Mortality, survival and residual injury burden of Royal Navy and Royal Marine combat casualties sustained in 11-years of operations in Iraq and Afghanistan


Abstract

We present eleven years of prospectively-gathered data defining the full spectrum of the United Kingdom’s (UK) Naval Service (Royal Navy and Royal Marines) casualties, and characterise the injury patterns, recovery and residual functional burden from the conflicts of the last decade. The UK Military Trauma Registry was searched for all Naval Service personnel injured between March 2003 and April 2013. These records were then cross-referenced with the records of the Naval Service Medical Board of Survey (NSMBOS), which evaluates injured Naval Service personnel for medical discharge, continued service in a reduced capacity or Return to Full Duty (RTD). Population at risk data was calculated from service records.

There were 277 casualties in the study period: 63 (23%) of these were fatalities. Of the 214 survivors, 63 or 29% (23% of total) were medically discharged; 24 or 11% (9% of total) were placed in a reduced fitness category with medical restrictions placed on their continued military service. A total of 127 individuals (46% of the total and 59% of survivors) RTD without any restriction. The greatest number of casualties was sustained in 2007. There was a 3% casualty risk per year of operational service for Naval Service personnel. The most common reason cited by Naval Service Medical Board of Survey (NSMBOS) for medical downgrading or discharge was injury to the lower limb, with upper limb trauma the next most frequent.

This study characterises the spectrum of injuries sustained by the Naval Service during recent conflicts with a very high rate of follow-up. Extremity injuries pose the biggest challenge to reconstructive and rehabilitative services striving to maximise the functional outcomes of injured service personnel.

Introduction

Since the invasion of Iraq in 2003 (OPERATION TELIC), the Naval Service i.e. the Royal Navy (RN) and Royal Marines (RM) have been involved in operations in Iraq and Afghanistan on land, sea and in the air. The Naval Service withdrew from Iraq in 2011 with the end of the RN’s training and mentoring mission with the Iraqi Navy. While small numbers of RN and RM personnel remain in Afghanistan, the last major Naval Service deployment there ended with the completion of 40 Commando RM’s tour as part of OPERATION HERRICK 17 on 30 April 2013.

The most commonly used outcome measure for assessing success in combat casualty care is mortality. Whilst this is arguably the most important metric and clearly unambiguous, it is a crude outcome measure and predominantly assesses acute care and not efforts to reconstruct and rehabilitate after serious injury.

With the culmination of eleven years of continuous operational deployment for the Naval Service, there is the opportunity to examine systematically the burden of injuries which these conflicts have engendered for RN and RM personnel. This work is a continuation and completion of the study that has previously been published elsewhere (1) and examines outcomes following combat trauma, including survival and RTD within the RN and RM. This paper represents the continuation of that work with an additional three years of data collection.
The aims of this study were to: i) determine the rate of fatality and injury amongst Naval Service personnel deployed on operations; ii) define the occupational recovery of those injured; iii) establish the residual burden of injury amongst Naval Service survivors of combat injury.

Methods
This study was approved by, and registered with, the UK’s Joint Medical Command and conducted at the Institute of Naval Medicine (INM).

The Naval Service operates a single, centralised Naval Service Medical Board of Survey (NSMBOS) for evaluating all injured sailors and Royal Marines. Its purpose is to determine the extent of an individual’s recovery and their fitness for further military service. This allows a review of the full clinical spectrum of injuries sustained and their potential impact on the patient’s military career and takes into account social and functional recovery.

The UK Defence Statistics group provided the authors with data on all RN and RM personnel who had deployed to either Iraq or Afghanistan from 1 April 2007 (the earliest available computerised records) to 30 April 2013. The numbers of deployed RN and RM personnel were multiplied by the number of days that they had served in operational theatre to give person days at risk, and this was then divided by 365 to give person years at risk (PYAR). The casualty rate for this period was therefore calculated by obtaining the corresponding number of casualties during this period.

The Defence Medical Service Joint Theatre Trauma Registry (JTTR) is an electronic database of prospectively gathered information collected by trained research nurses working both in deployed medical facilities and in the Royal Centre for Defence Medicine (RCDM) in the UK. All cases of trauma fatalities, cases triggering a ‘trauma-call’ on presentation to deployed medical facilities, and those whose injuries resulted in repatriation to the UK are recorded (2). The JTTR was searched for all RN and RM personnel injured between the invasion of Iraq in March 2003 and the end of the last major Naval Service deployment to Afghanistan in April 2013.

Demographic information, data regarding initial injuries, an anatomic measure of injury severity using the New Injury Severity Score (NISS) (3), mechanism of injury and treatment was also collected from the JTTR. These cases were then cross-checked against the records of the NSMBOS up to April 2014. The twelve-month lag period between injury and NSMBOS data collection is a result of Naval Service regulations, which state that all personnel must be referred to NSMBOS within twelve months of the onset of medical problems. Referral to the NSMBOS can result in one of three outcomes:

1. A recommendation for medical discharge;
2. Returning an individual to full military duties;
3. Assigning an individual to a reduced medical category (known as medical downgrading): this entails restrictions on the individual’s ongoing military duties e.g. no running, no load carrying, no service onboard ship.

For the purposes of this study individuals identified from JTTR and NSMBOS data were therefore placed in one of four categories:
1. Fatality
2. Medically discharged
3. RTD
4. Medically downgraded

Analysis
Statistical analysis of outcome versus injury severity was performed using a Kruskal-Wallis analysis of variance with a threshold for significance set at 0.05.

Results
There were 277 casualties in the study period: 63 (23%) of these were fatalities. Of the 214 survivors, 63 or 29% (23% of total) were medically discharged and 24 or 11% (9% of total) were placed in a reduced fitness category with medical restrictions placed on their continued military service. A total of 127 individuals (46% of the total and 59% of survivors) returned to duty without any restriction. The greatest number of casualties was sustained in 2007 with the casualty distribution over the eleven years of the study period shown in Figure 1. The median age of all casualties was 25 (inter-quartile range 22-30). Explosive injuries were the most common mechanism, being the cause of approximately 70% of casualties; further details

Figure 1: Naval Service casualties by year with fatalities and survivors shown.
Table 1: Injury mechanism. GSW: Gun-shot wound; MVC: Motor Vehicle Collision.

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosive</td>
<td>168</td>
<td>67%</td>
</tr>
<tr>
<td>GSW</td>
<td>69</td>
<td>25%</td>
</tr>
<tr>
<td>MVC</td>
<td>12</td>
<td>4%</td>
</tr>
<tr>
<td>Air Crash</td>
<td>15</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>3%</td>
</tr>
<tr>
<td>Unknown</td>
<td>5</td>
<td>2%</td>
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Injury severity was closely associated with NSMBOS outcome, as shown in Figure 2 (p<0.0001, Kruskal-Wallis). Limb injuries were the most common medical reasons for patients to undergo medical discharge or downgrading, with further details shown in Figure 3.

Discussion

This study details the medical sequelae of eleven years of combat operations for Naval Service personnel in Iraq and Afghanistan. We calculated that a year of operational Naval Service generated a 3% risk of becoming a casualty, and that the residual burden of injuries is overwhelmingly ortho-plastic in nature.

The fatality rate of casualties in this study population was 23%, which is consistent with the overall UK military fatality rate over the study period (4). Our results demonstrate a general association between greater injury severity, as measured by NISS, and likelihood of fatality or discharge from Naval Service (Figure 2). Conversely, those with less severe injuries were more likely to return to full military duty.

Examination of the outcome categories reveals outliers to this association: 18 individuals with a NISS of less than ten (i.e. less severely injured) were medically discharged or downgraded. Though this small sample size prevents detailed statistical analysis, it can be noted that four had a diagnosis of post-traumatic stress disorder (PTSD), and six had visual or hearing loss. Special sensory deficit or loss presents a particular obstacle to continuing

Figure 2: Scatter plot showing New Injury Severity Score (NISS) of casualties in each of the four outcome cohorts. RTD: Returned to Duty. Bar-and-whiskers showing median and inter-quartile range. Kruskal-Wallis analysis indicates a significant association between NISS and outcome (p<0.0001).

Figure 3: Reasons cited by Naval Service Medical Board of Survey for medical discharge or downgrading. PTSD: Post-traumatic Stress Disorder. N.B. each case can have more than one medical condition cited as a reason for discharge or downgrading.

Table 2: Casualties per year with population-years at risk (PYAR) and casualty rate per PYAR expressed as a percentage.
military service due to the safety implications of impaired situational awareness. It is important to note that due to the methodology used in this study, patients with PTSD would only be included in our figures if they had concurrent physical injuries. Those with psychiatric injuries alone would not have been identified, even if they were discharged or downgraded as a result.

Our findings show four survivors with a supposedly non-survivable NISS of 75 and eleven with a NISS > 50. This echoes recent research examining all UK military casualties showing that the standard of medical care is already very close to the physiological survivable limits of these catastrophically injured patients (4). This suggests that the focus of resources and research should be partly shifted from improving survival, to improving reconstructive surgery and rehabilitation therapies.

Of the survivors in this study there is a high residual burden of injury, with the extremities most commonly affected. US military physicians have similarly found that the sequelae of extremity injuries form the vast majority of reasons for eventual medical discharge from military service following combat trauma. Cross et al. found that 76% of medically discharged patients had a primary orthopaedic diagnosis (5). However it is possible for those with severe limb injuries, up to and including amputation, to return to high function including returning to active service and re-deploying on operations (6, 7).

There are recognised weaknesses in this study. A proportion of individuals will have attended a provisional NSMBOS and have been temporarily medically downgraded to facilitate ongoing treatment. Once full recovery potential has been achieved, patients will attend a subsequent NSMBOS to determine a final outcome i.e. that they have sufficiently recovered to RTD, that they will be retained in service permanently medically downgraded, or that their residual injuries are so significant to be incompatible with ongoing military service. The relative proportion of those within this group who will go on to recover to full duties or will be fully discharged from the service is not assessed by this study.

Secondly, there is no way to recognise how significant individual injuries summate in any patient’s overall injury burden; there may be a bias to over-recording of injuries, since this contributes to pension calculations. NISS was used in preference to ISS, as it has been shown to correlate more accurately with outcome (8). Also, despite Naval Service regulations that referral to NSMBOS take place within twelve months of injury, it is possible that in a few cases individuals have managed to postpone this to maximise their recovery prior to appearing before the board.

Replicating this study across the wider UK military would be problematic due to the regional nature of the British Army’s medical boarding system. However, the authors believe that this study is likely to be a proxy-measure for the wider UK military. It should be noted that the medical and rehabilitative care described is standardised across all three UK armed services.

Despite these acknowledged weaknesses the authors believe that this study is valid in its characterisation of the injury burden and recovery of combat trauma from recent conflicts. While this study focuses on a single part of the UK military it has the unique strength of comprehensively tracing every injured individual from a single armed service from point of wounding to eventual occupational outcome.

Conclusion
This study confirms that the Defence Medical Services provide a high level of acute trauma care, capable of saving the lives of very severely injured casualties. In addition, a large number of relatively severely injured casualties are either returned to full fitness or retained in the Naval Service following military surgical reconstruction and rehabilitation. Limb injuries represent the largest morbidity burden, requiring extensive ortho-plastic intervention as part of rehabilitation. The resulting advances in trauma care and survival have engendered the need for a tight focus on reconstructive surgery and rehabilitation therapies.

References
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