Injury, Int. J. Care Injured 46 (2015) 1779–1783

Contents lists available at ScienceDirect

Injury

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

Admission fibrinogen levels in severe trauma patients: A comparison of elderly and younger patients

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ARTICLE INFO

Article history:
Accepted 2 April 2015

Keywords:
Acute coagulopathy of trauma
Elderly patient
Fibrinogen
Haemorrhage
Severe trauma

ABSTRACT

Introduction: Acute coagulopathy of trauma has been much discussed recently. However, the changes in coagulation markers after trauma in the elderly are unknown. Furthermore, the baseline fibrinogen level is high in elderly patients, and the question remains as to whether fibrinogen levels also decrease early and the degree of decrease in elderly trauma patients. The purpose of this study was to compare coagulation markers including the fibrinogen level on admission in younger and elderly severe trauma patients.
Methods: A cohort of severe trauma patients (Injury Severity Score (ISS) ≥16), admitted from January 2011 to June 2014, with coagulation markers including the fibrinogen level on admission available, was reviewed retrospectively. The patients were divided into a younger (16–64 years old) and an older (≥65 years old) group based upon their age at presentation. Activated partial thromboplastin time (aPTT), international normalized ratio (INR), fibrinogen, and D-dimer were compared between the younger and older groups.
Results: There were 251 patients who met the inclusion criteria for this analysis. The younger group included 117 patients and the older group included 134 patients. The median aPTT (26.3 vs 27.5 s, $P = 0.001$) and median D-dimer levels (18.8 vs 40.2 μg/dL, $P = 0.006$) were significantly higher in the older group. However, the fibrinogen level (205 vs 248 mg/dL, $P < 0.001$) was significantly higher in the older group. The regression lines of fibrinogen and age in non-massive transfusion and massive transfusion cases are given by $Y = 1.03X + 185$ ($r = 0.24$, $r^2 = 0.06$, $P < 0.001$) and $Y = 0.86X + 134$ ($r = 0.25$, $r^2 = 0.06$, $P = 0.09$) respectively, and the fibrinogen levels tended to increase with older age in severe trauma patients.
Conclusions: The fibrinogen level did not show a low value as it can in younger patients in elderly patients. Therefore, the fibrinogen level is difficult to use as an early indicator of acute blood loss with haemorrhage in elderly severe trauma patients, as it can be used in younger patients. Thus, it is necessary to keep in mind that the fibrinogen level increases by approximately 1 mg/dL when the age increases by 1 year and to carefully observe the fibrinogen level even if the admission level is not low.

Introduction

In recent years, life expectancy and the elderly population have been increasing in most developed countries [1]. Especially in Japan, 32.3% of the population was more than 60 years of age in 2010, and it is projected that it will reach 42.7% by 2050 [2]. The percentage of elderly persons accounting for trauma fatalities has also been increasing annually, and the percentage of fatalities occurring in elderly (≥65 years old) trauma victims from 2009 to 2013 reached 50.1% [3]. As a result, the number of elderly severe trauma patients is increasing in emergency departments. Elderly patients have been reported to have higher mortality caused by trauma due to physiological differences with younger patients, with a decline in baseline functions [4–7]. Therefore, early

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http://dx.doi.org/10.1016/j.injury.2015.04.007
0020–1383/

aggressive resuscitation and careful monitoring may be warranted in a large number of elderly severe trauma patients.

On the other hand, acute coagulopathy of trauma has been much discussed recently, and its definition by coagulation markers has been widely reported [8–16]. Recent studies have demonstrated that fibrinogen is decreased to a greater extent than other coagulation factors during major bleeding in trauma [17–19]. It has been widely reported that the fibrinogen level is associated with greater mortality and risk of massive transfusion, and a decrease in fibrinogen levels on admission has been attracting attention as an early predictor of prognosis [20–23]. Furthermore, an early observational study suggested that early administration of fibrinogen improved survival to hospital discharge in patients with severe traumatic injuries requiring massive transfusion [24]. Therefore, fibrinogen seems to be one of the most vulnerable coagulation factors, reaching a critically low threshold much earlier than any other coagulation protein.

However, the changes in coagulation markers after trauma in the elderly are unknown. Furthermore, the baseline fibrinogen level is high in elderly patients [25,26], and whether fibrinogen levels also decrease early and the degree of decrease in elderly trauma patients remain unclear. However, the coagulopathy changes after trauma in the elderly are unknown. The purpose of this study was to compare coagulation markers including the fibrinogen level on admission in younger and elderly severe trauma patients.

Materials and methods

General information

Kochi Health Sciences Centre, Kochi, Japan, is a 649-bed acute care hospital that sees more than 3000 trauma patients annually, most of which are blunt trauma cases. There are 20 intensive care unit beds, and approximately 200 trauma patients are admitted to this intensive care unit annually. The emergency medical system is mostly ground-based, though air transportation via helicopter is available. The rate of trauma patients (Injury Severity Score (ISS) $\geq$9) with helicopter transportation is approximately 32%. Elderly trauma patients ($\geq$65 years old) account for approximately 61% of total admissions. Since 2007, a trauma registry (ISS $\geq$ 9) has been maintained and managed in a prospective fashion.

Patient selection

A cohort of severe trauma patients (ISS $\geq$ 16 and age $\geq$16 years), admitted to the Kochi Health Sciences Centre from January 2011 to June 2014, with coagulation markers including the fibrinogen level on admission available, was reviewed retrospectively. Exclusion criteria were: isolated head injury (in order to avoid the effect of coagulopathy due to head injury), transferal from other hospitals (in order to avoid the effect of resuscitation with fibrinogen-poor fluid), arrival in the emergency department more than 3 h following injury (in order to focus the investigation on the early period after injury), dead on arrival, and missing data including coagulation markers.

Data collection

Demographics and characteristics of patients evaluated included age, sex, pre-injury anticoagulants, mechanism of injury, time from injury to emergency room arrival, Abbreviated Injury Score (AIS) for each body region (head, face, chest, abdomen, spine, pelvic, extremity), ISS, Revised Trauma Score (RTS), probability of survival (Ps), massive transfusion requirements (10 or more red cell concentrate (RCC) units during the initial 24 h after admission to the hospital or early death due to massive bleeding), emergency procedures to stop the haemorrhage (thoracotomy, laparotomy, transcatheter arterial embolization, fracture fixation), and outcomes (mortality and mortality due to haemorrhage). Survival or death was assessed during a 28-day follow-up period.

Sampling and coagulation markers

The laboratory parameters of interest in this study activated partial thromboplastin time (aPTT), international normalized ratio (INR), fibrinogen, and D-dimer were documented at the time of admission in the electronic patient database of the hospital or in the patient charts. The blood samples were collected within 10 min of arrival in the emergency department. The patients were divided into a younger (16–64 years old) and an older ($\geq$65 years old) group based on their age at presentation. The blood samples were compared between the younger and older groups. Furthermore, correlations between age and fibrinogen level were examined in non-massive transfusion (non-MT) and massive transfusion (MT) cases; the percentages of patients with low fibrinogen levels (<200 mg/dL) in non-MT and MT cases were compared between the younger and older groups.

Statistical analysis

All data are presented as medians (interquartile range (IQR)) for continuous variables and as numbers (percentages) for categorical variables. Comparisons of group differences for continuous variables were done by the Mann–Whitney *U*-test. Differences between categorical variables were evaluated by chi-squared test, chi-squared test with Yates' correction for continuity or by Fisher's exact test (double the one-tailed exact probability). The associations between age and fibrinogen were calculated by linear regression analysis and evaluated by Pearson's correlation coefficient. Values with correlation coefficients greater than 0.2 were considered candidates for model development. Differences between groups in proportions were compared by computing odds ratios (ORs) and 95% confidence intervals (CIs). A two-tailed p value of less than 0.05 was taken to indicate a significant difference. Statistical analysis was carried out using SPSS Statistics 19.

Results

Baseline characteristics

During the study period, 1294 patients were enrolled into a large observational trial over a three-year and six-month study period. Severe trauma (ISS $\geq$ 16) was seen in 609 patients (age $\geq$16 years), while 251 patients met the substudy inclusion criteria for this analysis. The younger group included 117 patients (47%), and the older group included 134 patients (53%) (Fig. 1). There were 27 patients (20%) in the older group on pre-injury anticoagulants. The mechanism of injury, time from injury to emergency room arrival, injury site (except abdomen and spine), ISS, and RTS were not significantly different between the groups. Ps was significantly lower in the older group because age strongly affects the Ps. The numbers of patients requiring MT, requiring emergency procedures, and dying due to haemorrhage were not significantly different between the groups (Table 1).

Comparisons of coagulation markers

aPTT and D-dimer levels were significantly higher in the older group (aPTT: P = 0.001, D-dimer: P = 0.006), and the older group was more likely to have abnormal levels than the younger group. INR was not significantly different between the groups (P = 0.19).