Military trauma care in Birmingham: Observational study of care requirements and resource utilisation

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Background: The Royal Centre for Defence Medicine is located at University Hospitals Birmingham (UHB). Since 2001 all UK military casualties injured on active duty have been repatriated here for their initial treatment. This service evaluation was performed to quantify the work undertaken, with the aim of providing a snapshot of a year's military trauma work in order to inform the delivery of trauma care in both the military and civilian setting.

Methods: Military patients admitted with traumatic injuries over a 12-month period were identified and the hospital notes and electronic records reviewed. Data were collected focusing on three areas – the details of the injury, information about the in-patient admission, and surgical interventions performed.

Results: A total of 388 patients were used in the analysis. Median total length of stay was 10.5 days (IQR: 4–26, range: 0–137 days), and a median 6.0 days (IQR: 3.0–11.0, range: 1–49 days) was spent on intensive care by 125 patients. Surgical intervention was required for 278 (71.6%) patients, with a median of 2.0 operations (IQR: 1.0–4.0, range: 1–27) or 170 min (IQR: 90.0–570.0, range 20–4735 min) operating time per patient. 77% of these patients had their first procedure within 24 h of arrival. Improvised explosives accounted for 50.5% of injuries seen. Spearman rank correlation between New Injury Severity Score with length of stay demonstrated significant correlation ($p < 0.001$), with a coefficient of 0.640. A model predicting length of stay based on New Injury Severity Score was devised for patients with battle injuries.

Conclusion: This report of 12 months work at UHB demonstrates the service commitment to these casualties, describing the burden of care and resource requirements for military trauma patients.

Introduction

Care of combat injured military personnel has been centralised in the United Kingdom (UK) to University Hospitals Birmingham (UHB), part of the Royal Centre for Defence Medicine (RCDM). The unique experience of trauma care in this Centre has not previously been described. Subspecialties have presented work on specialised areas including critical care,[1] maxillofacial injuries,[2] management of complex wounds[3] and others, but a general overview has been lacking.

The aim of this project was to quantify the overall burden of care that the injuries sustained represent, and examine basic and essential resource utilisation. Treating complex military trauma patients is a resource intensive activity; it requires careful planning and allocation of resources including, but not limited to, surgical operating time and bed allocation, in particular intensive care, to achieve optimal outcomes. In UHB planning is performed by the surgical teams at twice daily meetings. As a regional trauma centre, UHB can provide the full spectrum of acute medical, surgical and psychological resources required by these patients. The driver of this project was to identify how characteristic injury patterns were predictive of resource requirements. This is particularly practical as there is typically a 12–24 h lag phase during the casualty's evacuation for such planning to

take place. In the medium term this information could help predict length of stay (LOS) and rehabilitation requirements in addition to the initial surgical needs. Basic patient information is already being used to prepare trauma teams working in field hospitals,[4] and this work is an extension into the civilian setting following repatriation to the UK. Care of these patients occurs alongside that of civilian trauma patients and as such the trauma services at UHB were adapted to accommodate the workload described here. By describing the population and injuries, a snapshot of the unique trauma care in this Centre is delivered. It also strengthens existing suppositions on the most accurate scoring system for a specific mechanism of injury (MOI) in trauma care when predicting resources.

Military trauma patients reach RCDM via two principle mechanisms of the Tactical Medical Wing (TMW) of the Royal Air Force (RAF). The most critically injured are evacuated by the Critical Care Air Support Teams (CCAST), which provide a continuous capability to evacuate intubated and ventilated patients, immediately after their initial resuscitative surgery in the field hospital. These teams are able to fly directly from Camp Bastion in Afghanistan to RCDM via Birmingham International Airport. Less severely injured patients are transported via the Aeromed system, and these flights may be direct to Birmingham or via other staging posts according to operational logistical requirements. The decision to use CCAST versus Aeromed is made by treating clinicians in the theatre of operations.

Methods

Patient selection

All military personnel admitted to UHB as an in-patient between 1st January 2009 and 31st December 2009 (inclusive) were identified through a database collated prospectively by the UK Joint Medical Command (JMC), the Joint Theatre Trauma Registry (JTTR). The United States Department of Defense collates a similar database. Patient information was drawn from a combination of the UK JTTR database, electronic note records, electronic theatre records and retrospectively reviewed case notes. Any patient admitted with a non-traumatic aetiology was excluded, but non-battle injuries (NBI) were included where they classified as trauma, e.g. road traffic collisions.

Data gathered included basic patient demographics, injury details, length of in-patient stay including spells on the intensive care unit (ICU), injury severity score (ISS), new injury severity score (NISS), and surgical procedures during the acute admission. Surgical episodes examined included procedures carried out by all surgical specialties, but did not include surgery carried out prior to arrival at UHB, or surgery conducted at other sites. Surgical time was calculated as the time from induction of anaesthesia to the patient leaving theatre. Specific details for those patients sustaining amputation were also calculated separately. In this group amputation included any patient with amputation at the level of the ankle or above, and the hand or above, digit amputations were not included.

Statistics

Spearman rank correlation was used to describe the relationship between ISS and NISS and the LOS. Patients were then divided by MOI (battle or non-battle injury) and injury severity (NISS ≤ 16 or NISS > 16). Comparisons were made between the pairs of groups using Mann–Whitney tests, in order to consider the effects of these factors on the LOS and surgical requirements.

A multiple regression model was then produced to test the effects of NISS and MOI on the LOS of the patient. Due to the

skewed distribution of the LOS, the variable was $\log_{10}$-transformed prior to the regression analysis. However, since some patients had a LOS of zero days, an extra day needed to be added for each patient in order for logs to be calculable. Hence, the outcome variable for the regression model was: $\log_{10}(LOS + 1)$.

All analyses were performed using IBM SPSS 19.0.0 (IBM SPSS Inc.), with $p < 0.05$ deemed to be indicative of significance.

Results

Over the 12-month period a total of 393 military patients suffering traumatic injuries were admitted to UHB. In 4 cases (1.0%), where death was expected at the time of repatriation, the data was removed from further analysis. Data collection was incomplete for 1 patient (0.3%) and this data was also removed from further analysis. Therefore a total of 388 patients' data was analysed.

The median age of the patients was 24.4 years (IQR: 21.2–29.1, range: 17.9–43.5), and 385 were male (99.2%). During the study period 3 patients died during their hospital admission, all as a direct result of their injuries. One patient died after it became clear that the head injury sustained was more severe than initially thought, this patient underwent one surgical procedure for his other injuries prior to life support withdrawal on day 1. Another patient died from a pulmonary embolism following 17 surgical procedures on day 38, and one final patient died from sepsis and multi-organ failure secondary to SIRS after 3 surgical procedures on day 8.

The median LOS for all patients was 10.5 days (IQR: 4.0–26.0, range: 0–137 days). The median ICU LOS for 125 patients admitted to ICU was 6.0 days (IQR: 3.0–11.0, range: 1–49 days). The total number of admission days over the 12 months was 7033, with 1023 days on ICU. This equates to a daily bed occupancy rate of 19.3 military trauma patients, of which 2.8 beds are occupied on ICU. The median time from injury to admission was 2.0 days (IQR: 1.0–3.0), with a range of 0–106 days depending on the mechanism and type of injuries, and the locality of the patient (see Fig. 1). One patient spent 106 days in a specialist facility receiving treatment abroad prior to transfer. Twenty six patients (6.7%) were admitted more than 7 days after their injury. Casualties from operational combat areas, including Afghanistan, were admitted a median of 2 days after injury.

The median ISS for 388 patients was 5.0 (IQR: 4.0–16.0, range: 1–75) and the median NISS was 8.5 (IQR: 4.0–18.0, range: 1–75). Six patients scored ISS of 75 of whom 4 survived (66.7%), and 7 patients scored NISS of 75 of whom 5 survived (71.4%).
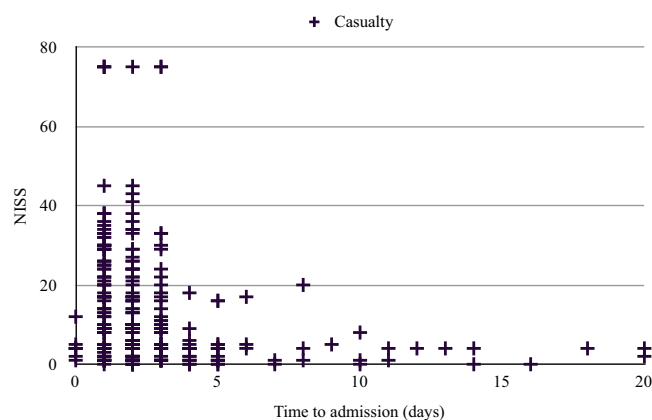
Fig. 1. Scattergram showing time to admission in days according to NISS excluding those patients admitted more than 30 days after injury (4 patients admitted on days 31, 34, 59 and 106 with NISS of 48, 4, 1 and 4 respectively).