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The effectiveness of a 'Code Red' transfusion request policy initiated by pre-hospital physicians

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ABSTRACT

Background: Major trauma is a leading cause of mortality and serious morbidity. Recent approaches to life-threatening traumatic haemorrhage have emphasized the importance of early blood product transfusion. We have implemented a pre-hospital transfusion request policy where a pre-hospital physician can request the presence of a major transfusion pack on arrival at the destination trauma centre.
Objectives: This study was performed to establish whether three simple criteria (1) suspicion or evidence of active haemorrhage (2) systolic BP <90 mmHg (3) failure of blood pressure to respond to an intravenous fluid bolus) which were used to activate a pre-hospital 'Code Red' transfusion request accurately identified seriously injured patients who required transfusion on arrival at hospital.
Methods: Prospective evaluation of all pre-hospital 'Code Red' requests over a 30-month period (August 2008–May 2011) was performed for patients transported to a major trauma centre. Mechanism of injury, Injury Severity Score, hospital mortality, and use of blood products were recorded. Patients were followed up to hospital discharge.
Results: 176 'Code Red' activations were made in the study period. 129 patients were transported to the Trauma Centre. Mechanism of injury was penetrating trauma in 39 (30%) cases, road traffic collision in 58 (45%), falls in 18 (14%) and 'other' in 14 (10.8%). Complete data was available for 126 patients. Of the patients reaching hospital, 20 died in the emergency department or operating theatre, 22 died following admission and 84 survived to hospital discharge. Mean Injury Severity Score (ISS) was 29.1. (range 0–66). Overall, 115 (91%) of the patients declared 'Code Red' pre-hospital received blood product transfusion after arrival in hospital. Eleven patients did not receive any blood products following hospital admission. In patients declared 'Code Red' pre-hospital, mean packed red blood cell transfusion in the first 24-h was 10.4 unit (95% CI 8.4–12.3 unit).
Conclusions: The use of simple pre-hospital criteria allowed physicians to successfully identify trauma patients with severe injury and a requirement for blood product transfusion. This allowed blood products to be ready on the patient's arrival in a major trauma centre with the potential for earlier transfusion.

Introduction

Major trauma is a leading cause of mortality and morbidity [1,2] and, worldwide, over two million deaths annually are attributed to it. Major haemorrhage is thought to be a significant factor in trauma mortality with over 40% of trauma deaths having major haemorrhage as the primary cause of death [3]. Previous studies have reported that haemorrhage and haemorrhagic shock account for 30–40% of trauma deaths and of these, 33–56% occur in the pre-hospital phase [4,5].

Acute Traumatic Coagulopathy (ATC) is triggered by tissue damage [6,7]. It has a high mortality and early identification with aggressive intervention is required to limit progression. ATC has

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been shown to be present in 25% of trauma patients on arrival at hospital, and is associated with a four-fold increase in mortality. This highlights the importance of rapid identification of this group of patients [6–10]. The recognition of major haemorrhage in the pre-hospital setting and early activation of major haemorrhage protocols has the potential (with early surgical intervention) to reduce the time to blood product administration and potentially limit the progression of ATC.

The concept of early blood transfusion [11] and massive transfusion (historically often defined as transfusion with 10 unit of red cells within 24 h) is well established in the treatment of major traumatic haemorrhage and ATC [12–14]. New resuscitation protocols aim to limit ATC by early infusion of appropriate quantities and ratio of packed red blood cells, coagulation factors (usually in the form of fresh frozen plasma, FFP) and platelets. In patients with life threatening haemorrhage, rapid delivery of MT protocols using increased transfusion (FFP:RBC) ratios has been reported to reduce organ failure and improve patient outcomes [15]. Early use of FFP and platelets has been reported to improve survival and decrease the incidence of multi organ failure [16,17]). FFP needs to be thawed prior to administration and advance warning of the need for FFP as part of an MT protocol may reduce time to administration.

Early identification of those likely to require MT is an important component of trauma resuscitation. A pre-defined MT protocol designed to avoid delays in the preparation and delivery of blood products will help to facilitate early, rapid transfusion for major trauma patients. Ideally, patients who may require MT should be identified during the pre-hospital phase. An accurate pre-alert to the hospital prior to the patients arrival can allow the preparation and immediate availability of blood products after arrival at the emergency department.

Various prediction models have been developed in both civilian [18] and military [19,20] populations to identify patients with life-threatening haemorrhage. Prediction models aim to identify triggers that can be used in the activation of MT protocols. Triggers previously explored have included mechanism of injury, heart rate, systolic blood pressure, base deficit, INR, haemoglobin on arrival and ultrasonography [5,21]. MT protocol triggers are frequently based on retrospective, in-hospital data with few studies examining early activation from the pre-hospital setting.

Use of blood products in MT is resource intensive. Despite clinical benefits of early blood product transfusion in major trauma, challenges regarding early use of MT protocols remain. These include the time delay of blood typing, the thawing of type-specific FFP, logistical challenges of delivering blood products from a remote blood bank, all of which can incur detrimental time delays. Blood products are a costly and scarce resource and is imperative that wastage is kept to a minimum. Accurate early identification of trauma patients likely to require MT is required to prevent overuse of MT protocols and wastage of blood products [21–23].

This study was conducted to establish whether three simple criteria; suspicion or evidence of active haemorrhage (from clinical examination and findings alone), systolic BP <90 mmHg, failure to respond to an intravenous fluid bolus, could be used to activate a 'Code Red' (pre-hospital request for the hospital to activate a massive transfusion protocol) and accurately identify seriously injured patients requiring massive transfusion on arrival at hospital.

This study was based in an urban pre-hospital physician-led service which delivers a dedicated pre-hospital response to victims of major trauma within an area of approximately 5000 km^2 with a population of up to 10 million. The physician/paramedic team undertake approximately 2000 missions per year and operate 24-h a day using a helicopter and rapid response cars. A major transfusion protocol (''Code Red'') can be activated from the scene to alert the receiving hospital in cases of suspected major haemorrhage.

Methods

Study design

Data was collected as a prospective, single centre, cohort study. The study ran for a 30-month period (August 2008–May 2011). We prospectively collated data on all patients declared ''Code Red'' by the LAA pre-hospital team. No changes of practice or additional interventions were carried out on study patients. The project was therefore approved as a service evaluation by the hospital research and development department.

Setting and study population

The receiving hospital is a designated major trauma centre, with approximately 1400 trauma team activations annually. Of these, approximately 25% have an Injury Severity Score (ISS) of >15.

All trauma patients transported to the MTC who had the ''Code Red'' protocol activated by the pre-hospital team were included in the study. It was not possible to follow up patients transported to other hospitals.

The inclusion criteria used to activate ''Code Red'' from the scene were patients displaying all of the following:

(1) Suspicion or evidence of active haemorrhage,
(2) systolic BP <90 mmHg,
(3) failure to respond to a fluid bolus.

Data collection

Data was entered onto the pre-hospital trauma registry and the hospital trauma registry. Age, sex, mechanism of injury, pre-hospital physiology and quantity of blood products transfused in the first 24-h post hospital admission were recorded. Injury Severity Score (ISS) was calculated. Patients were followed up to the point of death or discharge from the hospital.

Results

Patients

During the study period there were 176 'Code Red' activations. 129 patients were transported to the MTC, Age (years) ranged from 14 to 88 with a mean of 35 years. Mechanism of injury was penetrating trauma in 39 (30%) cases, road traffic collision in 58 (45%), falls in 18 (14%) and 'other' in 14 (10.8%). with complete hospital data available on 126 (97.7%) patients. 99 (77%) patients were male. Of those patients reaching hospital, 20 (16%) died in the Emergency Department or operating theatre, 22 (17.4%) died following admission and 84 (66.6%) survived to hospital discharge. Mean Injury Severity Score (ISS) was 29.1 (range 0–66). (Fig. 1).

Physiology

In five cases the patient was in cardiac arrest on arrival at hospital. All received blood products, 3 died in the ED/OR and two died following hospital admission to intensive care.

NIBP on arrival was unrecordable in 31 cases. Of the remainder, mean systolic NIBP was 99.2 mmHg (95% CI 92.9–105.1) on ED arrival. Mean heart rate on ED arrival was 112 bpm (95% CI 117–107). Mean first haemoglobin was 11.6 g/dl,(95% CI 11–12.3).