

Insidious bleeding; the danger of complacency: Case Report

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Abstract

Background: A recent publication in the Journal of Trauma and Acute Care Surgery reported that patients who received a tourniquet (TQ) for severe extremity bleeding had a fourfold decrease in overall shock related mortality (Scerbo et al., 2017). A systematic review conducted in the United States (US) by Beaucreux, Vivian, Miles, Sylvain, and Pasquier (2018) showed that tourniquets are an effective tool for haemorrhage control in civilian populations with low levels of associated complications. Not a lot is known about the attitudes of Australian paramedics toward TQ's or their use thereof, but anecdotal evidence suggests that their use is contentious.

Case: We present a case of severe extremity haemorrhage involving a 90-year-old male who sustained a partial amputation to the lower aspect of the left leg proximal to the ankle whilst cutting a tree branch with a 5-inch toothed garden saw.

Conclusion: In this case, the paramedics who attended to this patient believed that the use of a TQ was extreme. Standard trauma management and haemorrhage control measures that included a pressure bandage, vacuum splint and warming blanket served as confounding factors in obscuring an ongoing insidious bleed. Based on the injury profile, the patients advanced age, medications for comorbidities and associated decrease in physiological reserves this patient was a candidate for early TQ application. Failure to apply a TQ may have contributed to coagulopathy and the need for post-operative transfusions.

Key words: paramedics; bleeding; haemorrhage control; tourniquet.

Introduction

Recent publications have reported that patients who had a tourniquet (TQ) applied for severe extremity bleeding in the pre-hospital environment required fewer transfusions, had higher systolic blood pressure on admission to the trauma centre and had a fourfold lower

overall shock related mortality rate (Scerbo et al., 2017). Additionally, TQ's have been shown to provide effective haemorrhage control with low levels of associated complication (Beaucreux et al., 2018). These observations echo those of the military experience where tourniquets have experienced a resurgence of popularity based on their ability to significantly reduce mortality from exsanguinating extremity haemorrhage on the battlefield (Kotwal, Montgomery, & Kotwal, 2011).

Little is known about the use of TQ's for severe extremity haemorrhage by Australian paramedics but anecdotal evidence would suggest that their use remains contentious in the pre hospital environment.

Case report

We report a case involving a 90-year-old male who sustained a near complete above ankle amputation of his left leg whilst cutting a tree branch with a 5-inch toothed garden saw.

The accidental injury occurred at approximately midday on a weekday, 20 minutes transport time from a major tertiary hospital.

The initial dispatch indicated a full amputation and a critical care unit (CCU) was dispatched in addition to an advanced life support (ALS) unit given the reported severity of the injury. The CCU is staffed

by a critical care paramedic (CCP) and is able to provide an expanded scope of interventions in high acuity trauma.

On arrival of the first ALS ambulance paramedics, the patient was found outdoors in the front yard of his home with a bathroom towel being used in an attempt to control the bleeding. The ambulance paramedics applied circumferential pressure using a pressure bandage and obtained the following vital signs (Table 1).

Blood pressure	140/90
Heart rate	105 beats per minute with a strong radial pulse
SPO2	97 % on room air
Glasgow Coma Score	15
Respiratory rate	16 breaths per minute
Pain score	3/10
Skin	Pink and warm to touch systemically (excluding injured leg)
Neurovascular observations of the left leg	The foot appeared pale and cool to touch with reduced sensation over the lateral aspect of dorsum and plantar aspect also. No dorsiflexion was possible, however; the patient was able to initiate a slight plantar flexion.

Table 1: Patient vital signs

Intravenous Sodium Chloride (Normal Saline) was commenced to keep vein open (TKVO) and 25 mcg of Fentanyl was administered.

On arrival of the CCP, it was noted that the wound had already been bandaged using a 4-inch Emergency Bandage with the pressure bar and no twisting of the closure bar. The wound description from the ambulance paramedics had documented a near complete above ankle amputation with the distal limb remaining attached only by a small portion of tissue approximately 1-2cm in thickness. A deep anteroposterior laceration through approximately 85% of his lower leg tissue was noted with an obvious associated complete open fracture. Prior to bandage application, the bleeding appeared to be venous in nature and was reported to be adequately controlled.

A history (Hx) was sought from the patient revealing a medical Hx remarkable for atrial fibrillation and scoliosis, currently receiving aspirin and digoxin. The CCP requested the normal saline infusion be reduced to TKVA rate, given the presence of a radial pulse, and 25 mcg of Fentanyl was administered for analgesic purposes.

A tourniquet was applied to the left leg inferior to the groin area but was not tightened. The TQ was positioned proximally as the treating CCP and ambulance paramedics wanted access to the windlass device after the application of a full-length vacuum splint. The patient's lower leg was placed in a vacuum splint to allow for stability during extrication and a warming blanket applied prior to transport

to the hospital. There were no changes in the patient's vital signs during the 20-minute transport time to the hospital.

On arrival at the hospital, the warming blanket was removed to allow for transfer from the ambulance stretcher to the hospital bed. This revealed a large pool of blood of approximately 300mls. Additionally, the pressure bandage was soaked in blood when removed. Upon examination of the leg, it was noted that haemostasis had not been adequately achieved as noted by an ongoing pulsating bleed.

The hospital medical team was instructed to tighten the TQ, which allowed for inspection, irrigation and subsequent dressing of the wound using packing gauze.

The patient was given an additional 50mcg of Fentanyl and 2g of Cephazolin and an x-ray was ordered. The x-ray revealed complete distal tibial and fibular fractures with 100% anterior displacement of the distal fragments and the patient was concurrently referred to both the orthopaedic and vascular teams. Following the review, the patient was taken to the operating theatre where he underwent a successful anterior tibial artery repair by the vascular team, and an initial washout and external fixator application by the orthopaedic service. The patient was returned to theatre four

days later for a repeat washout and debridement, removal of the external fixator and definitive orthopaedic repair via application of internal fixation devices including insertion of a left tibial intramedullary nail.

Five units of packed red blood cells were transfused following the patient's surgery, however; it is unclear if this was due to blood loss associated with the vascular and orthopaedic repairs only.

Following surgery, the patient was coagulopathic and admitted to the ward for several days for ongoing treatment, monitoring and physiotherapy. At 10 days post injury, the patient was released with ongoing allied health support and outpatient review.

Discussion

In recent years, paramedics have become well versed on the effects of hypothermia, coagulopathy and acidosis in the trauma patient. Our knowledge of the "lethal triad" and subsequent management has progressed and now forms an important part of prehospital management of severely injured trauma patients (Perlman et al., 2016).

Atrial fibrillation in this patient was treated with Digoxin and Aspirin. Although Aspirin alone has not been shown to increase bleeding in the elderly immediately following severe trauma (Ohmori et al., 2016) there is a no dearth of evidence that

points to aspirin use as a contributing factor for traumatic coagulopathy (Spahn et al., 2013). Although this patient does not meet the technical criteria for massive transfusion coagulopathy based on the transfusion of only five units of post-operative packed red blood cells (Levy, 2006) it is reasonable to assume that the combination of uncontrolled haemorrhage, aspirin use and transfusion were likely responsible for the post-operative coagulopathic state of the patient. It is unclear if the use of Aspirin was given any consideration as a confounding factor to haemorrhage control or the coagulopathic consequences of ongoing bleeding by the ambulance paramedics.

Unfortunately, arterial blood gasses (ABG) or Lactate were not available for this review; therefore, we are unable to comment on the initial values. However, there are some discussion points related to vital signs and shock that need to be highlighted. The patient's advanced age and the subsequent reduced compensatory mechanism was not taken into account. With an initial shock index (SI) of 0.7, the limit of acceptability for normal healthy adults, this patient appears to have a low risk of mortality following the initial injury (Pandit et al., 2014). However, research indicates that SI alone is a poor predictor of mortality in the elderly due to insufficient physiological reserves (Bruijns, Guly, Bouamra, Lecky, & Wallis, 2013).

Research conducted by Bruijns et al. (2013) has shown that in the elderly, SI x age (SIA) is a more accurate predictor of mortality than traditional vital signs alone. Indeed, the likelihood of death within the first 48 hours is 8.4 times higher when the SIA exceeds 55 ($SI\ 0.7 \times 90 = SIA\ 63$). Based on these calculations this patient was at significant risk of shock related death.

The treating ambulance paramedics initiated effective hypothermia management using an active warming blanket. However, this and the addition of the vacuum splint obscured the wound making an ongoing assessment of the injury difficult and therefore unlikely during transportation and resulted in further preventable blood loss.

The nature of this wound profile presented several challenges in applying effective haemorrhage control. The almost complete amputation was attached by a small amount of skin and tissue and thus prevented the treating ambulance paramedics from applying a "stump" dressing. The wound also lacked a cavity, meaning it could not be packed using haemostatic gauze, which was also available to them. Although a TQ was proactively placed it was not utilised until the patient had been assessed in the emergency department of the receiving hospital. The ambulance paramedics reported feeling that the tourniquet was an

"extreme" measure despite overwhelming evidence to the contrary and kept the tourniquet loose in situ in case the wound began to haemorrhage more seriously during movement associated with extrication and transport.

The treating ambulance paramedics reported that they felt the application of the emergency bandage with a pressure bar and no twisting of the closure bar was appropriate. A study by Shipman and Lessard (2009) indicates the average pressure exerted by a mechanical emergency bandage is adequate to control haemorrhage in normotensive patients. In this case, the emergency bandage was not adequate and this was most likely related to the relative complicated wounding profile. Furthermore, the emergency bandage also contributed to obscuring the injury resulting in additional preventable blood loss.

Conclusion

Not enough is known about Australian paramedic's willingness to apply a TQ or their tolerance to witnessed extremity haemorrhage before considering TQ application. This case report indicates that there is still significant reticence and a high tolerance for bleeding even in at-risk population groups. There is overwhelming evidence to support the use of early TQ application yet in this case the treating

paramedics chose to forgo the TQ in favour of a more traditional approach.

Further research into TQ use in the Australian prehospital setting is required.

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