



First military use of activated Factor VII in an APC-III pelvic fracture

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Summary A male soldier in shock with an APC-III pelvic fracture was flown to an Air Assault Surgical Group (AASG) of 16 Close Support Medical Regiment at Al Amarah in Iraq. A pelvic external fixator was applied and his condition stabilized. Ultrasound scanning (FAST) showed an absent bladder, and a spreading retroperitoneal haematoma combined with intra-abdominal, free blood. Unfortunately he continued to bleed and required transfusion with the unit's entire stock of type-specific blood. At emergency laparotomy, uncontrollable pelvic bleeding was encountered and the abdominal aorta required clamping above the iliac bifurcation. Branches of the right internal iliac artery were the source and this was ligated. Some bleeding continued post-operatively: administration of activated Factor VII was associated with a marked reduction in the oozing from his fixator pin-sites and an improvement in his pH from 7.1 to 7.3. In total, 25 units of blood were transfused, 8 of which were fresh whole blood donated by individual members of the AASG. The patient survived, returned to the UK, had his injuries reconstructed, and is currently undergoing rehabilitation. This case illustrates the benefits of forward resuscitation surgery in wartime and the need for a multidisciplinary approach to trauma care.

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Introduction

Major pelvic fractures are commonly associated with significant haemorrhage, morbidity and death—even in a major western trauma center.³ In geographically inaccessible locations, such injuries are often rapidly fatal. We describe the success-

ful treatment of such an injury in a remote location in Iraq in May 2003. This involved orthopaedic, general surgical, haematological and intensive care and also the first field use of activated Factor VII by the British Army.

Case report

A male soldier with a suspected femoral fracture after a vehicular roll-over and ejection was flown to an Air Assault Surgical Group (AASG) of 16 Close

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Figure 1 APC-III Pelvic Injury, note the avulsion of the distal right sacral body.

Support Medical Regiment at Al Amarah in Iraq. During early resuscitation,¹ blood was seen at the external urethral meatus and rectal examination revealed a boggy, high riding prostate. Considerable bruising of both buttocks was noted. A standard trauma X-ray series revealed an anterior–posterior compression fracture (APC-3)³ of the right hemipelvis with complete disruption of the right sacro-iliac joint and avulsion of the right distal third of the sacrum (Fig. 1). Ultrasound scanning showed a contained retroperitoneal haematoma and an ascending urethrogram confirmed a transection of the membranous urethra (Fig. 2).

A Hoffman II (Stryker, UK) pelvic external fixator was rapidly applied and the pelvic fracture was reduced. Central and arterial line monitoring were inserted contemporaneously. The blood pressure stabilized and the pulse fell to below 100 bpm. An unsuccessful attempt was made to insert a supra-pubic catheter under ultrasound guidance. Check radiographs confirmed that the pelvic volume had been reduced. Arrangements were made to transfer him as a Priority 1 casualty to the UK Field Hospital in Basra some 180 km to the south. Unfortunately, he then rapidly developed a tachycardia in excess of 140 bpm and brisk oozing was noted from the pin

sites. Increased flank bruising was also seen. Repeat ultrasound scanning showed an absent bladder, a spreading retroperitoneal haematoma combined with intra-abdominal, free blood (Fig. 3a).

At emergency laparotomy, a massive retroperitoneal haematoma was found arising from the pelvis and pushing the abdominal contents upward. The haematoma extended up both paracolic gutters. The pelvis was tightly packed with four large abdominal swabs. This produced only a temporary reduction in bleeding and the patient became increasingly unstable. The patient's haemoglobin was now 3 g/dl despite a 10-unit stored A–ve blood and fluid transfusion. The abdominal aorta was therefore clamped above the iliac bifurcation. This allowed the anaesthetic team to catch up with the resuscitation. Ten units of A–ve blood were the complete holding of this type: in view of the critical condition of the patient an emergency blood donor panel was convened using serving soldiers of the surgical group and nine fresh units of compatible A–ve were venesected.

After 20 min of clamping, the patient's condition markedly improved as the fresh blood was administered. The aortic clamp was released and this immediately resulted in renewed arterial bleeding. The



Figure 2 Ascending urethrogram showing transection of the membranous urethra.

iliac vessels were explored. The bleeding was found to arise from branches of the right internal iliac artery and this was double ligated. No other intra-abdominal injuries were detected, the pelvic packs were left in situ and the abdomen was closed (Fig. 3b). Arrangements were made to move extra blood and adjunctive clotting products (and a haematologist), by road but with an estimated 5-h transit time.

Some pin-site oozing continued, but markedly less than before. When the clotting factors arrived: the patient was given 1.5 L of FFP, 10 packs of cryoprecipitate, 300 ml of platelets and activated Factor VII (Novo Nordisk) at a dose of 480 KIU every 2 h for 8 h. Administration of the Factor VII was associated with a marked reduction in the oozing from the pin-sites and an improvement in pH from 7.1 to 7.3. Perioperatively a total of 25 units of blood were transfused, 8 of which were the fresh whole blood donated by individual members of the AASG.

The next day, the patient was evacuated by a Royal Air Force Critical Care Team to the UK. He has required pelvic, bladder and urethral reconstruction. A right-sided foot drop remains and he is currently undergoing physiotherapy at a military rehabilitation centre.

Discussion

The philosophy behind forward surgical units in the military is resuscitation and stabilization prior to evacuation.^{6,8,13} This may involve damage control surgery and major vessel control.^{2,5} Patients with penetrating trauma and associated injuries bleed heavily: open book and posteriorly unstable pelvic injuries imply the application of a massive force to the pelvis and the predicted blood loss is usually in excess of 12 units (5 l) of blood. The associated mortality is over 50%.³ This transfusion requirement exceeds most hospitals' massive transfusion criteria. Blood and adjunctive clotting products will always be an essential part of their surgical and anaesthetic care. However, fresh frozen plasma and cryoprecipitate require storage at -30°C . Daytime temperatures in Iraq often exceed 45°C . Apparent limitations of modern technology make it currently impossible to deploy these products forward of field hospitals.

Activated recombinant human Factor 7 (rhVIIA) is a novel clotting factor. It significantly amplifies the clotting pathway (via tissue Factor VIIA complex, Factor X initiation) and causes platelet mediated thrombin generation.⁴ It is currently licensed in the UK to treat bleeding in haemophilic patients with



Figure 3 (a) Military FAST scanning using Sonosite 180 handheld portable scanner; (b) Pelvic volume reduction after packing and application of external fixation.

inhibitors. The first case report describing the use of Factor VIIA for the control of massive haemorrhage (following a gunshot wound) was published in 1999.⁷ There is now a growing body of evidence to show its efficacy in uncontrollable haemorrhage and also

its safe side effect profile.^{10–12} The main concern over the use of rhVIIA is thromboembolism. None of the series published to date have suggested an increased incidence of deep vein thrombosis or pulmonary embolism in patients given rhVIIA.⁹

Factor VIIA has proven to be a potent haemostatic agent. It comes in a small ampoule, has a shelf life of 3 years can be stored simply in a normal fridge. This short case report describes the first use of activated Factor VII by the British Army. This product fills a capability gap and we believe, should be deployed with all units capable of performing surgical resuscitation in conflict areas. This case also illustrates the benefits of forward surgery in wartime and confirms the need for a multidisciplinary approach to trauma care. Even in the UK with access to an interventional radiologist (which might have precluded the need for a laparotomy), this patient might well have died.

Conclusion

Forward surgery requires experienced personnel backed up by portable imaging,^{12,14} appropriate skeletal stabilization equipment, a lab with blood, an emergency donor panel, Factor VIIa and an ITU. In this way, NHS standards of care (or better) can still be provided within a highly mobile unit on the modern battlefield. Finally, this case illustrates the current ethos of the Airborne Medical Services “*Good Medicine in Bad Places*”.

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