CASE REPORT

ARE IVC FILTERS REQUIRED IN COMBAT SUPPORT HOSPITALS?

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Abstract

Background: Haemorrhagic shock from traumatic injuries is now often treated using a damage control resuscitation strategy that transfuses packed red blood cells, plasma and platelets in a 1:1:1 ratio, early use of activated recombinant factor VII and transfusion of fresh whole blood. These therapies are aimed at promoting thrombosis in injured vessels. Such patients are at high risk for thrombotic complications and thromboprophylaxis is necessary, but frequently impossible to use in the early phase of care.

Case presentation: We describe the case of an Afghan civilian worker who suffered a vertical shear pelvic fracture with massive bleeding in a pedestrian/truck collision that was treated with a damage control resuscitation strategy, and who later suffered a severe pulmonary embolus. The potential use of a temporary inferior vena cava [IVC] filters is discussed.

Recommendations: Care providers and policy makers must recognize that the increased use of prothrombotic strategies of resuscitation will likely increase the incidence of thrombotic complications in the high risk population of severely injured patients in combat support hospitals. Monitoring the incidence of these complications and development of strategies for prevention and treatment are required to avoid undermining the positive outcomes of damage control resuscitation. These strategies could include supplying combat support hospitals with the equipment and training necessary for placement of temporary IVC filters under fluoroscopic guidance.

Introduction

Severely injured patients in hemorrhagic shock are at risk of death unless measures to stop the bleeding are taken. Damage control resuscitation has evolved as a means of treating haemorrhage while promoting the correction of coagulopathy and enabling the formation of clots in injured blood vessels. The principle is to infuse blood products in a ratio that resembles the normal contents of fresh blood and avoid dilution of the components [1]. Promising results have sparked enthusiasm in the use of damage control resuscitation [2,3], but thrombotic complications are not well documented. Additionally, other measures such as the use of activated recombinant factor VII [rFVIIa] [Novoseven®, NovoNordisk, Denmark], cryoprecipitate concentrates and fresh whole blood aim to improve coagulation but also may increase the risk of later thrombotic problems [4,5]. A severely injured patient is at high risk of thromboembolic complications [6] and requires thromboprophylaxis, but which is often contraindicated in the initial trauma management phase. These complex issues force the clinicians to balance the improvement of coagulation with the risk of thrombosis. The positive outcomes of improved coagulation could be negated if no protection is offered against thromboembolic complications.

Case presentation

A 30 year old Afghan civilian worker pedestrian was brought to the resuscitation trauma bay of the NATO Role 3 Multinational Medical Unit [MMU] at Kandahar Air Field, after being hit by a truck. He presented with a decreased level of consciousness, spontaneous laboured breathing, severe hypotension and tachycardia. He was orally intubated and mechanically ventilated. Damage control resuscitation was initiated with transfusion of warmed packed red blood cells [PRBC], thawed and warmed fresh frozen plasma [FFP] and platelets [PLT] in a ratio of 1:1:1. Initial evaluation revealed facial injuries, a pelvic fracture, perineal ecchymosis and haematoma, a lacerated anal sphincter and a rectal tear. His haemodynamic status improved with resuscitation and the patient was sent for whole body computed tomography scan [CT]. This revealed an absence of brain injury, a right zygoma fracture, small bilateral pneumothoraces, a grade II liver hematoma and a vertical shear pelvic fracture with active bleeding [Figure 1a&b]. The patient went directly to the operating theatre from CT scan. Bilateral tube thoracostomies were placed and a urethrogram confirmed urethral disruption [Figure 2]. At laparotomy, there was only a minimal haemoperitoneum, a large zone III retroperitoneal hematoma and an anterior wall extraperitoneal bladder rupture. A sigmoid loop colostomy was performed and pelvic drains placed to treat the rectal injury whilst a suprapubic cystostomy and bladder repair were performed for the urethral and bladder injuries.

The pelvis was packed extraperitoneally to provide tamponade of the rapidly expanding haematoma which was successful. Temporary abdominal closure used a vacuum-assisted closure [VAC®, KCI, USA] device. An external fixator was placed to provide pelvic stability. He received a total of 20 units of PRBC, 20 units of FFP, 20 units of PLT, a single intravenous dose of 100 g/kg of rFVIIa and 4 units of

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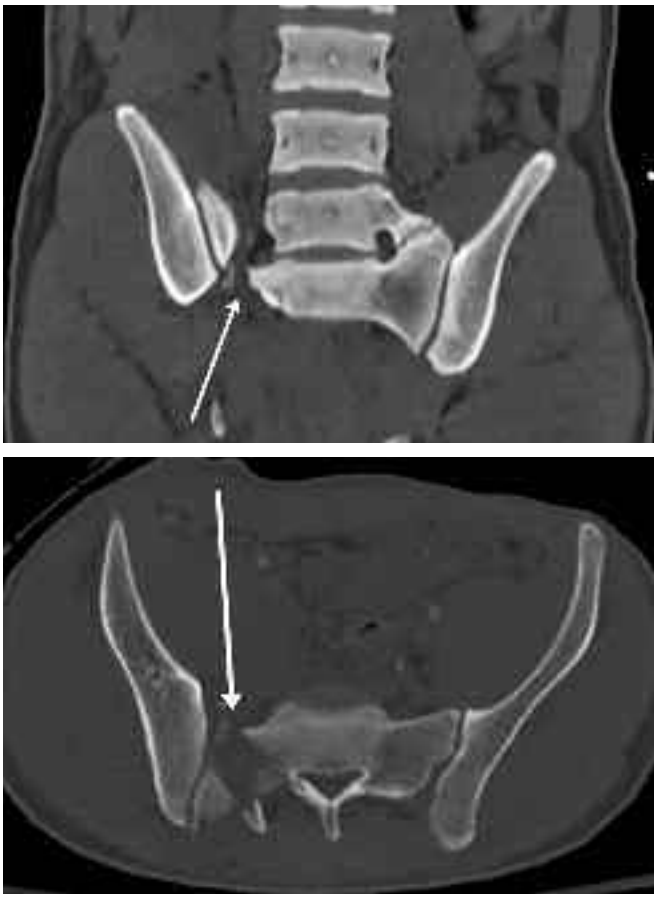

Figure 1a & b: CT scan of the pelvis demonstrating right hemipelvis vertical shear fracture with retroperitoneal hematoma.

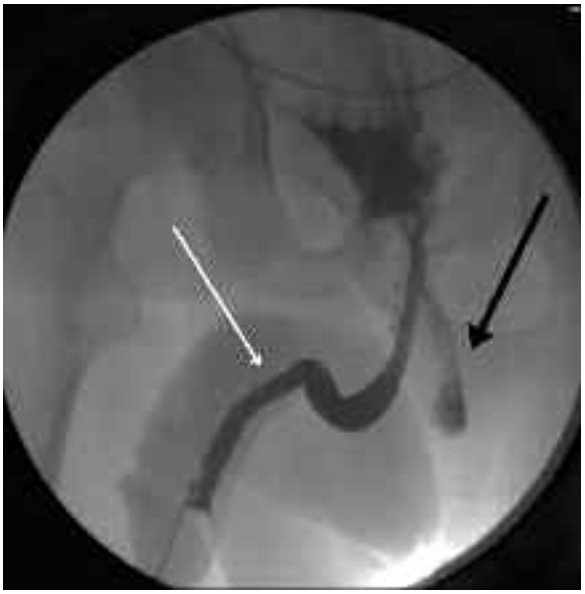

Figure 2: Intra-operative urethrogram demonstrating the normal urethra [white arrow] and extravasation of contrast [black arrow].

cryoprecipitate during the surgical procedure, but remained haemodynamically labile throughout the case. On the intensive care unit [ICU] he was warmed, resuscitated and received 4 units of fresh whole blood, obtained from the walking donor blood bank[i], for ongoing bleeding and sustained clinical coagulopathy. Deep venous thrombosis [DVT] prophylaxis was initiated on arrival in the ICU using sequential compression devices [SCD] on both lower extremities. Over the course of the following 4 days, the patient returned daily to the operation theatre for pack removal, washout and repacking. Complete haemostasis and definitive abdominal closure was achieved after a total of 5 surgical procedures. Chemical DVT prophylaxis was started on day 5 post-injury with enoxaparin 30 mg subcutaneous injection every 12 hours, after concerns about ongoing bleeding were dismissed. On the 7th post-injury day, the patient displayed new onset haemodynamic instability and was sent to the CT for evaluation. A large saddle pulmonary embolus was diagnosed [Figure 3]. The patient required inotropic and vasopressor support to maintain the cardiac output. Anticoagulation with intra-venous heparin was initiated and no haemorrhagic complications occurred. He was transferred on day 14 to a national care facility for the remainder of his treatment, with a tracheostomy *in situ* and still requiring mechanical ventilation. He died of pulmonary complications within one week of transfer.

[i]The walking blood bank is a registry of pre-screened voluntary blood donors that are available on demand to give blood for transfusion purposes

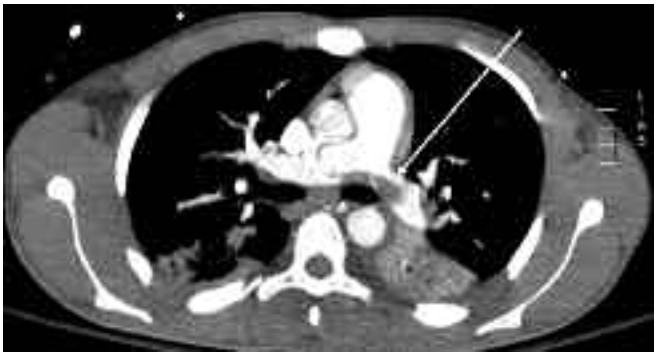

Figure 3: CT scan of the chest demonstrating a large pulmonary embolus [white arrow] extending on both sides of the pulmonary vasculature [saddle].

Discussion

The Role 3 MMU at Kandahar Airfield is one of many facilities involved in healthcare support for the military operations in Afghanistan. Role 3 facilities usually have surgical capacity [general surgery, neurosurgery and orthopaedic surgery], intensive care units and radiology support [CT, fluoroscopy]. Our understanding of the physiology of traumatic injuries has improved over the last decade and our resuscitation strategies have evolved accordingly. The challenge facing the clinician in the resuscitation of the severely injured patient is to find the adequate balance between good tissue perfusion and minimising blood loss. The best strategy to achieve this goal is to replace the blood losses with products that resemble whole blood as much as possible, to avoid raising the blood pressure at levels that disrupt clots until surgical control of the bleeding is ensured, to promote coagulation by avoiding hypothermia and coagulopathy, and to attempt early correction of coagulopathy. This strategy has been referred to as "damage control resuscitation" and its proponents have described good success rates with its use [1,7-9].

The severely injured patient is at high risk of developing DVT and pulmonary embolism [PE]. Incidence rates of DVT of up to 59% have been reported [6], and patients at high risk include those with traumatic brain injury [TBI] and lower extremity and pelvic fracture, conditions which are common in combat support surgical facilities. In order to minimize the risks of DVT and PE, prophylaxis is indicated either with use of low molecular weight heparins [LMWH] such as enoxaparin, intravenous unfractionated heparin or sequential calf compression devices [10]. However, contra indications to the use of prophylaxis are frequently present in the early stages of care of the critically ill trauma patient in the field,which include TBI, ongoing acute bleeding, coagulopathy and lower extremity injuries.

The downside to any strategy that aggressively treats coagulopathy is the potential for thromboembolic

complications. The incidence of these complications is not well documented in the literature for patients treated with damage control resuscitation. The incidence of complications in patients treated with rFVIIa has been more fully scrutinised. A 9.4% incidence of thromboembolic complications were retrospectively reported following its use; 10 out of 14 deaths were thought to be related to thromboembolic complications [11]. Recent surveys show increased use of rFVIIa for the management of haemorrhage in trauma patients despite the scarcity of level I evidence of benefit [4], and often with variable or even absent clinical protocols for use [1,12,13]. Little is known about the role of whole blood in the incidence of thromboembolic complications in the military trauma setting.

In high risk patients with contraindications to DVT prophylaxis, one emerging strategy is to employ Inferior Vena Caval [IVC] filters to reduce the risk of PE. Temporary filters have been successfully placed at the bedside using fluoroscopy or ultrasonography, with success rates of 97% at placement being reported [14]. These temporary filters can be removed up to 2-4 months after placement, again using fluoroscopy in facilities with angiography capability [15]. The protection from PE is reported to be above 90% [14,15]. The incidence of complications following placement was reported as 2% and include misplacement, groin haematoma and arteriovenous fistula [15]. Some studies show an increase in DVT after filter placement [16] but how this translates to our trauma population in terms of morbidity or mortality needs to be investigated. IVC filters do not replace DVT prophylaxis, but they mitigate the risks of PE, and chemical prophylaxis should be instituted as early as allowed.

The combat support hospitals currently deployed on operations in Afghanistan and Iraq usually have the capability to perform fluoroscopy with a C-arm when they have orthopaedic surgery capability, whilst critical care physicians managing the ICU patients are familiar with risk stratification for DVT and use of prophylaxis. The addition of the capacity to identify these high risk patients and deploy a temporary IVC filter may improve the outcome of a selected group of extremely sick patients that would tolerate PE poorly. These patients would possibly benefit from this additional protection and the filter could be subsequently removed at the higher level receiving facility. However, little data exists at the moment on the incidence of PE in this subset of patients nor on the use of IVC filters. It is a challenge to collect prospective data in this patient population. These patients are transferred early from the operational theatre to a Level IV facility in Germany, then to their respective country for ongoing care. Nevertheless, our future focus is on the outcome of the few selected patients in which Günther Tulip® filters [Cook®, Bloomington, IN] have been placed, using the guidelines published by the Joint Theater Trauma System [based on Level III evidence] [17] Also, we are prospectively monitoring thromboembolic events in patients where damage control resuscitation was employed. We hope this data will help to clarify further some of the unresolved issues in the use of IVC filters.

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