

## Commentary on First and second line treatment - A Retrospective View

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### PAF Hunt

SpR in Emergency Medicine and Critical Care Medicine. Department of Academic Emergency Medicine, The James Cook University Hospital, Middlesbrough, TS4 3BW

The original article by Jackson, Jowitt and Knight was first published in 1982 with a commentary by Col. Scott L/RAMC, Professor of Military Surgery at the time. The case report they describe involves significant lower limb traumatic injuries with a partial amputation secondary to blast. They present some interesting points worth reflecting upon again, particularly with the benefit of the subsequent 25 years of further experience in dealing with this group of casualties. Both the original authors, and Col. Scott in his later commentary, discuss a number of issues all of which are worthy of further consideration from a modern perspective. These points: haemorrhage control, analgesia and prevention of infection, will be discussed separately.

### Haemorrhage control

The authors state that the casualty received effective 'buddy-buddy' immediate care at the time of wounding, consisting of first field dressings and analgesia. Environmental and tactical considerations at the time inhibited the effective provision of 'buddy-buddy' immediate care and the authors stressed the importance of 'self-help' systems of immediate care in such circumstances. Recently, modern training and equipment has been designed to better meet these aims, including self- and buddy-aid Battlefield Casualty Drills, Team Medic, BATLS knowledge and core skills training and the provision of the Combat Aid Tourniquet which can be applied by casualties themselves. The evacuation of the casualty is interesting in so far as a support helicopter was used as transport - an infrequent opportunity during the conflict. The time taken from the point of wounding to reach an appropriate resuscitation area was less than one hour, which is quite impressive even by modern standards.

The authors specifically make note of the fact that no tourniquets were in place at the time of arrival in the resuscitation area, despite the presence of significant ongoing external haemorrhage, although they reflect on the fact that first aid teaching at the time of the conflict advised against the use of tourniquets other than as a last resort. They reiterate the contrast between peacetime and battle situations in cases where haemorrhage control is vital and recommend the re-introduction of tourniquets for cases of severe external haemorrhage, especially from traumatic amputations where the chance of limb salvage is slim. In his commentary, Col. Scott rightly re-emphasises the risks of injudicious use of tourniquets

and discusses the importance of direct pressure for the control of external limb haemorrhage.

The authors also stress the fact that no intravenous infusion had been commenced until the casualty arrived in the resuscitation area. This may have been due to inability to successfully site an intravenous line due to hypothermia and shock. The introduction of more effective and practical intraosseous devices provides the ability to administer resuscitative fluids to the casualty where previously unfeasible. The emphasis placed in the original article on the need to replace fluids aggressively in cases of severe or uncontrolled haemorrhage can now be considered inappropriate. Modern pre-hospital teaching recommends that the use of intravenous fluid in such cases should be limited to sustaining essential organ perfusion, especially cerebral, whilst permitting some degree of hypotension to reduce the risk of disrupting vital blood clot and exacerbating haemorrhage. The authors note that the casualty was "semi-conscious and quite incoherent" with a pulse rate of 100 and a systolic blood pressure less than 60mmHg. This may have been due to the opioid analgesia given at the scene although it was arguably more likely to be due to hypovolaemic shock. A rapid infusion of 1000ml of crystalloid was initially administered in the resuscitation room followed by two units of whole blood. The authors note that the casualty's condition deteriorated following this, requiring the application of tourniquets to both thighs in an effort to stem the continuing haemorrhage. They describe the use of the Esmarch Bandage (also known as an Esmarch Tourniquet), a narrow hard rubber band with a chain link that can allow the band to be tightened around the limb. It could be argued that the use of such a large volume of fluid before first ensuring adequate control of haemorrhage may have aggravated the clinical situation, although it is difficult to clarify this from the account given. The use of large volumes of fluid for resuscitation was routine practice at the time of the conflict although even current practice may have required the use of large volumes of fluid for resuscitation in the face of massive haemorrhage and critical hypoperfusion. While not stated explicitly in this case report, whole blood was generally used for emergency transfusion during the conflict and this may have had some advantages over the packed red cell units used today, especially in terms of providing some clotting factors as well as oxygen carrying capacity.

From the description given, the total volume of fluid administered in the first 24 hours amounted to around 3000ml of crystalloid, 1000ml of colloid and 6 units of whole blood. There was no mention of the estimated volume of blood loss throughout the casualty's initial resuscitation or surgery. Once

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Correspondence to: Maj Paul Hunt RAMC  
Research Fellow, Department Academic Emergency Medicine,  
James Cook University Hospital, Middlesbrough

evacuated to the hospital ship, the authors state that the patient was transfused a further 2 units of blood due to his haemoglobin level being 9.2 g/dl. It could be argued that a 23-year-old soldier would not require further blood transfusion with this level of haemoglobin and that the risks of a transfusion reaction or transmission of a blood-borne infection would outweigh the potential benefits, although no such complications were acknowledged in the case report. However it is fair to say that modern practise is to be far more cautious with blood transfusion than was the case twenty five years ago.

Initial haemorrhage control may have benefited in this case from one modern-day intervention, namely the use of novel haemostatic agents such as QuikClot or HemCon, the use of improved pressure dressings and possibly from the earlier use of tourniquets. Avoiding the lethal triad of coagulopathy, hypothermia and acidosis requires significant attention to detail for cases such as these. Vital measures include ensuring the maintenance of core temperature as much as possible with warming devices, warmed fluids where needed and protection from the elements in the pre-hospital setting. Resuscitation efforts must be concentrated on the providing adequate tissue oxygenation and perfusion in order to minimise acidosis, although the balance must be set against the need to reduce exacerbation of haemorrhage by overzealous fluid administration. The use of fresh frozen plasma in conjunction with packed red cell transfusion is recommended to maintain adequate coagulation in the face of increased clotting factor consumption and continued blood loss. Finally, there may be a role for the more swift use of recombinant Factor VIIa in severe trauma cases where coagulation disorders are expected although its effectiveness is markedly reduced in circumstances where hypothermia and acidosis have already taken hold.

## **Analgesia**

In the case report the casualty was given intramuscular papaveretum 20mg at the scene. Paraveretum (Omnopom), a mixture of hydrochloride salts of opium alkaloids, was a commonly used drug for pre-operative sedation and relief of moderate to severe pain until the early 1990's. The authors offer the opinion that the design of the drug delivery device and presence of hypovolaemic shock would have resulted in inadequate tissue absorption and an ineffective serum concentration of the drug. Multiple doses of the drug were often given over a relatively short duration of time despite, or perhaps because of, the limited analgesic effect. Once the hypovolaemic state was being corrected there was a significant risk of the rapid redistribution of a large concentration of opioid into the systemic circulation leading to potential complications from cardiorespiratory depression.

The original authors and Col. Scott both comment on the dangers of administering intramuscular opiates in shocked patients. The administration of analgesia by the intramuscular route in the pre-hospital setting has advantages and disadvantages. The equipment and training required is limited and the method is amenable to self-treatment. However, absorption from this route does not occur at a constant rate, is highly dependent on local tissue perfusion and is therefore particularly unreliable in shocked patients.

In this article, sublingual buprenorphine was proposed as satisfying all the criteria for an ideal pre-hospital analgesic. Buprenorphine is a partial agonist with a long duration of action. Although the side effects are rare, such as nausea and respiratory depression, when they do occur they can be persistent and difficult to reverse. The search for a reliable, safe,

effective, rapid, well-absorbed and stable alternative to intramuscular morphine continues and there is a lack of high-quality evidence, such as randomised control trials, regarding pre-hospital analgesia. Considerable research is ongoing in this area and several options have been suggested including oral (transmucosal) fentanyl citrate, intranasal diamorphine and methoxyflurane.

In his commentary, Col. Scott correctly emphasises the need for appropriate splintage of injured limbs for pain relief and disagrees that the intravenous route of drug administration is completely impractical in the field. However, with the recent advances in intraosseous access devices it is possible that these will replace the intravenous route in the field as a method for the administration of enhanced pain relief and other important drugs required in the pre-hospital setting.

## **Prevention of infection**

The authors comment that early administration of antibiotics may be beneficial to outcome in circumstances where there is a significant delay to primary debridement of wounds caused by penetrating trauma. However, there is no firm evidence to support the use of empirical antibiotic therapy in penetrating trauma where casualty evacuation times are short. The potential risks of serious complications from empirical penicillin therapy are infrequent but significant, with an overall risk of anaphylaxis estimated to be around 1 in 5000 cases with a subsequent mortality rate of around 1 in 10 of these. However, evidence does suggest that there is a lag phase of a few hours between initial wound contamination and the onset of wound infection. In this case, it is not unreasonable to accept the delay until casualties reach a facility that can provide definitive care and ultimately wound debridement. In cases where this care is substantially delayed there may be a role for empirical antibiotic therapy, either by the intramuscular or perhaps intraosseous or intravenous route. The choice of which antibiotic to use, and one that would remain stable in the pre-hospital setting, is still the subject of further investigation and research. Current clinical guidelines should be consulted and reflect the best presently available evidence.

## **Conclusion**

The authors present a case report describing a mechanism and pattern of injury all too familiar to UK military medical personnel with experience of current operational commitments. It serves to highlight a number of issues that are still as valid now as they were 25 years ago. A better understanding of the pathophysiology of severe trauma has provided potential therapeutic opportunities that were unavailable at the time the article was written. However, the problem of how essential clinical interventions for such casualties can be provided effectively in the field remains as much an issue now as it was then.

The main issues continue to be the control of external haemorrhage, appropriate resuscitation to restore adequate tissue oxygenation, analgesia and secondary prevention measures. The most important of these measures include cerebral protection and the prevention of hypothermia.

Finally, Col. Scott's comments on the importance of further research and continuous reevaluation of experience and practice (now considered central components of effective clinical governance) ring ever true with the increasing complexity of medical equipment, greater expectations and the ongoing challenges of modern warfare and operational environments.