FORWARD TRAUMA SURGERY IN AFGHANISTAN: LESSONS LEARNT ON THE MODERN ASYMMETRIC BATTLEFIELD

N Tai, P Hill, A Kay, P Parker

Field Surgical Team, 16 Close Support Medical Regiment, BMH Helmand, Camp Bastion, Afghanistan

Abstract

The deployment of 16 Air Assault Brigade to Helmand Province, Afghanistan in April-October 2006 was supported by a two -surgeon Field Surgical Team (FST) embedded within a 25 bed medical facility. We report the summative operative experience of the FST in order to analyse workload, case-mix and outline future training requirements. Within this period, 138 patients underwent 255 theatre episodes and 322 surgical procedures. 106 of the 138 patients requiring surgery were battle-injured. Surgical procedures undertaken involved wound excision (95), major amputation (9), laparotomy (9), application of external-fixation/skeletal traction (6), thoracotomy (4), plaster application (6), dural repair (2), and one tracheostomy with 13 other procedures. Procedures undertaken at subsequent surgery included delayed primary closure (65), split skin graft (7), wound excision (5), tendon repair (3) and 32 others. Complications included two patients with delayed reactionary haemorrhage / post-surgical bleeding requiring re-operation. There was one in-hospital death. Thirty-two patients underwent surgery to treat disease or non-battle injury (DNBI), including 9 patients with major burns who required 26 procedures for burn excision and primary skin grafting. Many of the operations required the deployed team to operate outside of their normal NHS comfort zone. The experiences and lessons learnt and re-learnt by this surgical team should be part of our institutional memory.

Keywords: military, surgery, blast, ballistic, trauma, training

Introduction

The deployment of 16 Air Assault Brigade to Helmand Province, Afghanistan over April-October 2006 was supported by a dual-surgeon Field Surgical Team (FST) embedded within a 25 bed medical facility. This was an insertion operation and much of the early part of the deployment was taken up with the establishment of a robust medical facility. The hospital at Camp Bastion was initially planned as a Role 2E (Enhanced) facility designed as a surgical resuscitation node with limited clinical imaging and laboratory support, providing life, limb and eye saving surgery, to an eligibility matrix-designated population and with limited patient hold ability. Role 3 support was to be provided by a multinational facility at a larger base in Kandahar (50 minutes fixed-wing flight away). Our R2E had a greater physical capacity than the R3 (25/50 vs. 11/14 beds). Thus we could expand rapidly from 25 to 50 beds and notwithstanding our lack of CT scanner, developed into the de facto R3 hospital for Helmand Province. The eligibility matrix was later relaxed by COMBRITFOR to earn the tolerance and co-operation of the local population. This led to the treatment of Afghan civilians, including paediatric cases as young as 18 months of age. Rehabilitation and some R4 functions were thus undertaken. Significant problems were encountered in returning treated civilians to local care.

Methods

Operative and case records were recorded prospectively and entered onto an Excel spreadsheet by each operating surgical team. These were also validated against the theatre operating records and individual surgeons' personal logbooks.

Corresponding Author: Lt Col Paul Parker FIMC FRCSEd FRCSOrth RAMC, Senior Lecturer, Academic Department of Military Surgery and Trauma, Consultant Adviser in Orthopaedics to DGAMS, MDHU(N), Friarage Hospital, Northallerton, DL6 1JG
Tel: +44 1609 764901 Fax: +44 1609 764638
Email: paul.parker@stees.nhs.uk

Results

Injuries and Surgical Procedures

The injuries treated were blast/fragmentation injuries in 56 patients, gunshot wounds in 44 and blast/thermal injury in six. The procedures undertaken at initial surgery are detailed in Table 1. At subsequent surgery there were 65 delayed primary closures; split skin grafting in seven patients, further wound excision [5], tendon repair [3] and 32 varied other procedures. Complications included two patients with delayed reactionary haemorrhage / post-surgical bleeding requiring re-operation. There was one in-hospital death. Thirty-two patients underwent surgery to treat disease or non-battle injury (DNBI), including nine patients with major burns who required 26 procedures for burn excision and primary skin grafting.

Procedure	Number
Wound Excision	95
Major Amputation	9
Laparotomy	9
External Fixation/Skeletal Traction	6
Thoracotomy	4
Plaster Application/MUA	6
Dural Repair	2
Tracheostomy	1
Others	32 (I&D Abscess 19, Cyst excision 5, Appendicectomy 3, Nasal packing 2, Hernia repair 2, Laryngoscopy 1.

Table 1. Initial surgical procedures.

Musculoskeletal Injury

Of the 106 battle-injured patients requiring surgery, 29 (27%) had sustained long bone fractures. There were 4 femoral fractures, 12 tibial fractures, 1 isolated fibular fracture, 5 humeral fractures, 1 distal radius fracture and 8 fractures involving the hand and foot. Twenty-six (84%) of the fractures were open. One patient with a closed femoral fracture had massive swelling of the thigh requiring emergent fasciotomies; he also had life-threatening 70% TBSA burns, a significant inhalational injury and blast lung. (Fig 1) Two patients required laparotomies for life threatening bleeding prior to lower limb amputation and one patient required control of the femoral vessels in the groin for haemorrhage control prior to commencement of thigh wound excision. Three vacuum (Vac) advanced wound dressings were applied. The extremity interventions performed are listed in Table 2.

Figure 1. Patient with a closed femoral fracture who had massive swelling of the thigh requiring emergent fasciotomies, he also had 70% TBSA with a significant inhalational injury and blast lung.

Procedure	Number	Details
Amputation	14	Digital (5); Above knee (4); Upper Limb (2); Through foot (1); Below knee (1); Through knee (1).
External Fixators	5	Femoral (3); Tibial (2)
Skeletal Traction	1	
MUA/Plaster Application	6	Tibial Fractures
Tendon Repairs	8	Extensor (6); Flexor (2)
Split Skin Grafts	8	
Gastrocnemius Flap	1	With Tibial X-Fix above

Table 2. Extremity Interventions.

Torso Trauma

Twelve battle-injured patients (11.3%) required cavity exploration for injuries of the thorax and abdomen. Of these, eight patients underwent laparotomy, two patients underwent thoracotomy and 2 patients underwent combined thoracolaparotomy (2 'clamshells' overall). Three patients required temporary abdominal closure with 'Bogota Bags' – one after decompressive laparotomy for a burns-related abdominal compartment syndrome, and two after a damage control laparotomy. This experience, along with other contemporary accounts of combat injury, confirms that operative exploration of a torso cavity is required in only a small proportion of combat injuries [1-7].

Neurosurgical Trauma:

Three craniotomies and two dural repairs were undertaken for penetrating cranial injury including an 18 month old Afghan girl (Fig 2) who made an excellent recovery; thus survivable penetrating brain injury will be seen and it will be necessary to perform the initial wound surgery in these cases. Prevention of secondary infection and secondary brain injury remain paramount.

Burns and Plastics Surgery

Nine major burn cases required twenty-six excision and grafting surgeries. These included 5 emergency escharotomies. The management of burn injury in war is known to produce large demands on materiel, time and manpower [8]. This was clearly demonstrated by the large workload generated by a small number of burn casualties.

Discussion

We believe that this deployment demonstrates many areas that should be highlighted and lessons that may be learnt in terms of the necessary skill sets that deploying surgeons require, most of which may lay outside of a standard NHS practice. These are discussed on a regional/systems basis and the views are personal ones derived from our combined operative experiences, but in virtually all instances represent consensus with the published literature.

Musculoskeletal Injury

Many patients will sustain multi-system trauma despite the wearing of body armour. Thoraco-abdominal bleeding needs to be treated before limb trauma is addressed. Patients injured by blast may have thermal and lung injuries as well as fractured limbs and control of limb vessels in either the axilla or groin may be required. A whole-system team approach is necessary which needs to involve anaesthesia, radiology, laboratory and nursing care. Anticipatory Treatment of Trauma Coagulopathy (ATTaC) with hypothermia prevention, time-limited surgeries and early use of adjunctive blood products is recommended. (1:1:1 administration of blood, plasma and platelets) [9-11]. One patient had to be returned to theatre for delayed primary haemorrhage following débridement of a massive thigh wound, as once an adequate circulating volume and normothermia had been restored in ITU, bleeding commenced from 3 branches of the profunda femoris artery that were subsequently tied off. This may have been avoided if the patient had remained in the operating theatre for half an hour after surgery and had a 'second look' wound inspection performed prior to moving to the ITU. However this would always need to be balanced against the tenets of DCS and the tactical situation. Hypothermia of critically ill patients during surgery remains a problem in the desert environment and can lead to coagulopathy. Night action at altitude, extended pre-hospital hold times which are more common in entry operations, combined with delayed casevac open-door air retrieval are associated with the highest risks.

The majority of fractures were open and the use of antibiotics given in the field shortly after wounding is highly likely to reduce the incidence of infection, and this should be emphasised in pre-deployment training [12,13]. Tetanus immunoglobulin is required for non-immunized personnel and this becomes pertinent when treating local civilians. One Afghan national developed tetanus after wounding and required 30 days on a ventilator to recover. The difference between Tetanus Toxoid and Immunoglobulin must be clearly understood.

In the highly charged atmosphere of a busy trauma room, many features of basic medical care may be overlooked and it

Figure 2. 18 month old Afghan girl with meningitis following compound depressed skull fracture and penetrating dural wounds, presenting 3 days after fragment injury. Post debridement feeding and rehabilitation.

is important that attention is paid to basic medical principles, such as a full clerking, pre-operative iv fluids, second antibiotic dose, full patient scrub (front and back), joint splintage and pain control which may include peripheral nerve blocks. Consent, including that for medical photography remains a legal requirement and x-rays (with bullet markers) and a tertiary survey must not be forgotten - rapid Multi-Detector Helical CT scanning is probably best for this.

The ICRC wound classification [14] was found to aid surgical decision making and small wounds less than a centimetre in size without cavity formation were often be treated non-surgically with simple dressing and oral antibiotics. No wounds should be closed at initial surgery [15-17] and no wounds should be closed under tension. We believe that if a wound will not close with 3/0 nylon, it is not suitable for closure. Amputations should be performed at the lowest level possible as part of the debridement process and guillotine amputations avoided. If amputation is contemplated, it is prudent that the decision-making process is clearly recorded in the notes and pre/post operative digital images taken [18].

Tourniquet application in the field may reduce deaths due to peripheral exsanguination. However, these tourniquets should be released as soon as possible. If absolutely necessary they can be replaced in the Emergency Department by a padded pneumatic device [19]. Wide fasciotomies should be performed when there has been any prolonged ischaemic time and they should also be strongly considered prophylactically before evacuation whilst anaesthetised by Critical Care Air Support Team (CCAST) move to U.K. (Fig 3). Muscle compartments should be laid open widely and any non-viable tissue removed. One patient required débridement four times for a gunshot wound to the posterior calf prior to skin grafting. The ability to debride effectively and safely, but without causing further tissue damage is key.

Figure 3. High-energy fragment injury to left thigh: Rapid wound debridement, femoral external fixation and wide area fasciotomy.

The deployed surgical team must be able to provide basic surgical skills such as tendon repair and skin grafting as treatment of local nationals necessitates definitive care at the outset. External fixators should only be applied for control of the soft tissues or to act as temporary splints [20], and they may have to be applied without image intensifier guidance. Plaster-of-Paris immobilisation still has a rôle to play, as does skeletal traction and Thomas splintage, especially in the treatment of local nationals.

The general principles of Damage Control Surgery [21] apply equally well to extremity trauma - patients must not become unnecessarily cold, acidotic or coagulopathic during extremity debridement and it must be remembered that treatment in the field should not prevent or preclude later reconstruction.

Torso Trauma

The only surgical mortality seen at Camp Bastion during Herrick IV resulted from a high energy transfer trans-torso gunshot wound to the liver and inferior vena cava who died of unsurvivable injuries during surgery. There were two non-therapeutic torso procedures: a laparotomy for a blunt splenic injury that had ceased bleeding by the time of surgery, and a thoracotomy for an unstable patient with junctional thoraco-abdominal fragmentation injuries caused by minestrike who also required laparotomy. Although the tenets of damage control surgery are well known, all surgeons deploying to the combat zone must have a thorough understanding of the principles and more importantly the practices of this mode of surgery.

Although 50% of preventable combat casualty deaths occur due to haemorrhage, opportunities for efficacious surgical control of incompressible bleeding are few, largely because of self-selection of casualties by extended retrieval times due to terrain, distance and tactical circumstance [22-25]. The surgical capability to cross anatomical boundaries and maintain competence in multiple anatomical arenas will always be required to salvage that small number of patients with survivable torso trauma who would otherwise die without adequate surgery to control ongoing bleeding and contamination. It is clear that Combat body armour (CBA) influences the distribution of survivable wounds [25]. The necessity to train such a cadre of such surgeons is made harder by the absence of any formal training in definitive trauma care for modern general surgeons based in the NHS [26].

Neurosurgical Injury

The transfer of patients with neurosurgical trauma to a facility with a working CT scanner and/or neurosurgeon will not always be possible and non-specialists will have to carry out the primary surgery, which again in the case of local nationals may represent definitive surgery [27]. This may well include children and thus paediatric cases must be planned for if the eligibility matrix is extended to include the local populace. An ability to debride skull, dura and brain is necessary, as is the skill to raise a formal craniotomy flap to gain the necessary access; if dural patching is required, only autologous material should be used. When an artificial (bovine) substitute was used in one case, this became infected and caused secondary brain sepsis.

Burns and Plastic Surgery

It is unrealistic to expect any surgical team at Role 2 to deliver definitive burn care. If burn casualties are retained at R2, they will receive sub-optimal care and consume a disproportionate amount of resources [8]. This is a recurrent problem with host-nation forces or civilians – especially where there has been an inhalational injury requiring ventilatory support; however burn patients can tolerate long distance evacuation if early management is measured and apposite [28]. The ability to deliver early resuscitation, high quality critical care and appropriate surgery for burn victims is a key requirement of the deployed surgical team.

In our cohort of cases, there was no requirement for complex non-burn soft-tissue reconstruction. This may have been simple serendipity rather than an accurate predictor of future needs. When campaigns become more static, intentionally or otherwise, coalition hospitals become the de-facto local health care system [29,30]. The ability to undertake soft-tissue reconstructive procedures, with specialist nursing and rehabilitation support, becomes more appropriate as conflicts mature.

Conclusions

As military surgeons practising in an austere environment, we encountered multiply injured patients with high-energy-transfer fragment, projectile and blast wounds that required an assortment of damage control and definitive operative competencies unparalleled in standard civilian practice. Clearly these demanding surgical interventions are best delivered by well-trained, NHS current, trauma-competent, consultant-led surgical teams. However that training cannot be wholly provided within UK clinical practice. Increasing the opportunities to improve skills, for example by simulator training or overseas attachments, may be required. Finally, we firmly believe that teams that train together for significant periods before deployment are more likely to produce improved patient outcomes.

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