Audit

A method for determining the rate of major limb amputations in battle casualties: Experiences of a British Field Hospital in Iraq, 2003

T Ramalingam^{1,2}, G Pathak^{1,3}, P Barker¹

¹Royal Centre for Defence Medicine, Selly Oak Hospital, Birmingham UK

²Department of Colorectal Surgery, John Radcliffe Hospital, Oxford, UK

³Department of Orthopaedics, Royal Hospital Haslar, Gosport, Hampshire, UK

Introduction: The majority of battle casualties undergoing surgery at 34 Field Hospital, the sole Coalition field hospital in Iraq during the conflict, sustained injuries to the extremities. To compare our experiences with those from previous conflicts, we report data on major limb amputations and propose a method for determining the rate of major limb amputation in a conflict setting.

Patients and Methods: A retrospective review of battle casualties admitted to the hospital was carried out based on casualty records and operating theatre logbooks. Data were collected for the period 26 March and 8 May 2003, focusing on casualties undergoing surgery for battle-injured extremities during the conflict.

Results: 68 (55%) casualties underwent surgery for battle injuries to extremities. Six upper and eight lower limb amputations (proximal to carpals and tarsals) were carried out from a total of 87 battle-injured limbs that had surgery, giving an overall amputation rate of 16% (14/87).

Conclusions: In presenting our amputation rate of 16%, we highlight the lack of uniformity in describing 'amputation rates' between conflicts. A consistent method for quantifying amputations performed in a conflict setting could prove to be a useful tool.

Key words: Limb amputations – Rates – War

A major limb amputation (*i.e.* proximal to carpals and tarsals) is a common surgical procedure in war. Since more than 50% of casualties treated in a conflict are likely to have wounds to the extremities,¹ it is inevitable that a proportion of these limbs will be amputated.

After 3 years of conflict in World War I, 300,000 amputations had been carried out in Europe alone¹ and World War II

data from US medical facilities in the Mediterranean and Europe indicate that 3177 major amputations were carried out there.² Similar data on the incidence of major limb amputations from the Korean and Vietnam wars are scarce. In his paper relating to the experiences in the Korean war, Hughes reported an amputation rate of 13% in casualties who had arterial surgery for extremity injuries.³

Correspondence to: Mr T Ramalingam, University Department of Pharmacology, Mansfield Road, Oxford OX1 3QT, UK
E-mail: thanesanr@hotmail.com

Figure 1 Patients undergoing surgery: proportions due to battle injury and disease non-battle injury.

Following recent, smaller scale conflicts involving US troops, amputation rates of 19%, 14% and 14% were reported from Grenada, Iraq (Gulf War I) and Somalia, respectively.⁴ The amputation rates quoted here were determined by the number of amputations per 'treated orthopaedic' injuries. Jovanic and colleagues, in their paper relating to the war in Croatia, quote an amputation rate of nearly 5%.⁵ Their definition included minor amputations such as digital amputations, in calculating the amputation rate.

In this paper we report data on major limb amputations performed at 34 Field Hospital based in Iraq at the time of the conflict, and propose a method for determining the rate of major limb amputation in a conflict setting.

Patients and Methods

At the onset of the war in Iraq, 34 Field Hospital, a 200-bedded British Field Hospital was mobilised to southern Iraq. It was established in its forward position on the 26 March in order to provide medical support for Coalition troops and to deal with Iraqi casualties. The hospital comprised of a reception/triage area, an 8-bay resuscitation area, three operating theatres (two operating tables in each), an intensive care unit and 8 wards. There were limited pathology and radiology services available. Six surgeons (3 general and 3 orthopaedic) deployed with the hospital and worked as paired specialists.

Data were collected retrospectively from the surgical casualty database, individual casualty records, and from the

Figure 2 Distribution of battle-injured limbs according to the mechanism of injury (MOI).

operative logbooks. From these sources, the number of casualties that underwent surgery for battle and non-battle injuries were determined. The number of casualties with battle-injured extremities and their mechanism of injury (MOI) were noted.

Finally, the number of major limb amputations (proximal to carpals and tarsals) performed and the clinical indication for each of these were recorded.

The data were obtained for the 6-week period between 26 March and 8 May.

Results

During the 6-week period there were 432 admissions to surgical beds. Of these, 124 (29%) patients underwent surgery, of whom 82 (66%) sustained battle-related injuries. Sixty-eight casualties had surgery to extremities caused by battle injuries, representing 55% of all casualties who had surgery and 83% of all those casualties operated on with battle injuries (Fig. 1).

Figure 2 shows the number and pattern of distribution of extremity injuries according to the mechanism of injury (MOI). Of the battle-injured limbs that underwent surgery, 40% ($n = 35$) were caused by fragmentation injuries. Lower limbs injuries that had surgery were mainly due to gunshot ($n = 21$) or fragmentation ($n = 20$) wounds as opposed to blast ($n = 6$).

Fourteen major amputations were performed in 13 patients (Table 1). There were fewer upper limb ($n = 6$) than lower limb ($n = 8$) amputations. The rate of amputation, calculated as 'the number of amputations per number of battle-injured limbs that underwent surgery', was 17% for the upper limb and 15% for the lower limb, with a combined rate of 16%.

Table 1 Amputation characteristics

Level of amputation	Number of limbs (casualty numbers)	Amputation rate (%)
Above elbow	2 (2)	17
Below elbow	4 (4)	
Above knee	1 (1)	
Below knee	7 (6)	15
Total	14 (13)	16

Amputation rate = number of amputations/number of battle-injured extremity operations.

Table 2 Indications for amputation

Indication	Upper limb	Lower limb	Total (%)
'Useless' limb	3	6	9 (64)
Vascular injury	2	2	4 (29)
Nerve injury	1	0	1 (7)

All but one of the amputations were performed at initial presentation. The sole delayed amputation (below knee amputation) was performed because of subsequent ischaemia of that limb. All amputated limbs sustained injuries consistent with Gustilo-Anderson⁶ Grade 3. There were two unsuccessful attempts at limb salvage for vascular injuries, in two separate limbs, using vein grafts. Seven external fixators were used in the femur ($n = 3$), tibia ($n = 2$), radius ($n = 1$) and pelvis ($n = 1$). None of the amputations were performed for sepsis.

Table 2 shows the indications for which the amputations were carried out. All the injured limbs which were amputated had open, comminuted fractures with associated soft tissue injury. A number of these sustained such severe wounds (a combination of extensive soft tissue, bone and neurovascular injuries) that they were considered to be unsalvageable. These were grouped together in the 'useless' limb category.

There were nine (64%) amputated limbs in the 'useless' limb group. Four limbs (2 upper and 2 lower) were amputated for predominantly vascular injuries. The single upper limb that was amputated for nerve injuries had not only sustained significant functional deficit due to ulnar and median injuries but had also an open, comminuted fracture of the elbow joint.

Finally, of the amputated limbs, 9 (64%) were the result of gun shot wounds and the rest (36%) were caused by blast injuries.

Discussion

Unlike recent conflicts in Afghanistan and Gulf War I, which involved a prolonged air bombardment campaign, Gulf War II was fought in a more conventional manner

using heavy artillery and hand-held firearms. 34 Field Hospital, the only Coalition field hospital in Iraq for the duration of the conflict, was located approximately 5 km from the front line, something that was last seen in World War I.⁷ Consequently, it was able to receive casualties directly from the front line, often bypassing first- and second-line combat medics and surgical teams, who would otherwise provide the initial medical support at or near the front line.

In total, 14 major amputations (Table 1) were performed in 87 battle-injured extremities that underwent surgery. Based on this, our amputation rate, calculated by the number of amputations performed (numerator) divided by the number of battle-injured extremities operated on (denominator) during this period was 16%.

Available data from large-scale military conflicts such as the American Civil War and World Wars tend to describe amputation rates as incidence of amputations while papers from the Korean and Vietnam wars have tended to describe amputation rates in relation to the type of injuries such as vascular injuries.⁸

The amputation rates described from more recent conflicts are often confusing and inconsistent. The amputation rates from smaller scale military conflicts in Somalia (14%), Grenada (19%) and Iraq during Gulf War I (14%) were poorly defined.⁴ In their paper, Islinger *et al.*⁴ suggest, but do not clearly state, that the rates of 14%, 19% and 14% in Somalia, Grenada and Iraq, respectively, relate to 'major' amputations *i.e.* proximal to the carpal and tarsal bones. Furthermore, using the denominator 'treated orthopaedic injuries', they do not specify what constitutes 'treatment' or 'orthopaedic'. Not surprisingly, the amputation rate of barely 5% given by Jovanic and colleagues⁵ during the war in Croatia, is lower. The denominator they used was larger, *i.e.* 'number of patients found with extremity injury'.

The various terms used to quantify amputations performed during conflicts, such as the 'number' of amputations, 'incidence' of amputations and the 'rate' of amputations are often confusing and do not lend themselves for useful comparisons to be made between different conflicts or periods.

Using our method of derivation, both the numerator and denominator were determined by the surgeons, thus allowing for some consistency and uniformity. Furthermore, the ease with which these data can be documented and retrieved (available in casualty operative notes, operating theatre lists and operating theatre logbooks of the unit or individual), makes such a method of calculation reliable and reproducible.

Comparisons can and should be made between the experiences of different conflicts. For example, our findings that 83% (68/82) of battle casualties undergoing

surgery sustained injury to the extremity compares well with the 70% and 92% figures quoted by Coupland⁹ and Bhatnagar and Smith¹⁰ for patients treated for war wounds to extremities. The fewer blast/mines related injuries seen at 34 Field Hospital, particularly to the lower limbs, could be either because fewer antipersonnel mines were deployed during this conflict or due to the low 'exposure' of personnel to these weapons (civilian population movements were curbed by curfews and, it is apparent now that the majority of Iraqi forces did not engage in combat). Our commonest MOI, due to fragmentation injuries, is mirrored by others.^{5,11}

Despite some observed similarities regarding type and mechanism of injuries, the lack of a uniform definition of major limb amputation rate makes it difficult for meaningful comparisons to be made relating to this, a relatively common procedure in war. A reliable amputation rate could be valuable as an index to reflect the severity of wounding among battle casualties and hence act as a guide to plan surgical/medical support in a conflict zone.

References

1. Livingston RD. Orthopaedic management of wartime trauma patients. *Mil Med* 1985; **150**: 72.
2. Debakey ME, Simeone FA. Battle injuries of the arteries in World War II: an analysis of 2471 Cases. *Ann Surg* 1946; **123**: 534–79.
3. Hughes WC. Arterial repair during the Korean War. *Ann Surg* 1958; **147**: 555–61.
4. Islinger RB, Kuklo TR, McHale KA. A review of orthopaedic injuries in three recent US military conflicts. *Mil Med* 1999; **165**: 463–5.
5. Jovanic S, Wertheimer B, Zelic Z, Getos Z. Wartime amputations. *Mil Med* 1993; **158**: 755–66.
6. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones. Retrospective and prospective analysis. *J Bone Joint Surg Am* 1976; **58**: 453–8.
7. Crile GW. Notes on base hospital no. 4, U.S. army on active service. *JAMA* 1917; **69**: 206–7.
8. Dougherty PJ. Wartime amputations. *Mil Med* 1993; **158**: 755–63.
9. Coupland RM. War wounds of bones and external fixation. *Injury* 1994; **25**: 211–7.
10. Bhatnagar MK, Smith GS. Trauma in the Afghan guerilla war: effects of lack of access to care. *Surgery* 1989; **105**: 699–705.
11. Korver AJ. Amputees in a hospital of the International Committee of the Red Cross. *Injury* 1993; **24**: 607–9.