

## Potentially avoidable blood transfusion during trauma resuscitation



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### ABSTRACT

**Introduction:** Red blood cell (RBC) transfusion is often essential during trauma resuscitation but is associated with high cost and potential adverse outcomes. This study aimed to determine the incidence of potentially avoidable RBC transfusions (PAT) among adult major trauma patients.

**Materials and methods:** A retrospective review of data collected by <name blinded> Registry on patients presenting between Jan 2006 and Dec 2011 was conducted. Eligible patients received at least 1 unit of RBC in the first 24 h following presentation to the Emergency Department (ED). Episodes of PAT were determined according to haemodynamic stability and post-transfusion haemoglobin levels.

**Results:** There were 621 patients included, of whom 224 (36.1%; 95% CI: 32.3–40.0) received PAT. Of them, 132 (58.9%) were haemodynamically stable on arrival and did not require a surgical procedure. Patients with PAT had significantly lower injury severity scores (30 vs 34,  $p < 0.01$ ), higher presenting systolic blood pressure (129 vs 112 mm Hg,  $p < 0.01$ ) and a lower frequency of a shock index  $\geq 1$  (24.1 vs 65.0%,  $p < 0.01$ ), compared to those without PAT. They also had a significantly lower mortality (13.4 vs 21.7%,  $p < 0.01$ ).

**Conclusions:** PAT after trauma was common and often delivered to haemodynamically stable patients who did not require surgical procedures. Clinical decision pathways for trauma resuscitation should aim to limit PAT.

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### Introduction

Advanced Trauma Life Support (ATLS) recommends transfusion of red blood cells immediately after failure to achieve haemodynamic stability with 2 L of crystalloid solution [1]. This recommendation assumes that haemodynamic stability or instability can be readily recognized by crude signs and that the cause of instability is bleeding. Such assumptions are not always accurate. In addition, substantial risks have been associated with transfusions [2,3] and following trauma, such risks may be independent of

injury and shock severity [4,5] including, but not limited to, death, acute lung injury and multi-organ failure [6].

A restrictive transfusion practice can mitigate some of the risks and reduce costs. Previous reports have suggested 33–62% of all transfusions in trauma patients as being inappropriate [2]. In the setting of massive transfusion, excessive plasma administration alone has been quantified to occur in 20% of patients when using a massive transfusion protocol and in 10% of patients when using laboratory based triggers [7]. Cotton et al. studied the impacts of specific performance improvement measures on blood product overuse during massive transfusions and found such practice to be less likely when transfusion protocols were activated in the emergency department (ED), by specialists and formally discontinued rather than continued till its end [8].

However, the degree of avoidable blood and blood product usage during trauma resuscitation has not been examined in detail,

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in particular among patients who do not require massive transfusions. This study aimed to identify the proportion of patients that received potentially avoidable transfusion (PAT) in the first 24 h post injury among major trauma patients. Our hypothesis was that PAT occurs frequently and is associated with identifiable characteristics.

**Materials and methods**

*Setting*

The state of Victoria, Australia has one Paediatric and two Adult Major Trauma Services (MTS), all located within metropolitan Melbourne. Major trauma triage guidelines result in 85% of major trauma patients being directed to a MTS for definitive treatment [9]. The <name blinded> registry prospectively records pre-hospital and hospital data on all major trauma patients, defined as having an Injury Severity Score (ISS) greater than 15, requiring urgent surgery or Intensive Care Unit admission, or dying in hospital.

*Participants*

Eligible patients were retrospectively identified through a search of The Alfred trauma registry. Patients included in The <name blinded> registry, injured between 1st of January 2006 and 31st of December 2011 and who received a red blood cell transfusion in the first 24 h post presentation to hospital were included in the study. Individual patient medical records were reviewed by a single operator for post transfusion haemoglobin values.

A 'haemodynamically stable' patient was defined as one with a shock index of <1 [10] and a systolic blood pressure of  $\geq 100$  mm Hg, while a 'haemodynamically unstable' patient was defined as one presenting with a shock index of  $\geq 1$  or a systolic blood pressure of <100 mm Hg. The first recorded pre-hospital and in-hospital vital signs and blood test results were used for all analyses. A massive transfusion was defined as the transfusion of 5 units or

more of red blood cells in a 4 h period [11]. A cut-off of a lower volume of RBC in a shorter period of time than the traditional definition of 10 units of RBC in 24 h was used to capture patients who require transfusions early during trauma resuscitation [12]. In 2008, a massive transfusion protocol was instituted that recommended transfusion of 2 units of fresh frozen plasma and a pool of platelets with 4 units of red blood cells, cryoprecipitate when fibrinogen count was measured to be <1.0 g/L, and consideration to calcium based on the treating clinician. During the study period, there were no objective tools in use to determine the need for transfusion, massive transfusion or activation of the massive transfusion protocol. Such decisions were therefore based on individual clinician knowledge and experience only.

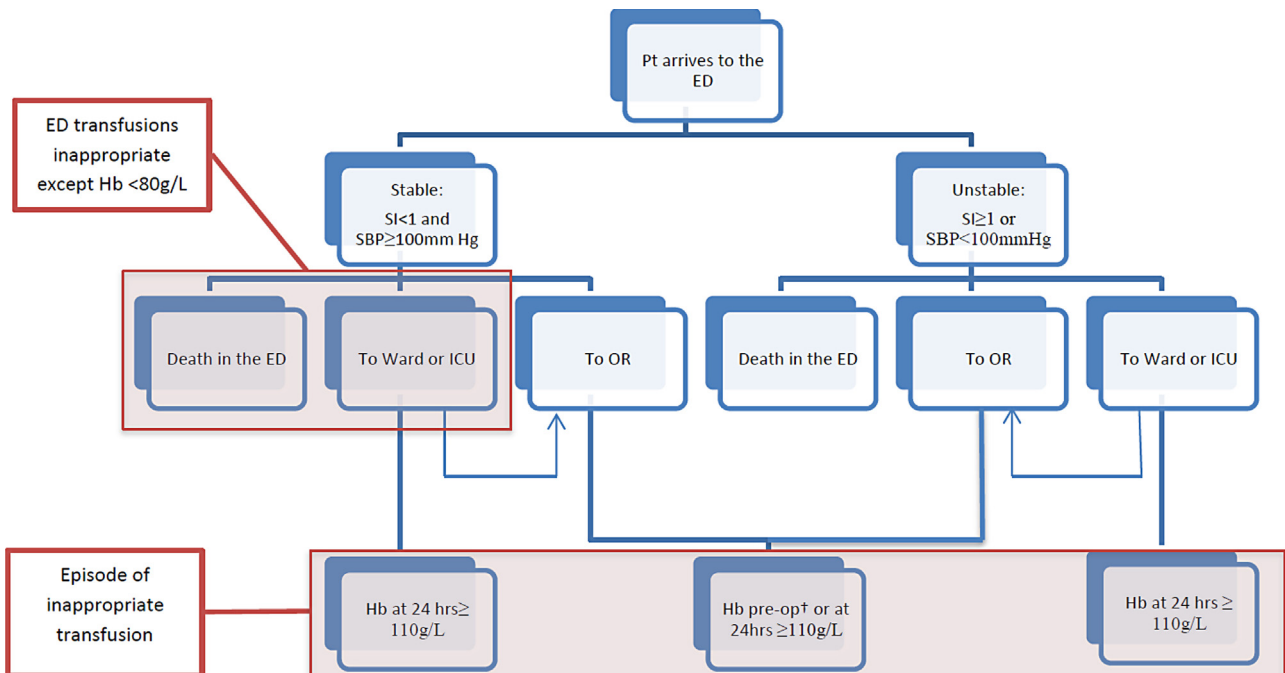
*PAT*

To identify cases that received PAT, patients had to meet one of the following criteria as illustrated in Fig. 1.

Patients transferred to the angiography suite for embolization were considered to have been transferred to the OR. For haemodynamically stable patients, the criteria were based on the restrictive transfusion threshold of 70 g/L recommended for critically ill patients [13]. An allowance of an additional 10 g/L was made as results of blood tests may not always have been available at the time of decision to transfuse. It was considered that transfusions among haemodynamically unstable patients or those requiring urgent surgery was reasonable regardless of the initial haemoglobin level. Among patients transfused, red blood cell administration during trauma resuscitation was titrated to physiological endpoints and a further allowance of 5–10 g/L was made over the usual target haemoglobin level of 100–105 g/L [14].

*Analysis*

All analyses were performed using Intercooled Stata version 11.2 (StataCorp, College Station, Texas). Normally distributed data are presented as mean (SD) and significance for differences calculated using the Student's *t*-test. Non-normal data are



**Fig. 1.** Criteria for determining potentially avoidable transfusions.

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