Trauma Revisited

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Abstract

Trauma is a diverse specialty; patients of variable age groups present with varying severity and types of injuries. We report our experience with a trauma patient in a regional centre to highlight several issues encountered in this patient population, and in this particular case, included failure of a rapid infuser catheter (RIC).

INTRODUCTION

A sub-population of trauma patients survive the initial insult to present to the operating theatre (OT) urgently, often in extremis, requiring salvage operation (damage control approach)[1]. This is frequently the anaesthetist's first contact, after resuscitation efforts have failed to stabilise the patient. For some, emergent surgical intervention is crucial for survival but for others, the outcome is predetermined by their premorbid conditions, the severity of injuries sustained and the extent to which they have succumbed to the immediate post-trauma triad of hypothermia, acidosis and coagulopathy.

CASE HISTORY

We present a case involving a 47 year old man with no significant medical history who was involved in a motor vehicle accident. He was the passenger in a water tanker which collided with a motorcycle. Neither the driver nor the patient were wearing seatbelts and they were thrown from their vehicle when it rolled over six times; the motorcyclist died instantly while the tanker driver sustained significant facial and lower limb injuries.

At the scene, the patient had a Glasgow Coma Score (GCS) of 7 (E_2 V_1 M_4). Multiple attempts were made before successful intravenous (IV) access was established with an 18G IVC in the dorsum of his right hand. Extrication and transport time was 30 minutes. On arrival at the Emergency Department, his GCS had deteriorated to 3, his HR 120/min and BP 75/50mmHg. He was intubated using 100mcg fentanyl and 200mg suxamethonium, with application of cricoid pressure and in-line immobilisation. He received 3L crystalloid and 4 units type O blood through a rapid infuser via the peripheral IVC while a 4-lumen CVC line was inserted into his left femoral vein and saphenous cutdown was performed at his left ankle to place another 18G IVC. A right radial intra-arterial line was inserted with difficulty. His BP was 70/50mmHg despite further large volume fluid resuscitation and bolus doses of metaraminol.

His circulation remained unstable after his airway and breathing was secured. Primary survey revealed a severely crushed and partially avulsed L arm at the level of proximal humerus with bones and muscle on view and a large left sided scalp laceration with exposure of his skull from the temporal to occipital region. He was not exsanguinating from his injuries. CXR showed significant contusion and collection in his right lung. He was transferred to the OT for urgent laparotomy for suspected intra-abdominal bleeding (focused abdominal ultrasonography was not available at our centre). Noradrenaline infusion was commenced at 30mcg/min and he also received 1 unit of pooled platelets prior to the transfer.

Bilateral intercostal catheters (ICC) were inserted upon arrival in theatre; the right ICC drained ~600ml frank blood immediately. Adrenaline infusion was started and the 18G IVC on his dorsum right hand was exchanged for an 8.5Fr RIC and 1L crystalloid was infused by gravity. Laparotomy by the general surgical team was negative; his viscera were intact with no free blood or fluid in his abdominal cavity. His scalp wound was sutured to stop the continuous venous ooze of blood and an external fixator was inserted into his left arm by the orthopaedic team.

His remained hypotensive (SBP~60mmHg) despite the inotropes and 15 minutes into the surgical time, his right forearm had increased in size secondary to significant subcutaneous fluid extravasation, and the intra-arterial trace

was reduced to a flat line. Infusion through the RIC was ceased immediately. Several attempts were made at inserting a femoral arterial line percutaneously under sterile conditions but were unsuccessful in view of his hypotension. A femoral vascular cut-down was performed by the general surgeon and his femoral artery was successfully cannulated. A 14G IVC was also inserted into his femoral vein under direct vision.

His inotrope requirement escalated to 50mcg/min of both adrenaline and noradrenaline as well as bolus doses of 500mcg adrenaline (total 10mg used) to keep his SBP >70mmHg. By that time, he had received 10 units packed cells, 4 units fresh frozen plasma, 1 unit pooled platelets and 4L crystalloids. His CVP was >25mmHg when measured via the femoral CVC. 3 ampoules of 6.8mmol calcium chloride were administered throughout the case, as well as a bolus dose of 40IU vasopressin and 200mg hydrocortisone. The patient only responded transiently to the drugs and after a discussion between all medical teams involved, the decision was made to withdraw treatment. The patient died shortly in recovery after the inotropes were ceased.

Other injuries sustained in the preliminary autopsy report were bilateral pulmonary oedema and contusions with the pleural cavities containing moderate volume of blood (~500ml). The peritoneal cavity was normal but he had significant retroperitoneal bleeding (not quantified) with an unidentified primary site of injury. He had cerebral oedema and two small areas of superficial cerebral bruise about the size of five cent coins. His heart and pericardium were both normal.

DISCUSSION

Our interventions have not altered the outcome for this patient but this case served to highlight several issues commonly encountered in trauma patients[2]. The following discussion focuses on the problems that we faced, coupled with the benefit of hindsight and post-mortem.

Venous access is a basic requirement for resuscitation but establishing large bore accesses in hypotensive trauma patients with limited access sites would pose a challenge even for skilled individuals. Percutaneous femoral access and saphenous cutdown are both acceptable techniques, with the femoral access being the preferred route because it can be performed more rapidly and allow for more rapid fluid infusion[3,4]. However, retroperitoneal haematoma is a recognised complication at this insertion site, particularly with multiple attempts and without ultrasound guidance[5].

CVP measurements from femoral CVC are notoriously inaccurate under normal circumstances and in this patient, His CVP may have overestimated his intravascular volume status in the presence of the retroperitoneal haematoma.

As to the device inserted, a large bore catheter would offer better flow compared to the high resistance of a multi-lumen catheter, especially when massive blood and fluid requirement is anticipated[6], but that has to be balanced against the multiple accesses required for running infusions and drug delivery.

The incidence of vascular access problems comprise only a small proportion of cases reported to the Australian Incident Monitoring Study (AIMS) but of those cases, 51% involved a fault at the catheter/skin interface i.e. late detection of incorrect catheter placement[7]. In this patient, firstly, the RIC inserted was too large for a vein on the dorsum of his hand and secondly, the error was unrecognised because the RIC flushed easily without signs of extravasation initially and subsequent infusion continued to run freely under gravity, resulting in loss of vascular access and crucial invasive monitoring.

Due to the nature of his injuries, only the patient's right arm was available to the anaesthetic team in the OT as his cervical spine was not cleared. All his patent venous accesses were located in his lower limbs and gaining access to his femoral line was made more difficult after he was prepped and draped and had two surgical teams working on him simultaneously.

Haemorrhage is a major cause of early trauma mortality (within the first 24hours) and although impossible to quantify, the extent of blood loss is reflected by blood pressure and the number of packed cell units transfused[8]. This patient had had a massive transfusion in addition to fluid resuscitation to treat his hypotension, but the intervention itself contributed to the coagulopathy of trauma by causing further haemodilution of procoagulant factors and platelets. This is compounded by blood products administered without fluid warmer because hypothermia is an independent contributor to coagulopathy due to its effect on enzyme activity in the coagulation cascade[9].

Vasopressin is undergoing intensive studies currently, yet with limited proven clinical application at this time. The Australian Resuscitation Guideline recommends 40IU bolus dose(s) as an alternative or in combination with adrenaline in adult advanced life support and only a few case reports (with

doses ranging from 0.04IU/min to 40IU bolus) and conflicting opinions have been published regarding its use in shock[10,11,12]. The rationale for using vasopressin in this patient was his refractory hypotension despite high dose catecholamines. He had a transient response (systolic BP 90mmHg) associated with significant bradycardia, necessitating the use of 0.6mg atropine.

Taking into account the autopsy report, it is likely that this patient succumbed to a combination of cardiogenic and haemorrhagic shock. Neurogenic shock cannot be excluded due to the mechanism of injury and his persistent hypotension despite aggressive resuscitation. Performing an intra-operative trans-oesophageal echocardiography (TOE) would have provided useful information on his cardiac function as well as guided resuscitation[13].

CONCLUSION

In summary, anaesthesia for trauma surgery is a situation of controlled chaos

In an environment where multiple teams are simultaneously involved in the care of the patient, a leader is required to co-ordinate and prioritise the barrage of information and tasks which need to be performed and this role is frequently undertaken by the anaesthetist and/or surgeon. Effective communication with all parties and the ability to function effectively under stress underpin the success of this role. As this case unfolded during the early hours of the morning, understanding the limitations of one's resources, the availability of the hospital's resources and recognising fatigue are important issues to take into consideration[14].

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