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IV access in bleeding trauma patients: A performance review

Paul T. Engels [a,b,*], Edward Passos [c], Andrew N. Beckett [c,d,e], Jeffrey D. Doyle [c,e], Homer C. Tien [c,d]

[a] Department of Surgery, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada
[b] Division of Critical Care Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada
[c] Division of General Surgery, University of Toronto, Toronto, ON, Canada
[d] Canadian Forces Health Services, Ottawa, ON, Canada
[e] Division of Critical Care Medicine, University of Toronto, ON, Canada

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ABSTRACT

Background: Exsanguinating haemorrhage is a leading cause of death in severely injured trauma patients. Management includes achieving haemostasis, replacing lost intravascular volume with fluids and blood, and treating coagulopathy. The provision of fluids and blood products is contingent on obtaining adequate vascular access to the patient's venous system. We sought to examine the nature and timing of achieving adequate intravenous (IV) access in trauma patients requiring uncrossmatched blood in the trauma bay.

Methods: We performed a retrospective chart review of all patients admitted to our trauma centre from 2005 to 2009 who were transfused uncrossmatched blood in the trauma bay. We examined the impact of IV access on prehospital times and time to first PRBC transfusion.

Results: Of 208 study patients, 168 (81%) received prehospital IV access, and the on-scene time for these patients was 5 min longer (16.1 vs 11.4, $p < 0.01$). Time to achieving adequate IV access in those without any prehospital IVs occurred on average 21 min (6.6–30.5) after arrival to the trauma bay. A central venous catheter was placed in 92 (44%) of patients. Time to first blood transfusion correlated most strongly with time to achieving central venous access (Pearson correlation coefficient 0.94, $p < 0.001$) as opposed to time to achieving adequate peripheral IV access (Pearson correlation coefficient 0.19, $p = 0.12$).

Conclusions: We found that most bleeding patients received a prehospital IV; however, we also found that obtaining prehospital IVs was associated with longer EMS on-scene times and longer prehospital times. Interestingly, we found that obtaining a prehospital IV was not associated with more rapid initiation of blood product transfusion. Obtaining optimal IV access and subsequent blood transfusion in severely injured patients continues to present a challenge.

Introduction

Exsanguinating haemorrhage is the most common cause of trauma mortality in the first hour after arrival to a trauma centre and accounts for almost one half of the deaths in the first 24 h.[1–3] The treatment of exsanguinating haemorrhage involves (1) the immediate treatment with simple measures (i.e., direct pressure, splinting, tourniquet, and pelvic binding) and subsequent definitive control of bleeding via surgical or interventional radiological means as appropriate; (2) the correction of any coagulopathy; and (3) resuscitation with intravenous fluids and blood products. While haemorrhage control remains the cornerstone of the definitive management of haemorrhagic shock in trauma patients, intravenous infusion of crystalloid and blood products remains the mainstay of the resuscitation of these bleeding patients. Thus, timely and adequate intravenous access is of paramount importance to the actively bleeding trauma patient. Furthermore, in the evolving world of "damage control resuscitation"[4] which mandates the early use of larger volumes of plasma and platelets in addition to red blood cells, obtaining early and adequate intravenous access[5] can be a rate-limiting step in providing this life-saving[6] therapy.

According to the most recent ATLS guidelines,[7] "access to the vascular system must be obtained promptly. This is best done by inserting two large-calibre (minimum of 16 gauge) peripheral intravenous catheters before placing a central venous line is considered". ATLS guidelines further state that "a minimum of two large-calibre intravenous (IV) catheters should be introduced"

* Corresponding author at: Royal Alexandra Hospital, Room 205, CSC, 10240 Kingsway Avenue NW, Edmonton, AB, T5H 3V9 Canada. Tel.: +1 7807356924; fax: +1 7807356925.
E-mail addresses: pengels@ualberta.ca (P.T. Engels), edward.passos@sunnybrook.ca (E. Passos), andrew.beckett@utoronto.ca (A.N. Beckett), jeffrey.d.doyle@gmail.com (J.D. Doyle), homer.tien@sunnybrook.ca (H.C. Tien).

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with the "[preference being]. . .establishment of upper-extremity peripheral IV access".[7] No other guidance exists in ATLS. While the American Heart Association Guidelines[8] and European Resuscitation Council Guidelines[9] both describe intraosseous as options in those where IV access is unobtainable, there are no guidelines that expound on the necessary timing and successive steps to be taken in obtaining adequate intravenous access in trauma patients. Difficulty obtaining IV access in non-trauma emergency department (ED) patients[10] has been described but limited data exist about the actual time required to obtain IV access in trauma patients. Obtaining intravenous access in the field may be associated with longer transport times in bleeding trauma patients,[11,12] which may have an adverse effect on outcome.[2] The development of intra-osseous devices presents a potentially viable alternative in difficult patients, both in the prehospital and emergency room setting.

We performed a retrospective cohort study of bleeding patients at our institution (requiring uncrossmatched blood in the trauma room) to characterise the timing and nature of intravenous access achieved in these patients. We hypothesised that obtaining prehospital peripheral IV access delays transport to the trauma centre. Furthermore, we postulated that obtaining prehospital peripheral IV would not improve timely transfusion of blood products or outcomes.

Methods

Our study was approved by the Research Ethics Board of the University of Toronto.

Study design, population, setting

This was a retrospective review of trauma patients who were treated at the Sunnybrook Health Sciences Centre, a Canadian Level I trauma centre, during the period from January 1st 2005 to December 31st 2009. As we sought to examine the patients who most clearly required timely intravenous access, we specifically selected all patients who were transported directly from the scene of injury to our trauma centre and who required the transfusion of uncrossmatched packed red blood cells in the emergency department (ED). Patients were excluded if they were not transported directly to our institution, were not treated by the Trauma Team, or did not receive any blood transfusion during their time spent in the ED. Patients treated by the Trauma Team are done so in accordance with ATLS® Guidelines.[7] For haemodynamically unstable patients requiring blood in the Trauma Room, we routinely attempt both peripheral and central venous access. In our institution, the Trauma Team is composed of two nurses, a respiratory therapist, an anaesthesia resident, orthopaedic surgery resident, general surgery senior and junior resident, and a trauma team leader board-certified in their respective specialty, which can either be general surgery, emergency medicine or anaesthesiology. During the study period, our trauma centre had a blood refrigerator in the trauma room with 8 units of PRBCs (4 units each of O-neg and O-pos).

Prehospital analysis

We compared those patients who had any peripheral intravenous access achieved in the prehospital setting with those who did not. Our primary outcome was prehospital time. Secondary outcome included time to initiating red blood cell transfusions.

"Adequate" versus "inadequate" intravenous access

For the time period that patients were in the trauma room, we then characterised intravenous access as "inadequate" versus "adequate". This is a clinically important distinction, as management of "Circulation" within ATLS® protocol requires the trauma team to not only achieve any IV but "adequate intravenous access". We determined "adequacy" of IV access by examining the prehospital record and the hospital medical record. We also accounted for IVs that were not-functioning on arrival in the trauma bay, or were inadvertently pulled out. Although ATLS defines adequate IV access as two sixteen gauge IVs, prehospital protocol in Toronto allows paramedics to place 18 gauge peripheral IVs in the field, at their discretion. Thus, our trauma patients frequently have a combination of 18 and 16 gauge intravenous access. As our trauma team would not actively seek to replace a functioning 18 gauge intravenous with a 16 gauge or larger intravenous, we therefore defined "adequate" IV access as: the presence of two functioning 18 gauge or larger IV catheters (i.e., 18 + 18, 18 + 16, 16 + 16).

Trauma room analysis

In the trauma room, we determined the timing and placement of all intravenous catheters by examining the hospital medical record. Furthermore, we noted if patients also received any intraosseous devices. The main trauma room analysis focused on determining the time that "adequate peripheral IV access" was achieved, and the proportion of cases where "central venous access" was achieved. We then determined whether or not the timing of achieving adequate peripheral intravenous versus central access was associated with the initiation of blood product transfusion.

Protocol and data collection

Patients meeting our inclusion criteria were identified from the trauma registry and their demographic, physiologic, and blood transfusion data from the registry was collected. Identified patients had their charts reviewed (PE) and information was collected regarding the time and nature of any vascular access devices placed by emergency medical services personnel in the prehospital setting, and the time and nature of any vascular access devices placed by the Trauma Team in the Emergency Department, as well as the charted transfusion details.

Statistical analysis

Data was collated using Microsoft Excel (Microsoft Corporation, 2010, Redmond, WA, USA). We presented dichotomous variables as proportions, and compared them using chi-square test, utilising the Yates correction for continuity. For continuous data, we presented means with 95% confidence intervals, and compared them using the Student's *t*-test. The correlation between time to achieving adequate IV access (peripheral vs central) was furthermore analysed using Pearson's product moment correlation coefficient.

All *p*-values were two-tailed, and data was analysed using SAS (SAS version 9.2, SAS Institute Inc., NC, USA).

Results

During the study period, 5505 patients were assessed by the trauma team, with 3145 of these arriving to hospital directly from the scene of injury. Of these, 208 patients received at least one unit of uncrossmatched PRBCs in the trauma room, and constituted our study group. Baseline characteristics of the study group are shown in Table 1. Overall, this was a young group of patients who were mostly males, who had predominantly suffered blunt injury, who were critically injured, and required massive transfusions. The