Injury, Int. J. Care Injured xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Experience of implementing a National pre-hospital Code Red bleeding protocol in Scotland

Matthew J. Reed[a,b,c,*], Alison Glover[b,d], Lauren Byrne[c], Michael Donald[e,f], Niall McMahon[f,g], Neil Hughes[f,h], Nicola K. Littlewood[f,i], Justin Garrett[e], Catherine Innes[j], Margaret McGarvey[k], Eleanor Hazra[l], P. Sam M. Rawlinson[1,d,l], on behalf of the Scottish Transfusion and Laboratory Support in Trauma Group (TLSTG)

[a] Department of Emergency Medicine, Royal Infirmary of Edinburgh, NHS Lothian, 51 Little France Crescent, Edinburgh EH16 4SA, UK
[b] Emergency Medicine Research Group Edinburgh (EMERGE), Royal Infirmary of Edinburgh, 51 Little France Crescent, Edinburgh EH16 4SA, UK
[c] College of Medicine and Veterinary Medicine, University of Edinburgh, The Chancellor's Building, 49 Little France Crescent, Edinburgh EH16 4SB, UK
[d] Scottish National Blood Transfusion Service, 21 Ellen's Glen Rd, Edinburgh EH17 7QT, UK
[e] Department of Emergency Medicine, Ninewells Hospital, Dundee DD2 1UB, UK
[f] EMRS, Emergency Medical Retrieval Service, ScotSTAR, Hangar B, 180 Abbotsinch Road, Paisley PA3 2RY, UK
[g] Department of Emergency Medicine, Royal Alexandra Hospital, NHS Greater Glasgow and Clyde, Corsebar Rd, Paisley PA2 9PN, UK
[h] Department of Emergency Medicine, Monklands Hospital, NHS Lanarkshire, Monkscourt Ave, Airdrie ML6 0JS, UK
[i] Department of Emergency Medicine, Queen Elizabeth University Hospital, NHS Greater Glasgow and Clyde, 1345 Govan Rd, Glasgow G51 4TF, UK
[j] Department of Transfusion Medicine, Royal Infirmary of Edinburgh, NHS Lothian, 51 Little France Crescent, Edinburgh EH16 4SA, UK
[k] Department of Transfusion Medicine, Queen Elizabeth University Hospital, NHS Greater Glasgow and Clyde, 1345 Govan Rd, Glasgow G51 4TF, UK
[l] Department of Transfusion Medicine, Ninewells Hospital, Dundee DD2 1UB, UK

ARTICLE INFO

Article history:
Accepted 9 September 2016

Keywords:
Massive transfusion
Trauma
Haemorrhage
Pre-hospital care

ABSTRACT

Introduction: The Scottish Transfusion and Laboratory Support in Trauma Group (TLSTG) have introduced a unified National pre-hospital Code Red protocol. This paper reports the results of a study aiming to establish whether current pre-hospital Code Red activation criteria for trauma patients successfully predict need for in hospital transfusion or haemorrhagic death, the current admission coagulation profile and Concentrated Red Cell (CRC): Fresh Frozen Plasma (FFP) ratio being used, and whether use of the protocol leads to increased blood component discards?

Methods: Prospective cohort study. Clinical and transfusion leads for each of Scotland's pre-hospital services and their receiving hospitals agreed to enter data into the study for all trauma patients for whom a pre-hospital Code Red was activated. Outcome data collected included survival 24 h after Code Red activation, survival to hospital discharge, death in the Emergency Department and death in hospital.

Results: Between June 1 st 2013 and October 31 st 2015 there were 53 pre-hospital Code Red activations. Median Injury Severity Score (ISS) was 24 (IQR 14–37) and mortality 38%. 16 patients received pre-hospital blood. The pre-hospital Code Red protocol was sensitive for predicting transfusion or haemorrhagic death (89%). Sensitivity, specificity, positive and negative predictive values of the pre-hospital SBP <90 mmHg component were 63%, 33%, 86% and 12%. 19% had an admission prothrombin time >14 s and 27% had a fibrinogen <1.5 g/L. CRC: FFP ratios did not drop to below 2:1 until 150 min after arrival in the ED. 16 red cell units, 33 FFP and 6 platelets were discarded. This was not significantly increased compared to historical data.

Conclusions: A National pre-hospital Code Red protocol is sensitive for predicting transfusion requirement in bleeding trauma patients and does not lead to increased blood component discards. A significant number of patients are coagulopathic and there is a need to improve CRC: FFP ratios and time to transfusion support especially FFP provision. Training clinicians to activate pre-hospital Code Red earlier during the pre-hospital phase may give blood bank more time to thaw and prepare FFP and may improve FFP administration times and ratios so long as components are used upon their availability.

* Corresponding author at: Emergency Medicine Research Group Edinburgh (EMERGE), Royal Infirmary of Edinburgh, 51Little France Crescent, Edinburgh EH16 4SA, UK.
E-mail addresses: mattreed1@hotmail.com, matthew.reed@nhslothian.scot.nhs.uk (M.J. Reed).

[1] Deceased 13 March 2016.

http://dx.doi.org/10.1016/j.injury.2016.09.020
0020-1383/

Introduction

Despite improvements in trauma care over the last 20 years major haemorrhage is still a significant cause of death in trauma patients, with up to 40% dying of acute haemorrhage [1]. The Scottish Transfusion and Laboratory Support in Trauma Group (TLSTG) were therefore established in March 2014 to provide a forum focused upon optimising the transfusion support given to patients following major trauma in Scotland. Over the last couple of years, three of Scotland's four pre-hospital services, Emergency Medical Retrieval Service (EMRS) based in the West of Scotland, Tayside Trauma Team (TTT) based in the East and Medic 1 based in the South East, have worked together through the TLSTG to introduce a unified national pre-hospital Code Red protocol. This is activated prior to a patient with major or massive haemorrhage arriving in the Emergency Department (ED), allowing time for blood components such as Fresh Frozen Plasma (FFP) to be thawed.

It is recognised that it is difficult in the pre-hospital setting to accurately predict trauma patients who are at risk of massive haemorrhage. These patients are at risk of Acute Traumatic Coagulopthy (ATC) and require treatment with appropriate blood components as early as possible. It is therefore important that any criteria selected to identify these patients is accurate and able to identify those most at risk of developing coagulopathy to enable early treatment. Blood components are equally a precious commodity and care must be taken not to waste them.

The aims of this study are:

(1) To establish whether current pre-hospital Code Red activation criteria successfully predict need for in hospital transfusion or haemorrhagic death?
(2) To establish what is the current admission coagulation profile of pre-hospital Code Red trauma patients in Scotland and whether they are receiving appropriate treatment of any coagulation derangement?
(3) To establish the current Concentrated Red Cell (CRC): Fresh Frozen Plasma (FFP) ratio being used in pre-hospital Code Red trauma patients in Scotland?
(4) To see whether use of a pre-hospital Code Red protocol leads to increased FFP and CRC discards?

Patients and methods

Patients likely to require Massive Transfusion (MT; defined here as 10 or more CRCs in 24 h) with life threatening haemorrhage can be difficult to diagnose and there is no reliable pre defined criteria that can be used to identify them. As a guide and based on other pre hospital services' practice [2] it was decided that the pre-hospital physician should be asked to consider the following factors in order to decide whether to activate the National pre-hospital Code Red protocol:

1. Suspected or confirmed bleeding
2. Systolic blood pressure <90 mmHg in an adult patient
3. Patient unresponsive to fluid boluses.

On receiving a standby call from the pre-hospital team, the ED Nurse in Charge (NiC) first checks that there is O Rhesus D negative CRCs in the ED satellite fridge (usually 4 units). The NiC then phones the hospital blood bank emergency line stating that a pre-hospital Code Red patient is arriving in the ED and gives brief clinical information and estimated time of arrival. The hospital blood bank then prepares 4 further units of O Rhesus D negative CRCs, one unit (or adult therapeutic dose) of platelets (Group A preferred or Non High Titre A/B Group O) and immediately thaws 4 units of frozen AB FFP, which a dedicated emergency porter can take to the ED once released from the hospital blood bank. During the study, fixed ratio packs were not available and further blood components were then requested at the discretion of the ED team leader. The same National pre-hospital Code Red protocol and Code Red activation criteria were used in all regions. ED and in-hospital transfusion protocols differ slightly between regions.

TTT were first to introduce a pre-hospital Code Red policy in January 2012, EMRS followed soon after in June 2013 and Medic 1 has used the now unified national pre-hospital Code Red protocol since April 2014. Data was reported for each region only after the instigation of the National pre-hospital Code Red protocol at each centre. Massive Transfusion was defined as transfusion with 10 units of CRCs within 24 h as it has been defined historically and in previous similar studies [2,3].

TTT has had pre-hospital CRC transfusion capability for several years, EMRS introduced pre-hospital CRC transfusion in June 2014 and Medic 1 had not introduced pre-hospital CRC transfusion during the time of this study. It was launched in December 2015.

A clinical and transfusion lead was identified for each centre. A standardised Case Report Form (CRF) was then designed and agreed by the TLSTG [see Supplementary Fig. S1 in the online version at DOI: http://dx.doi.org/10.1016/j.injury.2016.09.020]. Page one of the CRF contained patient information and a unique National Code Red number, which was retained in each local hospital. Pages 2–4 of the CRF contained anonymised data. These pages, once completed at the local hospital were sent to Edinburgh who coordinated the study, to enter onto a secure electronic database. Each of Scotland's pre-hospital services who take patients to hospitals where the pre-hospital Code Red Policy is in place, and the receiving hospitals, agreed to enter data into the National pre-hospital Code Red study for all trauma patients for whom a pre-hospital Code Red was activated.

The study was deemed a service evaluation by the South East Scotland Research Ethics committee (Ref: NR/1408AB11) and therefore did not require full ethics submission. The study was also registered with each hospital's clinical effectiveness/governance teams where available, and a favorable Caldicott opinion was obtained. Funding of £500 was provided by the Scottish National Blood Transfusion Service (SNBTS) to use an online accessed secure database (REDCAP; http://www.project-redcap.org) the server of which is held within the University of Edinburgh, for anonymised data entry [4,5]. This database was maintained by two of the study team (MR/AG).

Data was imported into Microsoft Excel (Microsoft Corporation, US) and GraphPad Prism (GraphPad Software, US) for analysis. Statistical tests were performed where appropriate. D'Agostino-Pearson normality tests were performed on all data and significance was accepted at the 5% level. To assess CRC: FFP ratios, the mean cumulative ratio of blood components transfused was calculated at 30 min intervals from arrival to the ED. As no FFP was administered prior to 30 min, it was not possible to establish a ratio on arrival at the ED (0 min). CRC units transfused in the pre-hospital setting were included after this time point. Low haemoglobin was defined as <120 g/L in females and <135 g/L in males.

Results

During the 30-month study period between June 1 st 2013 and October 31 st 2015 there were 53 pre-hospital Code Red activations for trauma. 23 activations were to Royal Infirmary Edinburgh (South-East), 18 to Queen Elizabeth University Hospital (West), 10 to Ninewells Hospital (East), 1 to Victoria Infirmary (West) and 1 to Glasgow Royal Infirmary (West).

Please cite this article in press as: M.J. Reed, et al., Experience of implementing a National pre-hospital Code Red bleeding protocol in Scotland, Injury (2016), http://dx.doi.org/10.1016/j.injury.2016.09.020