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Acute bilateral leg amputation following combat injury in UK servicemen

J.G. Penn-Barwell [a,b,*], P.M. Bennett [a], A. Kay [a], I.D. Sargeant [a]

On behalf of the Severe Lower Extremity Combat Trauma (SeLECT) Study Group:
J.G. Penn-Barwell [c], P.M. Bennett [c], C.A. Fries [c], J. Cooper [c], J.M. Kendrew [c], M. Midwinter [c], R.F. Rickard [c], I.D. Sargeant [c], K. Porter [c], T. Rowlands [c], A. Mountain [c], A. Kay [c], S. Jeffrey [c], D. Evirviades [c], T. Cubison [c]

[a] Academic Department of Military Surgery and Trauma, Royal Centre for Defence Medicine (RCDM), Birmingham, UK
[b] Institute of Naval Medicine, Gosport, Hampshire, UK
[c] RCDM/Queen Elizabeth's Hospital, Birmingham, UK

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ABSTRACT

Background: This study aims to characterise the injuries and surgical management of British servicemen sustaining bilateral lower limb amputations.
Methods: The UK Military Trauma Registry was searched for all cases of primary bilateral lower limb amputation sustained between March 2004 and March 2010. Amputations were excluded if they occurred more than 7 days after injury or if they were at the ankle or more distal.
Results: There were 1694 UK military patients injured or killed during this six-year study period. Forty-three of these (2.8%) were casualties with bilateral lower limb amputations. All casualties were men with a mean age of 25.1 years (SD 4.3): all were injured in Afghanistan by Improvised Explosive Devices (IEDs). Six casualties were in vehicles when they were injured with the remaining 37 (80%) patrolling on foot. The mean New Injury Severity Score (NISS) was 48.2 (SD 13.2): four patients had a maximum score of 75. The mean TRISS probability of survival was 60% (SD 39.4), with 18 having a survival probability of less than 50% i.e. unexpected survivors. The most common amputation pattern was bilateral trans-femoral (TF) amputations, which was seen in 25 patients (58%). Nine patients also lost an upper limb (triple amputation): no patients survived loss of all four limbs. In retained upper limbs extensive injuries to the hands and forearms were common, including loss of digits. Six patients (14%) sustained an open pelvic fracture. Perineal/genital injury was a feature in 19 (44%) patients, ranging from unilateral orchidectomy to loss of genitalia and permanent requirement for colostomy and urostomy. The mean requirement for blood products was 66 units (SD 41.7). The maximum transfusion was 12 units of platelets, 94 packed red cells, 8 cryoprecipitate, 76 units of fresh frozen plasma and 3 units of fresh whole blood, a total of 193 units of blood products.
Conclusions: Our findings detail the severe nature of these injuries together with the massive surgical and resuscitative efforts required to firstly keep patients alive and secondly reconstruct and prepare them for rehabilitation.

Introduction

Wounds sustained in modern military conflicts predominantly affect the extremities [1]. The preponderance of extremity wounds has been exacerbated by several factors specific to the current conflicts. British military personnel serving in the conflicts of Iraq and Afghanistan have benefited from body armour and helmets superior to those issued to any of their predecessors. This conflict has also seen significant advances in techniques of rapid casualty extraction by helicopter including en-route resuscitation with blood products by a consultant anaesthetist or emergency physician. The combination of these factors has contributed to servicemen surviving significant blasts that would likely have been un-survivable in previous conflicts. Consequently these casualties are left with significant extremity injuries.

This study aims to characterise the injuries and surgical approach to the treatment of British servicemen who have sustained traumatic bilateral lower limb amputation following combat injury.

* Corresponding author at: Academic Department of Military Surgery and Trauma, Royal Centre for Defence Medicine (RCDM), ICT Research Park, Vincent Drive, Edgbaston, Birmingham B15 2SQ, UK. Tel.: +44 7810867555; fax: +44 121 415 8869.
E-mail address: Jowan@doctors.net.uk (J.G. Penn-Barwell).

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Patients and methods

This study was registered with, and approved by, the Joint Medical Command institutional review process. The UK military 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 triggering a 'trauma-alert' on presentation to deployed UK medical facilities or subsequently requiring return to the UK following injury are included. The database is managed by the Academic Department for Military Emergency Medicine at RCDM and administered by Defence Statistics.

The JTTR was searched for all cases of bilateral lower limb amputation between March 2004 and March 2010. Cases were excluded if they involved amputation at the ankle or more distally. Patients in whom amputation occurred more than 7 days after injury were also excluded.

Data was then collected from the JTTR, checked against clinical records and the details of injury severity, mechanism and treatment were recorded. Descriptive data was presented as a mean or median with standard deviation or range.

Results

There were 1694 UK military patients injured during this six-year study period. Forty-three of these (2.8%) were casualties with bilateral lower limb amputations. All casualties were men with a median age of 25 years (IQR = 22–28). All casualties in this study were injured in Afghanistan by Improvised Explosive Devices (IEDs). Six casualties were in vehicles when they were injured with the remaining 37 (80%) patrolling on foot.

The median New Injury Severity Score (NISS) [2] was 48 (IQR = 41–57): four patients had a maximum score of 75. The mean TRISS probability of survival was 60% (SD 39.4), with 18 having a survival probability of less than 50% i.e. unexpected survivors.

Bilateral trans-femoral amputations (TF) were the most common amputation pattern seen, occurring in 25 patients (58%): further details of amputation levels are given in Table 1. Nine patients (21%) also lost an upper limb (triple amputation): no patients survived loss of all four limbs. In retained upper limbs extensive injuries to the hands and forearms were common, including the loss of digits.

Six patients (14%) sustained an open pelvic fracture. Perineal/genital injury was a feature in 19 (44%) patients, ranging from unilateral orchidectomy to loss of genitalia and permanent requirement for colostomy and urostomy.

The median requirement for blood products was 62 units (IQR = 38–84). The minimum transfusion requirement was 8 units and the greatest was a patient requiring 12 units of platelets, 94 packed red cells, 8 cryoprecipitate, 76 units of fresh frozen plasma and 3 units of fresh whole blood, a total of 193 units of blood products. Twenty patients (47%) had immediate laparotomy, 3 were treated with resuscitative thoracotomy while two required urgent thoraco-laparotomies as part of their damage control surgery-resuscitation.

The median ITU stay was 7 days (range 0–64). The median number of orthopaedic operations per residual limb was 3 (range 1–10) with the median total operations per patient 8 (IQR = 6–10).

Table 1
Distribution of amputation levels-upper and lower limbs in the 43 cases with bilateral lower limb loss included the 9 patients who have also lost an upper limb.

	N (%)
Lower limb (43)	
Bilateral trans-tibial	4 (9)
Trans-tibial/knee disarticulation	1 (2)
Trans-tibial and trans-femoral	9 (21)
Bilateral knee disarticulation	0
Knee disarticulation and trans-femoral	4 (9)
Bilateral trans-femoral	25 (58)
Concurrent upper limb loss (9) (triple amputation)	
Trans-radial	3 (33)
Elbow disarticulation	0
Trans-humeral	6 (66)

Initial management of casualties

The injury pattern described in this study is at the severe end of the spectrum of survivable injury. The first priority of treatment is the control of major haemorrhage. In the event of limb loss in the field all personnel are trained to rapidly apply the Combat Applied Tourniquets (CAT)® (Composite Resources, USA); two being issued to each service member together with field dressings. Each patrol is also supported by embedded pre-hospital medical technicians and often by a doctor. This allows early checking of placement and effectiveness of tourniquets and dressings, establishment of intravenous or intra-osseous access, administration of analgesia, application of pelvic binders and other splints and appropriate triage for prioritisation of evacuation. Administration of pre-hospital crystalloids is restricted.

Casualties are extracted by either the UK Medical Emergency Response Team (MERT) on-board a Chinook HC2 helicopter, or a US paramedic team (PJs) on a HH60G Pavehawk. The UK MERT has a consultant grade doctor skilled in pre-hospital emergency care including advance airway interventions. Pre-hospital blood replacement is routine and in the form of packed red cells and pre-defrosted FFP in a 1:1 ratio [6]. Following the findings of the CRASH 2 and MATTERs trials [7,8], the first dose of 1 g of tranexamic acid is preferably given pre-hospital.

On arrival at the emergency department pneumatic tourniquets are applied and CATs removed; resuscitation with blood products is continued, guided by real time thromboelastography [9]. Restoration of effective circulating volume with blood products is achieved quickly with the use of Belmont Rapid Transfuser (Belmont Industries, Billerica, USA), which can infuse up to 1 L of blood products per minute. The majority of patients are stable enough at this stage to have a whole body CT scan which has proved invaluable in delineating the full extent of the injures. Only those with uncontrollable massive haemorrhage or traumatic cardiac arrest are taken straight into the adjacent operating theatre. Antibiotic therapy is initiated on arrival in the emergency department and all casualties with extremity wounds receive 1.2 g of co-amoxiclav intravenously.

Initial interventions in the operating theatre follow Damage Control Surgery principles [10]. If necessary, surgical control of damaged major blood vessels is performed, which may involve temporary cross-clamping of the iliac or common femoral arteries. This is combined with application of an anterior pelvic external fixator if indicated.

Where possible though, control of bleeding is maintained through continued use of pneumatic tourniquets. Perineal injury may require rectal de-functioning, normally achieved initially with simple cross stapling of the sigmoid colon. Even with severe injury to the external genitalia, urethral catheterisation is attempted along with open placement of a supra-pubic catheter as indicated.

Within the normal DCS pathway the patient would be transferred to ITU for a period of stabilisation. However, the combination of the described pre-hospital and initial surgical interventions (described as Damage Control Resuscitation) often leaves the patient at this point in a good physiological state, being