응급실에서 대량수혈을 받은 외상환자 분석

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Analysis of Trauma Patients with Massive Transfusion in the Emergency Department

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Background: It is important that proper protocols are in place for trauma patients who require massive transfusion upon arrival at the emergency department. This study is a preliminary analysis of massive transfusion cases at the emergency department of our institution aimed to review the characteristics and situations in which massive transfusion occurs in an effort to better manage trauma patients receiving massive transfusion in the emergency department.

Methods: This study was conducted at the Department of Emergency Medicine in the Korea University Guro Hospital. We retrospectively reviewed the medical charts of trauma-related patients who required massive blood transfusions between January 2013 and December 2015. The inclusion criteria were as follows: patients who were over the age of 18 years and received more than 4 packed RBC (pRBC) units per hour, or 10 or more pRBC units during a period of 24-hours.

Results: A total of 669 patients were included in the study. There were significant differences of initial systolic blood pressure ($P < 0.0001$), diastolic blood pressure ($P < 0.0001$), and Injury Severity Score ($P < 0.0001$) between those who survived and those who expired.

Conclusion: Proper initial resuscitation is essential for the improvement of outcome in trauma patients that require a massive transfusion. The findings from this study may serve as preliminary data in developing proper transfusion protocols for massive transfusion among trauma patients. (Korean J Blood Transfus 2016;27:130-136)

Key words: Blood transfusion, Transfusion reaction, Emergency medicine, Multiple trauma

Introduction

Trauma accounts for approximately 41 million

visitations to the emergency department (ED) and 3 million hospital admissions across the United States, annually. It is the leading cause of death for Ameri-

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cans between the ages of 1 and 44 years, and it is the third leading cause of death overall.¹⁾ In South Korea, the preventable trauma-related mortality rate in 2010 was estimated to be 35.2%, owing to the lack of a proper trauma system.²⁾ Devastating central nervous system injuries and massive exsanguination are the major causes of acute mortality in trauma patients. Many trauma patients who do not die immediately have enough blood loss to cause hypotension or hemorrhagic shock. However, with proper pre-hospital care and resuscitation, it is possible for these patients to survive long enough to arrive and be treated at trauma centers. It is important to recognize that proper organization—rapid assessment, triage, resuscitation, diagnosis, and therapeutic intervention—is necessary for efficient patient management.³⁾

Massive hemorrhage is not only the second most common cause of trauma-related deaths, but also contributes considerably to mortality associated with any kind of surgery.^{4,5)} In addition to bleeding control, massive blood transfusion is a critical part of treatment, and is defined as 4 packed red blood cell (pRBC) units per hour, or as 10 or more pRBC units during a period of 24 hours.⁶⁾ The number of trauma patients who require a transfusion is increasing yearly. Thus, a course of action is necessary to ensure that proper protocols are in place for trauma patients who require massive transfusion (MT) upon arrival at the ED. This study is a preliminary analysis of patients with MT at the ED of our institution over the course of 2 years. We reviewed the characteristics and situations in which MT takes place in an effort to better manage trauma patients who require MT in the ED.

Materials and Methods

This was a single-center, retrospective study based on a medical record review. It was conducted at the ED of a tertiary teaching hospital, which receives approximately 60,000 annual visits. It is a nationally-designated Level II trauma center. We reviewed the medical charts of trauma-related patients who required massive blood transfusions between January 2013 and December 2015.

Non-trauma patients—cases for which the etiology of the suspected hemorrhagic shock was uncertain—and patients who expired during transfusion were excluded. The inclusion criteria were as follows: 1) age over 18 years, 2) patients who received more than 4 pRBC units per hour or more than 10 pRBC units during a 24-hour period.

The general patient demographics and characteristics were reviewed. Standard deviation was calculated for the mean age, and ratios were derived for patient sex. Characteristics included the mean systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR). The means were calculated with 95% confidence intervals. The final status of patients (admission, expiry, or discharge) was also included.

In addition to the type and mechanism of injury, the injury severity score (ISS) was also calculated. ISS is an established medical score, which was used to assess trauma severity, and is correlated with mortality, morbidity, and hospitalization time after trauma. Moreover, it is also often used to define major trauma, which is defined as an ISS score greater than 15.⁷⁾

Patient characteristics were compared between

Table 1. General characteristics of the study group

Characteristics	Total (n=669)	Non-survivor (n=150)	Survivor (n=519)	P value
Mean age (years) (SD)	53.9	56.5	51.4	0.145
Male:female	2.9:1	2.7:1	2.9:1	0.994
Mean systolic blood pressure (mmHg)	73	65	92	<0.0001
Mean diastolic blood pressure (mmHg)	47	40	57	<0.0001
Mean heart rate	108	109	105	0.163
Mean injury severity score	25	35	17	<0.0001

Abbreviations: SD, standard deviation; CI, confidence interval; SBP, systolic blood pressure; DBP, diastolic blood pressure; ISS, injury severity score.

Fig. 1. Types of injury.

survivors and non-survivors. Non-survivors were defined as those who did not survive past 48 hours from arrival to the hospital. Student t-test was used to compare the significant differences in age, sex, DBP, SBP, HR, and ISS of the two groups. Pearson chi-square test and Fisher's exact test were used to compare the survival rates in accordance with the type and mechanism of injury between the two groups. *P* values of less than 0.05 were considered statistically significant.

Results

A total of 2,778 patients received a transfusion of pRBC blood products pursuant to the definition of MT during the study period. Of them, 2,109 patients were excluded on the basis of age, unknown etiology of shock, or death during the transfusion period. The remaining 669 trauma patients were included for analysis.

The general characteristics of the study group were analyzed. The male-to-female ratio was 2.9:1, and the mean age of the study population was 53.9 years. The mean SBP was 73 mmHg, and the mean DBP was 47 mmHg. The mean ISS was 25 (Table 1).

For the type of injury, blunt injury (n=427, 63.8%) was the most common, followed by compound injury (n=205, 30.6%) (Fig. 1). Motor vehicle accident (n=273, 40.8%) and pedestrian traffic accident (n=186, 27.8%) were the most and second-most common mechanisms of injury, respectively. These were followed by fall from height (n=122, 18.2%), fall of a heavy object (n=42, 6.3%), and stab wound (n=27, 4.0%), in order of frequency (Fig. 2).

An analysis of the outcome of post-transfusion

status in patients with MT showed that 513 patients (76.7%) were admitted, 150 patients (22.4%) expired within 48 hours, and 6 patients (0.9%) were transferred out to a different hospital (Fig. 3).

In comparing the survivor and non-survivor groups, there were significant differences in the mean SBP

($P < 0.0001$), mean DBP ($P < 0.0001$), and ISS ($P < 0.0001$) (Table 1). Age, sex, and HR showed no differences between the two groups. There was no significant difference of survival rate according to the type of injury ($P = 0.361$); however, that of injury mechanism ($P \leq 0.001$) between the two groups was significantly different (Table 2). Among those who expired, pedestrian traffic accident was the most common mechanism, while motor vehicle accident was most common among survivors.

Discussion

The majority of preventable early-stage death by major trauma still originates from uncontrolled hemorrhage.⁸⁻¹²⁾ In recent years, there has been an emphasis to develop protocols for rapid initiation of MT in trauma cases.¹³⁾ At our ED, MT can be ini-

Fig. 2. Injury mechanism.

Fig. 3. Post-transfusion status.

Table 2. Number (%) of survivors vs. non-survivors by injury type and mechanism

	Non-survivors (n=150)	Survivors (n=519)
Type of injury (survival rate)		
Blunt injury (25.5%)	87 (58%)	298 (57.4%)
Penetrating injury (72.2%)	22 (14.7%)	57 (11.0%)
Compound injury (80.0%)	41 (27.3%)	164 (31.6%)
Injury mechanism		
Motor vehicle accident (83.7%)	41 (27.3%)	210 (40.5%)
Pedestrian traffic accident (71.6%)	57 (38%)	144 (27.7%)
Fall from height (71.3%)	37 (24.7%)	92 (17.7%)
Fall of heavy object (100.0%)	0 (0%)	42 (8.1%)
Stab wound (55.6%)	12 (8%)	15 (2.9%)
Crush wound (84.2%)	3 (2%)	16 (3.1%)

tiated by an attending emergency physician and by third- or fourth-year residents when one or more of the following criteria is met during trauma resuscitation: SBP of less than 90 mmHg, initial Glasgow Coma Scale (GCS) score of less than 12 points accompanied by injury of trunk or extremity, and unstable pelvic bone fracture of 2 or more skeletal bone fractures.

In making a comparison between survivors and non-survivors in our study, we found that the initial mean of SBP and DBP was significantly lower, and that the ISS score was significantly higher among non-survivors; while age, sex, as well as type and mechanism of injury did not show significant differences. Other studies have demonstrated that SBP is often the best available surrogate for shock, and hypotensive patients with major injuries are most likely to have internal bleeding that cannot be controlled easily.¹⁴⁾ This suggests that regardless of age and sex, as well as of the method in which trauma was sustained, immediate assessment of blood pressure and ISS for the rapid identification of patients requiring MT can potentially lead to improved mortality in trauma patients.

There are limitations to this study that one must consider, particularly those inherent to a retrospective chart-based review. Selection bias may have confounded some results, as this study only looked at specific trauma cases in which MT was implemented. Furthermore, as our institution does not have official MT protocols, the results may differ from other MT studies. Without guidelines that use viscoelastic hemostatic assays, such as rotational thromboelastometry or thromboelastography for trauma cases, making a diagnosis of early traumatic coagulopathy can be

difficult.¹⁵⁾ In recent practice, such assays use different coagulation triggers that are helpful in the early recognition and prevention of possible complications. Moreover, other studies have shown that MT can be somewhat predicted via a scoring system, i.e. the shock index.¹⁶⁾ In retrospect, it would have also been of value to verify a correlation between our ISS and need for MT, as well as the amount of transfusion in our study as well.

Multiple trauma patients are at risk for mortality and morbidity from injuries alone and often in varying states of hypovolemia. A rapid initiation of balanced transfusion through proper MT protocols is a key component of trauma resuscitation. Further study is necessary to determine the protocols for rapid identification of patients who may require MT.¹⁷⁾ The findings from this study may serve as preliminary data in the development of proper transfusion protocols for MT among trauma patients.

요 약

배경: 대량 수혈을 필요로 하는 외상 환자는 응급실 도착 시 적절한 방법으로 치료가 시행되어야 한다. 이 연구는 응급실에서 대량 수혈을 필요 하였던 외상 환자들의 특성과 예후를 분석하여 이들의 처치에 도움을 주고자 하였다.

방법: 본 연구는 고려대학교 구로병원 응급응급의학과에서 2013년 1월부터 2015년 12월까지 대량 수혈을 필요로 한 환자들의 기록을 후향적 연구로 검토하였다. 연구포함 대상은 18세 이상의 환자 중 응급실 내원 후 24시간 동안 시간 당 농축 적혈구 4단위 이상 또는 10단위 이상을 투여 받은 외상 환자로 정했다.

결과: 연구 기간 동안 대상 환자는 669명이었

다. 이중 생존 환자군과 사망 환자군의 차이를 비교한 결과 도착시 수축기 혈압($P < 0.0001$), 이관기 혈압($P < 0.0001$), 그리고 Injury Severity Score ($P < 0.0001$)에서 의미 있는 차이가 있었다. 대량수혈 환자의 22.4% (150/669)는 사망하였다.

결론: 대량 수혈이 필요한 외상 환자에서 예후 개선을 위한 적절한 초기 대응이 필요하며 이러한 자료는 응급실에서 대량 수혈이 필요한 외상 환자들에 대한 기본 자료를 제공 할 수 있을 것으로 여겨진다.

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