combat Casualties. *J Trauma* 2006; 60: 573-578.
7. Feltis JM. Surgical experience in a combat zone. *Am J Surg* 1970; 119: 275-8.