The Mortality Review Panel: A Report on the Deaths on Operations of UK Service Personnel 2002–2013

10

Robert J. Russell, Nicholas C.A. Hunt, and Russell Delaney

10.1 Introduction

Healthcare Governance is a central function within the Defence Medical Services (DMS) [1–4]. Assuring optimal performance of the DMS operational trauma system is an important contribution to the moral effect for troops, families and the public. In the assessment of the performance of any trauma system, a review of adverse outcomes is essential [4, 5].

The UK Joint Theatre Trauma Registry (JTTR), maintained by the Academic Department of Military Emergency Medicine (ADMEM) at the Royal Centre for Defence (RCDM) and Defence Statistics (Health) is a prospective trauma database that collects information on all casualties admitted to UK deployed military hospitals as the result of a trauma call or who are evacuated back to the "Role 4" base hospital at Queen Elizabeth Hospital, Birmingham as a result of trauma. As a result, JTTR holds data on all UK military deaths as a result of operations and exercises abroad. Details are collected from clinical notes, post mortem reports and incident reports and a member of ADMEM attends all military post mortems to prevent the loss of potentially important medical intelligence [6, 7] and provide appropriate feedback to the theatre of operations as soon as possible via the Defence Professor. This clinical presence also ensures that the military and medical contexts can be clarified to the pathologists and other experts present to monitor personal and vehicle protective equipment effectiveness.

Box 10.1: Members of the Military Mortality Review Panel

Defence Professor, Anaesthetics and Critical Care
Defence Professor, Surgery
Defence Professor, Orthopaedics and Trauma
Home Office Pathologists
Senior Scientist, Dstl Porton Down
Senior Consultant Critical Care, Queen Elizabeth Hospital Birmingham
OC Nursing, RCDM, Queen Elizabeth Hospital Birmingham
Representative from Inspector General DMS

R.J. Russell, FRCEM, DipIMC, RCEd (✉)
Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, ICT Centre, Birmingham Research Park, Birmingham, UK
e-mail: robrussell@doctors.org.uk

N.C.A. Hunt, BSc, MBBS, FRCPath, DipRCPath
Forensic Pathology Services, Grove Technology Park, Wantage OX12 9FA, UK
e-mail: nickhunt@forensicpathologyservices.co.uk

R. Delaney, MB, ChB, MRCS, FRCPath
South West Forensic Pathology Group Practice, Bristol, UK
e-mail: rjdelaney@me.com

A.M.J. Bull et al. (eds.), *Blast Injury Science and Engineering: A Guide for Clinicians and Researchers*,
DOI 10.1007/978-3-319-21867-0_10

In addition to the initial evaluation, the Military Mortality Peer Review Panel meets 2–3 times a year to provide senior multidisciplinary review of deaths in the intervening periods. The panel first met in late 2006 and reported in 2008 on 12 months from 01 Apr 2006 [8] and is currently convened and chaired by the Defence Professor Emergency Medicine. Members are shown in Box 10.1. This chapter describes the patterns of UK Service deaths and results from the panel meetings.

10.2 Methods

A search was conducted of JTTR for all UK military deaths held from Jan 2002 to Nov 2013 and the judgement made by the Mortality Peer Review panel. The panel reviews each case using a description of the mechanism of injury, evacuation timelines, injuries sustained and procedures undergone at each location. A summary including trauma scoring results is given for each case and the clinical notes, post-mortem reports and incident details are also available.

Salvage-ability is determined first in each case using the definitions in Box 10.2. If a case is rated as non-survivable (S4) then further analysis is not recorded. If there are lessons identified, these are fed along the relevant channels. In all other cases, discussion as to the factors affecting survival takes place. These factors are grouped into 3 categories—Tactical, Equipment and Clinical, and a brief description of each factor and its impact is recorded if appropriate. This latter process replaced a further rating, which was given as to preventability until 2010 as it allowed more detail to be recorded and similar cases grouped together if necessary.

Box 10.2: Definitions of Salvage-Ability

Salvage-ability: "If these injuries had occurred 5 mins from a Major Trauma Centre what is the likelihood that surgical intervention would be attempted for given injuries and the predicted influence on survival":

S1: *Salvage-able*: intervention would likely have influenced survival (probability of survival >95 %)

S2: Potentially salvage-able: intervention would have been attempted and may have influenced survival (probability of *survival* 5–95 %).

S3: Possibly salvage-able: intervention would have been attempted but with a high probability of mortality (probability of *death* >95 %).

S4: Non-salvage-able: intervention would not have led to survival.

For cases reported in this paper prior to the start of the review panel process in 2006, an initial sifting process of all deaths from 2002 was undertaken by the Defence Professor EM. Cases that were clearly S4 (e.g., decapitation, whole body disruption) were recorded on JTTR as such, and only those in which salvage was thought possible or where there was doubt as to the grading were brought to the panel.

10.3 Results

JTTR holds records of 621 cases dating from 2002. The Army accounted for 500 (80.5 %), Royal Marines 70 (11.3 %), Royal Air Force 43 (6.9 %), and Royal Navy 8 (1.3 %). 611 (98.4 %) were male Service personnel with 10 (1.6 %) female. The age range was 18–51 with a mean of 26.7 years. The definitions and distributions of casualty categories are shown in Fig. 10.1 and Box 10.3. The ratio of Killed:Died overall was 6.48:1, but if Hostile Action only is included the ratio is 6.28:1.

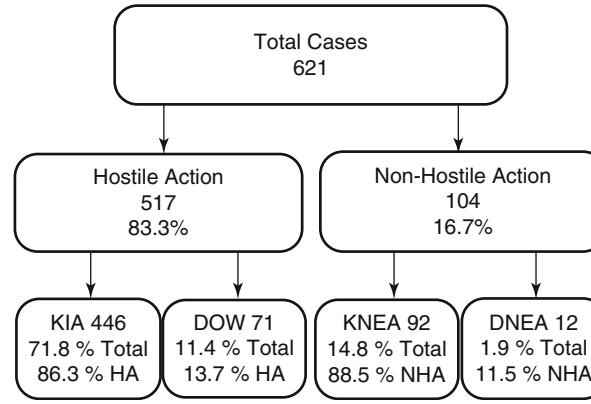

Fig. 10.1 Casualty category distributions

Table 10.1 Cases by year, theatre, operation and roulement

Operation/Roulement		Operation/Roulement	
TELIC 1	32	HERRICK 3	3
TELIC 2	15	HERRICK 4	34
TELIC 3	7	HERRICK 5	13
TELIC 4	11	HERRICK 6	29
TELIC 5	17	HERRICK 7	11
TELIC 6	10	HERRICK 8	27
TELIC 7	12	HERRICK 9	32
TELIC 8	12	HERRICK 10	70
TELIC 9	28	HERRICK 11	60
TELIC 10	24	HERRICK 12	60
TELIC 11	3	HERRICK 13	21
TELIC 12	0	HERRICK 14	19
TELIC 13	3	HERRICK 15	26
		HERRICK 16	23
Total	174	HERRICK 17	8
		HERRICK 18	3
Other	6	HERRICK 19 to Nov	2
		Total	441

Box 10.3: Casualty Category Definitions

KIA: personnel killed instantly or dying before reaching a UK or a coalition ally medical treatment facility as a result of hostile action.

DOW: personnel who die as a result of injuries inflicted by hostile action after reaching a UK or coalition ally medical treatment facility.

KNEA: personnel killed instantly or before reaching a UK or a coalition ally medical treatment facility as a result of non-hostile activity.

DNEA: personnel who die as a result of injuries caused by non-hostile activity after reaching a UK or coalition ally medical treatment facility.

Cases are shown by year, theatre of operation in Table 10.1 and by Operation and roulement in Table 10.2. The mechanisms of injury for the 620 cases for which it been determined at the

Table 10.2 Injury distribution by body region and AIS

Body region	No. region highest score	No with injury in region	Max no. injuries recorded (range)	Av. no. injuries	No. with max. AIS 6 (fatal)	No. with max AIS 5 (critical)	No. with max AIS 4 (severe)	No. with max AIS 3 (serious)	No. With max AIS 2 (moderate)	No. with max AIS 1 (minor)
Head	249	321	18	3.32	220	44	19	0	2	4
Face	2	208	8	1.94	0	18	14	10	86	80
Neck	43	155	7	2.03	22	58	18	3	37	6
Spine	18	179	11	1.98	47	21	13	14	85	0
Thorax	99	273	19	3.78	108	58	91	62	22	7
Abdomen	39	342	15	3.97	14	76	86	45	47	11
Upper extremity	3	242	12	2.13	0	3	54	63	101	21
Pelvis and legs	53	348	12	3.55	0	139	56	51	14	12
External	27	75	5	1.22	37	1	1	3	3	30

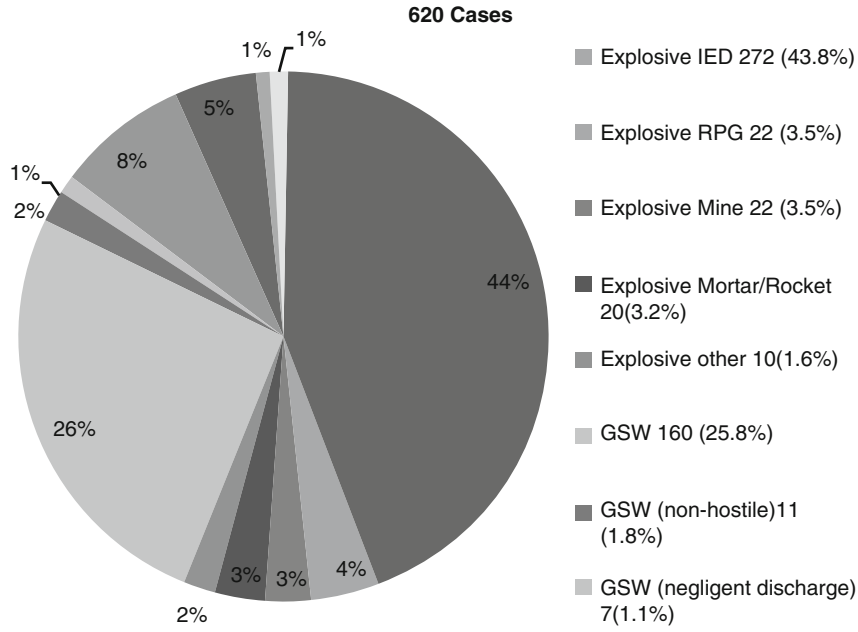

Fig. 10.2 Mechanism of injury

time of writing are demonstrated in Fig. 10.2. Explosive mechanisms produced 345 (55.65 %) and penetrating 178 (28.71 %).

10.3.1 Injury Scoring

The lowest Injury Severity Score (ISS) [9] was 4, the highest the maximum, 75. The median was also 75 with an inter-quartile range of 57–75. Twenty-one did not have a recorded score. Three cases were below an ISS of 15, 164 were in the range 16–59 and 454 had a score of 60–75, which has been defined as "un-survivable trauma". The New Injury Severity Score (NISS) [10] showed similar results but the inter-quartile range was 75–75.

The Triage Revised Injury Severity Score (TRISS) [11] and A Severity Characterisation of Trauma (ASCOT) [12] values could be calculated for 559. Missing physiological data accounted for the other 62 cases not having recorded values. For TRISS, 8 had a Ps >50 %; this being the cut off between "expected" and "unexpected deaths". ASCOT uses a calculated <50 % percentage chance of death (Pd) as a similar cut off and there were 16 in this category.

The total number of injuries recorded ranged from 1 to 57 with an average of 10.56 per casualty. The Abbreviated Injury Scale (AIS) [13] body regions injured per casualty ranged between 1 and 9 (all) with the mean number of regions injured being 3.34 and the median 3 (inter-quartile range 2–5). The distribution is shown in Fig. 10.3. Further data on the distribution of injuries to body regions is shown in Table 10.2.

10.3.2 Salvage-Ability

Six hundred seventeen cases have a recorded Salvage-ability judgement by the Peer Review Panel. Two cases were outstanding and 2 cases do not have enough information on injuries and medical treatment to form a considered opinion. Both these cases occurred outside the usual UK DMS medical chain. Table 10.3 shows the judgements by year.

One of the 3 "definitely salvage-able" casualties died as tactical issues prevented

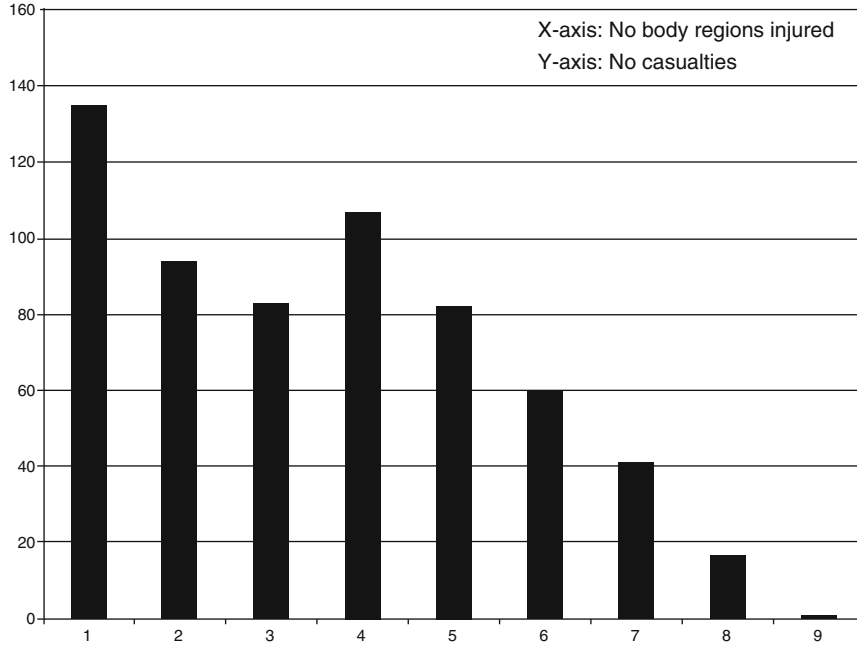

Fig. 10.3 Distribution of number of AIS body regions injured

Table 10.3 Results of mortality peer review panel

Year of fatality	S1 definite	S2 potential (>5 %, <95 %)	S3 possible (<5 %)	S4 (not salvage-able)	Outstanding/not rated	Total
2002	–	–	–	3	–	3
2003	1	–	–	47	–	48
2004	–	1	–	22	–	23
2005	–	–	–	24	–	24
2006	–	1	1	66	1	69
2007	1	2	6	80	–	89
2008	–	3	3	49	–	55
2009	1	4	14	90	–	109
2010	–	2	6	96	–	104
2011	–	–	2	43	1	46
2012	–	–	3	39	–	42
2013 (to Nov)	–	–	–	7	2	9
Total	3 (0.5 %)	13 (2.1 %)	35 (5.6 %)	556 (91.1 %)	4 (0.6 %)	621

medical aid reaching him. In both the other cases, treatment issues were thought to play a part (poor application of tourniquets, failure to call a trauma team, possible over-administration of opiates and poor handling of massive transfusion and hypothermia). The factors affecting the S2 cases were tactical in 9, military equipment in 1 and treatment in 4 (tourniquet application, incorrect drain site and development of complications). In 1 S3 case, a single aspect of treatment (tourniquet application) could have been improved but it would be unlikely to have produced a different outcome. Twenty-four cases were affected by tactical considerations and in the remaining

10 it was considered that everything possible had been done and that whilst survival was possible, it would be extremely unlikely in even the best circumstances (percentage chance of survival <5 %).

10.4 Discussion

The Peer Review Panel is an important part of providing assurance to the Chain of Command that the DMS Trauma system is functioning optimally and that Healthcare Governance of the system is in place in that continuous adjustments and improvements are made. As well as immediate feedback to theatre following a post mortem, comments are passed to clinicians through the Deployed Medical Director (DMD) and at the weekly Joint Theatre Clinical Conference. Feedback can also be passed from the DMD to the Medical Regiment and thus to the Combat Medical Technicians, who dealt with the casualty at the point of wounding. This also allows everyone involved in a casualty's care the opportunity to raise questions and receive answers about what happened. Where there has been deviation from standardised procedures, explanations are sought that may result in identification of a training gap and appropriate measures taken.

Further benefits derived from the in-depth review of military operational mortality have been the increased linkages between clinical personnel and those working for other Defence agencies. The review has been used to determine emerging injury and treatment patterns, to determine potential areas of clinical research and to inform the on-going development of personal and vehicular protective systems and equipment.

There is a potential overlap in the definitions of KIA and DOW that is duplicated for KNEA and DNEA. Depending on circumstances, a casualty that arrives at hospital in cardiac arrest may receive blood and undergo surgery before resuscitation attempts are ceased and death pronounced. The convention that has been applied in these cases is that if there have been any signs of life at any time after arrival at the hospital then DOW is used, otherwise KIA is the designation. There are 32 cases that received blood in ED and/or theatre but as they did not regain a cardiac output at any stage, are still classified as KIA. In one case 9 units of packed red blood cells and 5 units of fresh frozen plasma were given. This case and 28 others were S4 when reviewed. The 2 S2 and 5 S3 cases all had prolonged evacuation periods as a result of tactical issues. The S4 cases potentially represent failure to recognise futility. In the resource-rich environment of Bastion Role 3 this may not have further ramifications if there are no other casualties requiring immediate treatment. However, as the Armed Forces move to contingency operations, resources will be much more limited. Whilst the final decision to stop resuscitative efforts should always rest with the clinicians at the trolley-side, a further study of these cases will be undertaken to determine if lessons can be drawn and if there is any potential for "rules of thumb" to be developed.

Comparison with the experience of American Forces described by Eastridge et al. [5] is interesting but no firm conclusions can be drawn as there has been no cross-review or communication on this subject between the reviewers and parameters may have differed. The KIA:DOW ratios of HA casualties between KIA and DOW are very similar (UK 6.28 v.US 6.87) but the UK review panel rated 93.5 % (416 cases) of HA casualties non-salvage-able compared with the US figure of 75.7 % rated non-survivable. There are many potential explanations for this difference not least a different application of the cut-off between KIA and DOW as described above. The KIA:DOW ratio has in the past been suggested as a measurement of trauma system performance but "inevitable" deaths surviving to reach hospital before dying make it a poorer tool than identifying unexpected outcomes [8].

The results of this work point to the overwhelming severity and nature of military trauma described in other studies [14, 15] especially given the proportion of injuries caused by IEDs. Data from the Vietnam War and previous modern conflicts showed a preponderance of single life-threatening injuries [16]. In the battlefield environment, any AIS score 4 or greater is potentially fatal [17]. In this study, 371 cases had AIS

4+ injuries to more than one body region, the highest being 6 regions, and 80 had AIS 6 injuries to 2 or more regions (highest 4). Of those killed by an AIS 4+ injury to a single body region, the head (72 cases) and thorax (46) were most often involved.

A further finding is the necessity to apply a clinical dimension to the review process as well as using the different trauma scoring methods, especially when considering individual cases. As was observed when analysing survivors over 18 months between 2006 and 2008 [4], there is not necessarily agreement between the methods themselves or between them and experienced clinical opinion. 17 cases were identified by ASCOT and/or TRISS as "expected survivors" (1 TRISS only, 8 ASCOT and 8 by both). Of these, clinical review graded 10 as S4, 3 S3, 1 S2 and 2 S1. 3 further cases had an ISS of <15 thus not reaching the threshold for "major trauma". All 3 were expected deaths on TRISS and ASCOT due to their physiological status on arrival at hospital and peer review award 1 to S2, S3 and S4. In all three, tactical aspects caused a delayed evacuation.

The members of the review panel have not been identical throughout the period of this study due in particular to deployments. This is a source of weakness but it is also a potential strength as it has meant that all the military members of the panel have had recent operational experience. Regardless, the membership has been relatively stable with the personnel listed in acknowledgements attending over two thirds of meetings and three of whom have attended all but one or two. Judgements have, as a result, been consistent to the standard of the best practice available at the time of that particular meeting. However, over time the parameters within which those judgements have been made have been shifting on a regular basis as advances in trauma treatment in the DMS developed. An injury pattern illustrating this is multiple amputations following an IED strike. This has been the signature injury pattern of OPERATION HERRICK and, when first seen in the meetings, survival was thought to be unlikely. As the DMS experience has developed along with training, equipment and techniques, good outcomes have been achieved on a regular basis and scrutiny of cases reaching the mortality meeting is intense.

A further study of the DOW cases dying at the UK Role 4 is in progress to determine if there are any specific lessons to be learned from this sub-group. A similar project is also ongoing into "unexpected survivors" over a longer period than described previously [4]. Whilst tactical issues were the most common factor identified in the cases graded S1-3 and each case has been examined individually, a more in-depth study of the group is required as a whole to identify if there are any key learning points that may inform clinical practice or force protection.

10.5 Conclusions

Mortality Peer Review has identified that 91.1 % of UK military operational deaths since 2002 were the result of un-survivable trauma. For casualties categorised as KIA, this figure is 93.5 %. Whilst trauma scoring systems are useful tools, clinical peer review is an essential part of the robust Healthcare Governance process that is in place to identify potential lessons and give feedback.

Acknowledgements 1. The following have been regular members of the peer review panel: Surg Capt M Midwinter; Col J Clasper, Col P Mahoney, Col R Russell, Mr A Hepper, Dr R Delaney, Dr N Hunt, Dr P Wood.
2. The staff of the Joint Theatre Trauma Registry, ADMEM attended post mortems, collected data on casualties and co-ordinated review panel meetings.
3. This material was originally published as Russell R, et al. J R Army Med Corps 2014: 160:150–154 and is reproduced here with some amendments with permission.

References

1. Hodgetts TJ, Davies S, Russell RJ, et al. Benchmarking the UK military deployed trauma system. J R Army Med Corps. 2007;153:237–8.
2. Smith J, Hodgetts TJ, Mahoney PF, et al. Trauma Governance in the UK Defence Medical Services. J R Army Med Corps. 2007;153:239–42.

3. Healthcare Commission. Defence Medical Services: a review of the clinical governance of the Defence Medical Services in the UK and overseas. London; 2009.
4. Russell RJ, Hodgetts TJ, McLeod J, et al. The role of trauma scoring in developing trauma clinical governance in the Defence Medical Services. Philos Trans R Soc Lond B Biol Sci. 2011;366:171.
5. Eastridge BJ, Mabry RL, Seguin P, et al. Death on the battlefield (2001–2011): implications for the future of combat casualty care. J Trauma Acute Care Surg. 2012;73:S431–7.
6. Marx WH, Simon HM, Jumbelic M, et al. Severity of Injury is underestimated in the Absence of Autopsy Verification. J Trauma. 2004;57:46–50.
7. Sharma BR, Gupta M, Harish D, et al. Missed diagnoses in trauma patient vis-à-vis significance of autopsy. Injury. 2005;36:976–83.
8. Hodgetts TJ, Davies S, Midwinter M, et al. Operational mortality of UK service personnel in Iraq and Afghanistan: a one year analysis 2006–7. J R Army Med Corps. 2007;153:252–4.
9. Baker SP, O'Neill B, Haddon W, et al. The injury severity score: a method of describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14:187–1966.
10. Osler T, Baker S, Long W. A modification of the Injury Severity Score that both improves accuracy and simplifies scoring. J Trauma. 1997;43:922–6.
11. Boyd CR, Tolson MA, Copes WS. Evaluating trauma care: the TRISS method. J Trauma. 1987;27:370–8.
12. Champion HR, Copes WS, Sacco WJ, et al. A new characterisation of injury severity. J Trauma. 1990;30:539–46.
13. Association for the Advancement of Automotive Medicine. Abbreviated Injury Scale 2005. Barrington; 2005.
14. Singleton JAG, Gibb IE, Hunt NCA, et al. Identifying future 'unexpected' survivors: a retrospective cohort study of fatal injury patterns in victims of improvised explosive devices. BMJ Open. Published Online First: 1 Aug 2013. doi:10.1136/bmjopen-2013-003130.
15. Ramasamy A, Harrisson SE, Clasper JC, et al. Injuries from roadside improvised explosive devices. J Trauma. 2008;65:910–4.
16. Bellamy RF. The causes of death in conventional land warfare: implications for combat casualty care research. Mil Med. 1984;149:55–62.
17. Champion HR, Holcomb JB, Lawnick MM, et al. Improved characterization of combat injury. J Trauma. 2010;68:1139–50.