SIGNA VITAE 2014; 9 (Suppl 1): 21 - 24

Transfusion in polytraumatised patients

DANIELA BANDIĆ PAVLOVIĆ • SANJA SAKAN • DINKO TONKOVIĆ • IGOR VIRAG • ROBERT BARONICA • ŽELJKO DRVAR • ŽELJKA MARTINOVIĆ • MLADEN PERIĆ

DANIELA BANDIĆ PAVLOVIĆ (✉) •
SANJA SAKAN •
IGOR VIRAG •
ROBERT BARONICA •
ŽELJKO DRVAR •
MLADEN PERIĆ
Department of Anesthesiology
and Intensive Care Unit
University Hospital Centre Zagreb
Zagreb, Croatia
Phone/Fax: 0038598515058
E-mail: dani.bandic@gmail.com

DINKO TONKOVIĆ
Department of Anaesthesiology and Intensive
Care Unit, University Hospital „Sveti Duh"
Zagreb, Croatia

ŽELJKA MARTINOVIĆ
Ministry of Labour and Pension System,
Zagreb, Croatia

ABSTRACT

Background and Aim. Recent evidence indicates that surgical bleeding due to injured vessels and traumatic coagulopathy are the main reasons of uncontrolled haemorrhage in polytraumatized patients in the first 24 hours. The cornerstone of the treatment is adequate empiric early transfusion. The aim of our study was to survey the early transfusion in patients with major trauma and define the ratio of applied transfusion component in our hospital.

Patients and Methods: Patients with major trauma for a one year period, admitted to the Emergency Department of the Clinical Hospital Centre, Zagreb, were enrolled in our retrospective study. The following data were collected: age, sex, mechanism of injury, initial shock index (SI), initial Glasgow Coma Score (GCS), Injury severity score (ISS), and initial hemoglobin (Hb) and prothrombin time (PT). Intra-operative transfusion and transfusion within the first 24 hours of injury, Intensive care unit (ICU) stay and clinical outcome were assessed.

Results. 16 patients with major trauma were admitted. Eight patients received transfusions. Two patients received a massive transfusion. The transfusion ratio of Fresh frozen plasma (FFP) : Packed red blood cells (PRBC) : Platelets (PLT) during major trauma resuscitation was 1:1,5:1 in our study. One of the 16 patients died.

Conclusion. Early and aggressive resuscitation with transfusion blood products in major trauma patients within the first 24 hours with the FFP:PRBC:PLT ratio 1:1:1 is the key for prevention of trauma induced coagulopathy and its lethal consequences. Massive transfusion protocol for major trauma patients should be implemented in everyday practice.

Key words: abbreviated injury scales, blood component transfusion, injuries, polytrauma

Introduction

Polytrauma is a significant cause of death due to severe haemorrhage in approximately 30% to 40% of all civilian trauma deaths. (1,2) Therefore, rapid control of bleeding in these patients is essential. Massive uncontrolled hemorrhage in polytrauma patients in the first 24 hours is a combination of surgical bleeding due to injured vessels and coagulopathic bleeding. (3,4) The cause of trauma-induced coagulopathy is complex and multi-factorial, is directly associated with the severity of the injury, and its presence is an independent predictor of the early 24-hour mortality. (4) Thereby, immediate recognition of a patient at risk, together with early and aggressive damage control resuscitation in the first hours after the injury, is the relevant key for preventing trauma induced coagulopathy. Haemostatic resuscitation is one of the three damage control resuscitation components with the greatest impact on the survival of polytrauma patients. It consists of

early use of blood transfusion products in a regimen which consists of fresh frozen plasma (FFP), packed red blood cells (PRBC) and platelets (PLT) in a 1:1:1 ratio usually based on an empiric clinical decision. (5,6) We conducted a retrospective study for a twelve-- month period at the University Hospital Centre, Zagreb, to analyse the consumption of the transfusion blood products in major trauma patients with an Injury Severity Score (ISS) greater than 15. The ISS is an established medical score to assess trauma injury severity. (7,8) It correlates with morbidity, mortality and length of hospitalisation after trauma injury. It defines major trauma or polytrauma as the ISS is greater than 15. (8) The primary outcome measure was the impact of early FFP, PRBC and PLT transfusion ratio on mortality.

Matherials and methods

We conducted a retrospective study which included patients with major trauma in the period from August 2012 to August 2013 who were admitted to the Emergency Department of the University Hospital Centre, Zagreb. Patients with isolated neurotrauma injury were excluded from the study as were patients younger than 18 years. The following patient's characteristics were included in the study: age, sex, mechanism of injury, initial shock index (SI), initial Glasgow Coma Score (GCS), ISS, and initial haemoglobin (Hb) and prothrombin time (PT) values measured at the Emergency Department. Shock index is defined as heart rate and systolic blood pressure ratio, which is a sensitive indicator of occult haemorrhage, especially in trauma and acute haemorrhage patients. Normally, shock index is approximately 0.5, but in the state of shock, SI value is greater than 1 due to rising heart rate and falling blood pressure. GCS analyses the best eye, verbal and motor responses.

Results

Our study included 16 patients (table 1). The median patient's age was 43 years (ranged from 18-67 years), 10 were males and six were females. The mechanism of injury was the consequence of traffic accidents in nine patients, train accidents in four patients, a fall from height in one patient, a suicide attempt in one patient, and a gunshot wound in one patient. Seven patients in our study were shocked and had SI value >1, however nine patients had SI value <=1. Initial GCS showed minor brain injury (GCS >=13) in 11 patients, moderate brain injury (GCS 9-12) in three patients, and severe brain injury (GCS <=8) in two patients. Fifteen patients had the ISS >15 and were classified as polytrauma, and one patient had the ISS <=15. The median of initially measured Hb value in the Emergency Department was 132 g/L (ranged from 104-149 g/L). All 16 patients had PT values >0.50, which were initially measured at the Emergency Department. Fifteen patients were classified according to the ISS greater than 15 as major trauma patients, which points towards a great incidence of severely injured patients in our emergency department. None of the major trauma patients were reanimated due to cardiac arrest for the period from hospital admission to the intensive care unit arrival. Damage control surgery was carried out in 14 patients and included the following procedures: laparotomy with splenectomy in four patients, laparotomy with vascular injury repair in two patients, amputations of lower extremity in two patients, osteosynthesis owing to bone fractures in five patients, thoracodrainage due to pneumo- or haemo-thorax or both in two patients, and wound management in three patients. Damage control surgery was done in general endotracheal anaesthesia in 14 patients, in spinal anesthesia in one patient, and in monitoring anesthesia care in one patient. Our results demonstrated that neither of the patients received transfusions in the emergency department. Blood derivates transfusions in our patients are shown in Table 2. Intra-operative transfusions and transfusions within the first 24 hours of injury were applied in 50% of the patients. It is important to emphasise that all transfused patients had normal initially measured values of Hb.

Table 1. Patients characteristics

Number of patients	16
Age, years median (range)	43 (18-67)
Sex	
Male, n	10
Female, n	6
Mechanism of injury	
traffic accident	9
train accident	4
fall from height	1
suicide attempt	1
gunshot wound	1
Shock index, f/sBP	
<=1	9
>1	7
Hg (g/l) in the Emergency department, median (range)	132, 104-149
PT in the Emergency department	
>0.50	16
<0.50	0
GCS	
14-15	11
9-13	3
<=8	2
ISS, median (range)	50 (11-75)
>15	15
<=15	1

BP, blood pressure; GCS, Glasgow Coma Score; Hg, haemoglobin; ISS, injury severity score
PT, prothrombin time

According to the results, eight patients received PRBC transfusions - median was 560 ml (ranged from 230-3310 ml), three patients received FFP - median was 1220 ml (ranged from 100-1500 ml), two patients received eight doses of PLT, and one patient was applied one gram of cryoprecipitate. Volume therapy with crystalloids was practiced in all 16 trauma injury patients with 2 L on average (ranged from 1.5 -4.2 L), which is in accordance with resuscitation guidelines. Colloids including 6% Hydroxyethyl starch isotonic sodium chloride solution (6% HES) were applied as initial resuscitation volume therapy in nine patients ranged from 0.5-1 L. One patient received PRBC and FFP. Only two patients received a massive transfusion defined as requiring >= 10 units of

Table 2. Transfusion resuscitation

	Operating room	ICU	TOTAL
PRBC n, median, range	6/16 560, 250-3080	5/16 520, 230-3310	8/16 560, 230-3310
FFP n, median, range	2/16 1000 i 1220	1/16 1500	3/16 1220,1000-1500
PLT, n, (number of doses)	1/16, 8 doses	1/16, 8 doses	2/16, 8 doses
Cryoprecipitate	1/16	0	1/16
FFP:PRBC			1:1.5
PRBC:PLT			1.5:1

FFP, fresh frozen plasma; ICU, Intensive care unit; PLT, platelets; PRBC, packed red blood cells

PRBC within the first 24 hours after injury or >4 units of PRBC in the first hour post-injury. (9-15) They received PRBC, FFP and PLT with the transfusion ratio of FFP:PRBC:PLT=1:1.5:1. The median ICU stay was four days. Early mortality in our study was low. One patient of the 16 patients died several hours after the operation.

Discussion

Trauma-induced coagulopathy due to massive bleeding in polytrauma patients is a reversible condition only if the patient at risk is identified early and damage control resuscitation measures are applied on time. (11-15) The problem is not the patients who arrive at the hospital in a state of profound haemorrhagic shock, but those who are stable and in the phase of compensated haemorrhagic shock and are difficult to identify on time. If not treated, trauma-induced coagulopathy leads to further bleeding and state of shock with a consequence of tissue hypoperfusion and decreased tissue oxygen delivery, together with reduced heat generation and emergence of clinically significant hypothermia. (6) Moreover, due to prolonged hypoperfusion anaerobic cell metabolism begins and metabolic acidosis with lactate genesis develops. (6) Thereby, a vicious circle of lethal triad in major trauma patients consists of acidosis, hypothermia and coagulopathy. (3,6) In the management of these patients it is relevant to act on every element of this circle to prevent further bleeding, but the coagulopathy represents the central role in survival benefit. (4,6) Haemostatic resuscitation could be the central component of damage control resuscitation. According to the studies, the transfusion ratio of FFP:PRBC which indicates survival benefit in polytrauma patients varies from 1:1 to 1:3. (16) However, many military and civilian major trauma studies demonstrated that a 1:1:1 transfusion ratio of FFP:PRBC: PLT is satisfying and is connected with stopping trauma-induced coagulopathy, increasing clot formation, and the best outcome for the patient. (10,11,14,17-22) In our study we also used these recommended transfusion ratios of blood products early during the first 6 hours post-injury. Consequently, we had low early mortality. One patient of the total 16 patients died. In our study, permissive hypotension and haemodilution with crystalloids and colloids was applied as the second component of damage control resuscitation according to the resuscitation guidelines. (6) This strategy of restricting fluid resuscitation shows that intravascular volume restoration is not the only goal of volume therapy, but the goal is also to decrease bleeding and to prevent the development of pathophysiological effects of haemorrhage by maintaining the systolic blood pressure form 80-90 mmHg, or 100 mmHg in those with traumatic brain injury, until the bleeding is under control. (6,23) Damage control surgery as the third component of damage control resuscitation was done in 14 patients in our study. Also, general endotracheal anaesthesia for damage control surgery is usually the recommended technique for these patients, but sometimes other anaesthesia techniques can be used depending on the patient's characteristics and injury severity.

Likewise, our study showed that all transfusions were done in the intra-operative phase, which indicates that major trauma patient care in the emergency department of our hospital and in the operative theatre benefit from good and close communication and cooperation between all parts of the trauma team. However, because the decision regarding transfusions in these patients is usually made empirically by a clinician, and routine laboratory tests are not specific and sensitive enough (and often their results are delayed), a massive transfusion protocol for major trauma patients in our hospital should be implemented in everyday practice. A massive transfusion protocol would improve interdepartmental communication, patient outcome, and the availability of blood products and delays in obtaining those (11). Likewise, implementation of thrombelastography as a rapid functional assay which gives us detailed information about clot formation is a good, quick, practical and real time diagnostic test. (23,24) The data can be used to inform the clinician about the blood products required in the management of life-threatening coagulopathy - PLT, cryoprecipitate, plasma, desmopressin, aminocaproic acid or specific clotting factors. (23) The use of thrombelastography can decrease the amount of transfusion and improve the outcome in major trauma patients. (23,25)

Conclusion

Early and aggressive resuscitation with transfusion blood products in

major trauma patients within the first 24 hours with the FFP: PRBC:PLT ratio 1:1:1 is key for the prevention of trauma-induced coagulopathy and its lethal consequences. Instead of particular Hb and hematocrit target values, resuscitation with the goal of achieving haemodynamic stability is recommended (11). In addition, a massive transfusion protocol for polytrauma patients alleviates care of polytrauma patients.

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