Soldiers Injured During the Falklands Campaign 1982

Sepsis in Soft tissue Limb Wounds

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Summary

The factors related to the development of sepsis in the soft tissue limb injuries sustained by soldiers during the Falkland Campaign have been assessed. Delay in surgery and delay in antibiotic administration are the most important factors, and where delay in surgery is inevitable, delay in antibiotic administration assumes an even greater importance.

Introduction

The principles of the management of battle casualties and the role of surgery in the treatment of missile injuries are well established [1,3]. Avoidance of septic complications with their associated increase in morbidity and mortality in the wounded has always been of paramount importance. This is achieved mainly by immediate antibiotic therapy, early debridement (within six hours) and delayed primary suture (DPS).

Method

Two hundred and thirty three soldiers were injured in the Falklands Campaign. Data were obtained from the field medical cards, case notes and Hostile Action Casualty System coding sheets, and the records of all soldiers who received soft tissue limb wounds were analysed. Burn injuries were excluded. There were 174 injuries to the limbs and of these 49 involved the soft tissues only, ie 28% did not damage bone. Twenty eight lower limb and 21 upper limb injuries were studied.

Results

The wounding agents covered the whole spectrum of weaponry (Table 1) and the range of tissue trauma varied from extensive, with tissue and skin loss and neurovascular injury, to minimal.

9 mm	4	Shell	5 (2)
Mine	5	HV. Unspec	2
Shrapnel	4 (2)	Helo Crash	1
7.62 mm	8 (2)	Sidewinder	1
Grenade	4	Bomb Fragments	3
Mortar	12 (3)	**TOTAL:**	**49**

Table 1 Wounding Agents
The figures in brackets indicate the number of cases in which sepsis developed.

The time intervals from wounding to first surgery and wounding to antibiotic administration are given in Table 2. Only 20 patients, 40%, underwent surgery before six hours had elapsed and nine patients, 18%, were delayed over 15 hours. A higher number of patients however, 28 (57%), received antibiotics before the six hour point.

Table 3 gives the intervals at which delayed primary suture was carried out and most operations took place between five and seven days after initial surgery. Delay beyond this point was usually because of a dirty wound which required further dressings or further excision before safe closure. In this event skin grafts were used as a method of delayed closure. This technique was used for three legs and two arms.

All the wounded in this series were given antibiotic cover (Table 4) and this was mostly one of the penicillins. In only one case was a combination used, Triplopen and Metronidazole, the latter being employed to cover possible concomitant bowel injury.

Hours	0-3	4-6	7-9	10-11	13-15	>15
Wounding to Surgery	11	9	8	10	2	9
Septic cases	1	1	2	1	1	3
Wounding to Antibiotics	17	11	7	5	2	7
Septic cases	0	2	4	1	0	2

Table 2. Intervals: Wounding to Surgery and Antibiotics

Days	0-4	5-7	8-10	11-13
Number	4 (3)	40 (6)	3 (0)	2 (0)

Table 3. Intervals: Surgery to DPS

Magnapen	2
Crystapen	8
Triplopen	26
Penicillin (unspec)	10
Tetracycline	2
Metronidazole	1
Erythromycin	1

Table 4. Antibiotics used in limb wounds

Of the 49 cases reviewed, three patients had septic wounds at delayed primary suture, ie frank pus in the wound, an incidence of only 6%: but subsequent infection after delayed primary suture developed in a further six cases making a total of nine or 18%. Erythematous or moist wounds and very minor degrees of infection, have been excluded, as have those wounds which had primary closure delayed because of separating sloughs and were not overtly clinically infected.

Examination of the time intervals between injury and first surgery in those casualties who developed sepsis (Table 2) reveals that seven of the nine cases occurred when wound excision was delayed beyond six hours. Twenty-one of the 49 casualties were given antibiotics after six hours.

Septic wounds also resulted in seven of the nine cases in whom the giving of antibiotics was delayed beyond six hours.

Unfortunately there was insufficient time to prepare a fifth table showing the delay to surgery in those cases in which antibiotics were administered within three and six hours respectively.

Table 1 also gives details of the wounding agents in the septic cases and does not suggest any link between the nature of the agent and the development of infection as the cases are evenly distributed.

Delayed primary suture was used as a method of closure in all casualties in this series and Table 3 illustrates the intervals between initial surgery and closure in the septic cases. It is striking that no infection occurred after DPS when that interval was greater than seven days.

Discussion

The prevailing conditions in the Campaign led to erratic and often very delayed casualty evacuation, particularly as most of the battles commenced at night, and helicopter transport was in short supply [2].

Current military surgical teaching dictates that all operations should be performed within six hours of injury to reduce infective complications [1]. Twenty nine of the 49 casualties were treated after six hours had elapsed and this can readily be explained by the nature of the terrain and the consequent evacuation difficulties, coupled with the application of the triage system relegating these injuries to a lower priority when force of circumstances dictated it [1,3]. The infection rate in this group approached 25% and this high infection rate can be related to delay in the primary wound excision.

There were no septic complications when antibiotics were administered within three hours of wounding and this confirms recent experimental work showing that early antibiotic therapy (benzyl penicillin) totally inhibits the usual growth of bacteria in missile wounds when excision is delayed for twelve hours [4]. It would appear that the antibiotic prevents the growth of the initial sparse mixed flora of contaminants derived from clothes and skin which, were they allowed to thrive, would have prevented the recovery of reversibly damaged tissue and led to super-infection with more pathogenic organisms. In addition, the recovery of tissue damaged on the periphery of the wound leads to a more limited primary excision. In another experimental study by the same authors with no antibiotic therapy, the conclusion is reached that infection can be overcome by wound excision within six hours but would be out of control by 12 hours [5].

Owen-Smith and Matheson demonstrated that benzylpenicillin totally protected clostridial-contaminated sheep thigh wounds from gas gangrene provided that antibiotics were given within nine hours of wounding [6]. No cases of gas gangrene were encountered in the limb injuries reviewed, but the infection rate in this series in that group of wounded who received antibiotics beyond six hours after injury was 33%.

The extent of initial wound excision is an unknown quantity in this series, the patients having been operated upon by several different surgeons of varying experience in the management of these types of wounds [2]. However, inadequate or insufficient wound excision will substantially contribute to the development of sepsis if at delayed primary suture devitalised tissue is not recognised and closure is undertaken. It should be appreciated that the second operation in the treatment of a battle wound provides an opportunity to inspect it and re-excise it where necessary and not just to close it. Indeed, altering the emphasis of the second operation from closure to inspection may permit a more conservative initial excision. In this series six cases of sepsis developed after delayed primary suture suggesting that the wounds were closed inappropriately. Five cases were closed well beyond the seven day point because of wounds which were of doubtful cleanliness. None became septic.

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