

## First and second line treatment - A Retrospective View

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### Summary

**The case history of a single casualty is recorded. A critique of aspects of his treatment is presented. Some suggestions for modifying aspects of his treatment are considered.**

**A factual account of the wounds received by a soldier during one of the land battles in the Falklands Campaign is presented together with an account of his initial (first and second line) and subsequent (third and fourth line) treatment.**

**Comments and suggestions are offered on aspects of treatment given in the first and second line medical facilities as they existed during the Falklands Campaign.**

### Case History

During the battle for Mount Longdon, a 23 year old man sustained extensive injuries of the legs from a mortar blast. His left leg had been almost completely amputated at mid-thigh level and there were numerous injuries of the right. The incident occurred at about 20.00 hours and field dressings were applied to the wounds almost immediately, papaveretum 20mg, being given intramuscularly shortly afterwards. Although he was bleeding freely from his amputation site, no tourniquet was applied and no intravenous infusion commenced at that time. He was evacuated to the Fitzroy Field Surgical Facilities by helicopter, a flight of about 20 minutes.

On his arrival in the resuscitation area, only 45 minutes after injury, his pulse was 100 and his systolic blood pressure less than 60 mm Hg.

He was semi-conscious and quite incoherent. An intravenous infusion was immediately set up and in spite of the rapid infusion of 1,000ml Compound Sodium Lactate Solution followed by two units of O Positive blood, his condition deteriorated. To control bleeding, an Esmarch Bandage was applied as a tourniquet to the left thigh.

During the initial infusion, a full clinical examination was made which revealed multiple deep shrapnel wounds of the right leg. An Esmarch Bandage was then applied to the right thigh as a tourniquet and a second intravenous line was established.

He was taken to theatre at about 21.15, i.e. about 75 minutes after injury. Anaesthesia was induced with ketamine and relaxation for intubation with suxamethonium bromide. Relaxation was maintained with alcuronium and the casualty was ventilated by hand using the Laerdal bag. However, his blood pressure remained unrecordable for the first 20 minutes of anaesthesia in spite of manually pumping the drip chambers and infusing a further two units of blood, 500mls of Polygeline and 1,000mls of Compound Sodium Lactate and dropping the head of the table about 15 degrees.

Slowly, his blood pressure and pulse returned to relatively normal values.

Wide excision and debridement of his various wounds and completion of the amputation lasted about 90 minutes. Post-operatively his blood pressure and pulse remained stable at 110 (systolic) and 85 respectively. The initial intravenous line was discontinued and he was given one litre of Dextrose Saline 12 hourly by the second line.

He was evacuated to our hospital ship, the M.V. Uganda, about 12 hours after his initial surgery, where his haemoglobin was found to be 9.2 g/dl and a further two units of blood and 500 mls of Polygeline were given.

Once aboard the M.V. Uganda, he underwent a further eleven general anaesthetics employing a variety of techniques. An epidural cannula was also placed to provide post-operative analgesia. Most of his later anaesthetics were given to facilitate inspection and redressing of his wounds. Other procedures included fasciotomy of the right leg (two days post-injury), delayed primary suture and refashioning of his amputation stump (five days post-injury) and split skin grafting of the right leg (at three weeks). Evacuation to the United Kingdom, by ship and air, took place one month after injury. In the United Kingdom, he received two further general anaesthetics, both for manipulation of the right knee.

### Comment

The Falklands Campaign is generally held to have been unusual in a number of ways and not altogether relevant to a N.W. European war, this latter being the contingency for which the principal training objectives of the RAMC are currently aimed. However, it is not disputed that the South Atlantic Campaign was the first occasion in recent years in which the RAMC, in any number, have provided first and second line medical support on the battlefield. It was undoubtedly the first occasion in which the RAMC had been involved in a large-scale battle utilising advanced electronic weapons systems similar to those which would be used in a European conflict.

In the case described, the injuries were substantial though by no means unusual as mortar wounds have been a feature of military surgery for many years. These important points arise from the management of this patient, all of which relate to the severity of the wounds and the delay likely to ensue between injury and evacuation in the less favourable conditions which are likely to exist in a conflict in Europe. These points, blood loss, pain and infection will each be considered in this paper.

The Buddy/Buddy system of primary care appears to have worked in this instance; field dressings were applied and analgesia given shortly after injury by his comrades. However, direct questioning by the authors of the casualty described and of others injured in the campaign revealed that self-help was often the only help available. When one considers the nature of the conflict, the

terrain, the weather and, above all, the intensive fire which was so often a feature of the campaign, this is not so surprising. Perhaps this need for self-help would benefit from greater emphasis during training, which still tends to stress the mutual-aid aspects of primary care.

### Blood Loss

Because of the extent of this casualty's injuries, blood loss was enormous with the patient presenting almost exsanguinated. It is well-recognised that fit young men can withstand very severe injuries providing that blood loss is halted, or fluid replacement commenced quickly. With the conditions that existed on the battlefields of the Falklands and which are likely to apply to future conflicts, the placement and maintenance of intravenous infusions in hypothermic, hypovolaemic patients is almost impossible. The reception at the Field Surgical Team locations of a casualty who had received intravenous fluids was consequently the exception rather than the rule. In such circumstances and in view of the probable absence of immediate intravenous fluid replacement, attention must be drawn to the staunching of blood loss. Because of the usual inadequacy of field dressings applied to this type of injury, perhaps consideration should be given to the re-introduction of the tourniquet for selected cases such as this.

Selected indications for the application of a tourniquet are traumatic amputations and limbs injured to such an extent as to make them unsalvageable<sup>1</sup>. Extending the use of the tourniquet to lesser limb injuries would expose the casualty to the many disadvantages and dangers of the tourniquet. However, most of the complications are the result of faulty application or management of the tourniquet rather than the tourniquet itself. It must be remembered that the particularly disastrous consequences of misuse of a tourniquet are likely to outweigh the benefits in unskilled or even semi-skilled hands.

Current teaching in the RAMC to unit first aid instructors is that a tourniquet should only be used as a last resort and the reality is that this means never. In a peacetime situation, in a country where skilled medical attention is readily available, the use of a tourniquet is probably not as vital as in a battle situation. However, with the conditions which existed in the Falklands and which are likely to apply to an even greater extent in a conflict in Western Europe, it is likely to be a matter of several hours before a casualty receives any form of skilled medical aid, particularly if injured at the start of a night battle<sup>2</sup>. It is the experience of the authors that all casualties received in the surgical centres who had sustained a traumatic amputation or a wound that rendered a limb unsalvageable arrived in a state of considerable haemorrhagic shock and probably would not have survived extension of the evacuation line. From this, it must be concluded that casualties with similar injuries may have just simply bled to death in the absence of immediate evacuation and it is these losses which a tourniquet may well prevent. That this hypothesis is likely to be accurate is confirmed by several Regimental Medical Officers and Medical Officers of 16 Field Ambulance who took part in the first line management of the injured<sup>3</sup>. Certainly it is their opinion that serious consideration be given to the re-introduction of training in the use of the tourniquet at all levels of First Aid instruction.

### Pain

Analgesia was given to casualties by the injection of 20 or 30 mg Papaveretum 'intramuscularly' from a syrette. Given the length of a needle atop a syrette, the extent of many of the injuries and the rapid onset of hypovolaemic shock, it is almost certain that insufficient quantities of the drug were absorbed to provide a serum concentration adequate to provide any measure of pain relief.

In this case, no further analgesia was given until the patient was well into the post-anaesthetic phase of surgery; no more than six hours after injury and at a time when his intramuscular volume had been replaced. Other patients had received multiple doses of Papaveretum in a relatively short duration of time without any analgesia but achieving a large depot of opiate which was later absorbed during resuscitation, rewarming and anaesthesia, to provide profound respiratory depression at the end of surgery, often requiring massive doses of Naloxone to reverse. In these cases, poor peripheral perfusion was possibly, and paradoxically, life-saving.

The authors suggest that the administration of an opiate by the 'intramuscular' route to the severely injured on the battlefield is questionable and the dubious value of 'intramuscular' opiates in this context has been discussed at great length in the past<sup>4</sup>. The problem was identified by the F.S.T.s in Salah in 1971 and very effectively controlled by the withdrawal of all syrettes from the troops<sup>5</sup>. This was discussed in a well-received paper in Edinburgh the following year. In addition, it is also the personal experience of one of the authors that the intramuscular administration of opiates gave no relief whatsoever to the pain of the injured after the bombing of R.F.A. Sir Galahad.

Having made the case for withdrawing intramuscular opiates as first line analgesia, consideration must be given to a replacement. Recent work has shown that those shocked patients who require analgesia should receive it intravenously and incrementally. However, we must accept that the intravenous route, however desirable, is almost completely impractical in the field.

Ideally to fulfil the role of a first line analgesic, a drug must have the following characteristics:

1. It must be well absorbed in the shocked casualty.
2. Overdosage must be unlikely
3. It must be strong enough to provide pain relief in the severely multiply injured.
4. In the self-help context discussed earlier, self administration should be simple and rapid.
5. It should be relatively stable and retain its potency in extremes of climate

It is suggested by the authors that Buprenorphine administered sublingually may well satisfy the criteria mentioned above.

Sublingual absorption is reasonably rapid<sup>6</sup> and the possibility of overdosage by this route is remote. In the one reported case<sup>7</sup> of overdosage where suicide was attempted by the sublingual dissolution of 35 to 40 400mcg tablets, no clinical effects were observed apart from slight drowsiness. One case of acute urinary retention in association with sublingual Buprenorphine has been observed<sup>8</sup> but this was in a 66 year old man.

That it is potent enough is well-documented, comparing favourably with intramuscular morphine or intravenous pethidine<sup>9</sup> and the duration of pain relief from buprenorphine is substantially longer than with other analgesics<sup>10</sup>. though the incidence of sedation and nausea are slightly greater with buprenorphine, this should not present a clinical problem<sup>11</sup>. Buprenorphine has little effect on the direct endocrine and metabolic response to surgical insult<sup>12</sup>.

It may be that reduced absorption will occur sublingually in the shocked casualty with the accompanying dry mouth. However, in the Falklands Campaign, wounded soldiers were anaesthetised by crash induction techniques<sup>13</sup> and therefore sips of liquid to aid dissolution of the tablet would make little difference to their subsequent management.

To our knowledge, Buprenorphine has not been used as a front-line analgesic and therefore there are no reports of its safety in this context. However, it is our contention that there is now

sufficient favourable evidence for this drug to be legitimately considered as a replacement for intramuscular opiates in the front-line and that it should be fully evaluated with this specific purpose in mind.

## Infection

Recent experimental work<sup>14</sup> has shown that if antibiotics, particularly a penicillin derivative, are given immediately on receipt of a missile wound, then the extent of wound excision required is significantly reduced when delayed debridement is anticipated. Also, the infective complications are reduced<sup>15</sup>. It is the contention of the authors that consideration should be given to the issue, to each soldier, of an injectable antibiotic which may be administered by himself or his buddy at the time of wounding. The wounded soldier would not suffer if absorption were inadequate but would have everything to gain if adequate serum levels were achieved, either prior to peripheral shut-down or if the injury were not sufficient to evoke a full shock response.

The drug should have a similar spectrum of activity to that of Benzylpenicillin and should be stable in liquid form in extremes of temperature – Gentamicin and Septrin are two possibilities. Perhaps the use of an auto-inject system, as used for the administration of Atropine to soldiers who are the victims of chemical attack, should be investigated.

The patient in this case history was extremely fortunate in that he was evacuated by helicopter direct to the F.S.T. at Fitzroy, and it is not an exaggeration to state that his life was saved by the speed of his evacuation, as were the lives of many others. Undoubtedly, he would not have been saved had the terrain and weather not mitigated against the conventional use of wheeled and tracked vehicles as envisaged in a European war. If the advanced surgical centres are deployed to save the substantially injured with immediate resuscitation and surgery, then, in the light of the Falklands experience, perhaps the whole format of medical evacuation should be restructured to take into account the unquestioned excellence of helicopter transport with squadrons dedicated to the Medical Services as in other armies.

## Conclusion

We feel that in the light of the Falklands experience, there are areas in the Medical Services which need to be improved or re-evaluated, particularly in relation to the use of tourniquets, control of pain and the use of antibiotics. The solutions suggested in this paper are based on current views.

It is only by raising questions and suggesting alternatives that the RAMC can continue to provide the teeth arms with the best medical support at all times and this has been the object of this paper.

## References

- 1 Hamilton Bailey's Emergency Surgery, 10th Edition, Dudley HAF ed, Bristol, John Wright and Sons Ltd. 1977
- 2 Jackson D S *et al.* The Falklands War: Army Field Surgical Experience. *Ann R Coll Eng* 1983; 65: 281-5
- 3 Willis M and Wagon R. Personal Communication.
- 4 Beecher H K. 1945
- 5 Mayes F B. Personal Communication.
- 6 Crossland J. *Lewis Pharmacology*, 5th Ed. Churchill Livingstone; 1980: P 34
- 7 *New Zealand Med J* 1979; 89: 633: 255-256.
- 8 *Br Med J* March 1983; 286: 763-764
- 9 Ellis R *et al.* Pain Relief After Abdominal Surgery – A Comparison of i.m. Morphine, Sublingual Buprenorphine and Self-Administered i.v. Pethidine. *Br J Anaes* 1982;54: 421-428
- 10 Kay B. A Double Blind Comparison of Morphine and Buprenorphine in the Prevention of Pain After Operation. *Br J Anaes* 1978; 50: 605-609
- 11 McQuay H J *et al.* Clinical Effects of Buprenorphine During and After Operation. *Br J Anaes* 1980; 1013-1019
- 12 Fry E N S *et al.* Relief of Pain After Surgery. *Anaesthesia* 34: 549-551
- 13 Jowitt M D and Knight R J. *Anaesthesia During The Falklands Campaign – The Land Battles.* *Anaesthesia* 1983; 38: 776-783

- 14 Dhalgreen B *et al.* Local Effects of Antibiotic Therapy (Benzyl-penicillin) on missile wound infection rate and tissue devitalisation when debridement is delayed for twelve hours. *Acta Chir Scand Suppl* 1982; 508: 271-279.
- 15 Jackson D S. Soft tissue limb injuries in the Falklands (awaiting publication).

## First and second line treatment in the Falklands Campaign

*From Col R Scott, L/RAMC, Professor of Military Surgery*

1. The case history presented in this issue of the Journal by Major Jackson, Major Jowitt and Lieutenant Colonel Knight, raises a number of issues for discussion.
2. As the authors point out there are injuries, particularly traumatic amputations of the limbs, for which pressure dressing alone is insufficient to control bleeding. In such cases a tourniquet applied, as distally as possible, may be a necessary life saving measure. However, I believe that more limbs and more lives will be lost by the unskilled application of tourniquets, than by neglect of their use, and that our first aid training should continue to stress the value of direct pressure for the control of haemorrhage. Since we now have records of almost 4,000 army casualties from the Falklands and from Northern Ireland held in the Department of Military Surgery, we will attempt to clothe the bare bones of this statement with some data.
3. I entirely support the authors' view of the dangers of intramuscular morphine in shocked patients, but I cannot accept that the intravenous route is almost completely impractical in the field. When the evacuation time is long and the need for analgesic greatest the patient will usually come into contact with a doctor soon after injury. When the evacuation time is short, as in this patient, control of haemorrhage and splintage of injured limbs may obviate the need for an analgesic. An oral analgesic which is absorbed and which is rapidly effective, would have obvious advantages especially if it were universally available. However, it has yet to be shown that Buprenorphine fulfils all the criteria necessary for an analgesic that is universally available to the soldier in action. Detailed study of its possible use in this situation is required.
4. The prevention of infection in missile wounds has long been a subject of study in the Department of Military Surgery and some experimental work by my predecessor suggested that fatal gas gangrene from contaminated penetrating missile wounds could be prevented by intramuscular penicillin<sup>1</sup>. During the Borneo confrontation we set up a trial of oral tetracycline to be taken by soldiers immediately after wounding and found that it was not absorbed. There is, therefore, a good case for antibiotics given intramuscularly but a vast amount of clinical and experimental work has shown that wound contamination develops into wound infection after a lag period of some hours, and we would hope that in the usual military circumstances the casualty would receive treatment from medical personnel.
5. The authors raise many questions of importance in the management of the injured. Their views underline the need for further research in this important field and a continuous reevaluation of our own experience.

*R Scott*

## Reference

1. Owen-Smith, M S Antibiotics and anti-toxin therapy in the prophylaxis of experimental gas gangrene. *Br J Surg* 1968; 55: 43-45