eISSN 2287-1683 pISSN 1738-8767
Journal of Trauma and Injury
Vol. 29, No. 1, March, 2016
http://dx.doi.org/10.20408/jti.2016.29.1.8

• Original Article •

Effect on Trauma Patients of Having Even One General Trauma Surgeon on Duty

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Purpose: Specialized general trauma surgeons play an important role in the care of trauma patients. Hemoperitoneum is a severe, but representative, condition following a life-threatened trauma. The objective of this study was to compare the outcomes for polytrauma patients with hemoperitoneum between the periods during which a trauma surgeon was available and that unavailable.

Methods: Thirty-one trauma patients with hemoperitoneum who were treated at Korea University Guro Hospital over a period of 4 years were included in this study, and their case records were analyzed retrospectively. The patients were divided into two groups, the 2011 and 2012 group and the 2013 and 2014 group corresponding, respectively, to the periods that a trauma surgeon was not and was working. Vital signs on admission, scores on the injury severity scale and, Glasgow coma scale, elapsed time to diagnostic, and therapeutic, and/or operative interventions were studied. The effects on intensive care unit and hospital lengths of stay, as well as mortality, were also studied.

Results: The study population consisted of 16 and 15 patients in group 1 and 2, respectively. The patients in both groups had six unstable hemodynamic on admission. The time to the main procedure (intervention, operation etc.) was longer during the periods when a trauma surgeon was not working than it was during the period when working. This difference did not reached statistical significance. The mortality rates for the two groups were not statistically different either (18.75% vs 26.67%; p=0.928).

Conclusion: Having at least one specialized general trauma surgeon on duty may reduce the time to intervention and surgery for severe trauma patients with hemoperitoneum, but appears to have no effect on the mortality rates. In conclusion, having only one trauma surgeon on duty does not improve the quality of care for trauma patients. [J Trauma Inj 2016; 29: 8-13]

Key Words: General trauma surgeon, Hemoperitoneum, Polytrauma, Trauma system, Mortality

I. Introduction

A trauma resuscitation team consists of doctors, nurses, and emergency-related workers. The size and number of a team can vary depending on the hospital size, the regulatory system, and the severity of the trauma. A trauma team for a patient with moderate trauma includes the 1) trauma surgeon, 2) emergency medicine doctor, 3) surgery and emergency medicine resident, 4) emergency medicine nurses, 5) radiology doctor who can intervene, 6) radiation technician, 7) critical care nurse, 8) anesthesiologist or skilled anesthesiology nurse, 9) operating room (OR) nurse, and 10) safety officer. For patients with less severe trauma, a team comprising an emergency medicine doctor and nurses generally cares for the patient before trauma surgeons arrive.(1)

We examine here the current status of trauma

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Submitted : December 10, 2015 **Revised** : December 22, 2015 **Accepted** : December 28, 2015

patient care at Korea University Guro Hospital. Korea University Guro Hospital opened in 1983 and has been treating fractures and amputations of workers injured while working at the nearby Guro Industrial Complex. While it continued the investment and development with a natural interest in the field of trauma surgery, it was designated as the nation's first trauma training hospital in 2014 and started to train residents who wanted to specialize in trauma in March 2015.(2)

As of 2015, the trauma team at Korea University Guro Hospital consists of 1 lead and 2 trainee trauma surgeons, 1 lead and 5 trainee orthopedic surgeons specializing in trauma, and 1 trainee each in neurosurgery and emergency medicine specializing in trauma. Although an anesthesiologist, thoracic surgeon, and intervention-capable radiologist needed for treating trauma patients are not always available, the on-duty system is designed to respond to calls in emergency situations. Furthermore, 2 coordinating nurses responsible for trauma and a physician's assistant in the OR also belong to the trauma training center.

The lead specialist in the surgical division of the current trauma training center was hired in 2013 by Korea University Guro Hospital. Before then, just like other university hospitals, when a severe trauma patient arrived at the emergency room (ER), a resident specializing in the area of the most critical trauma first evaluated the patient and reported to an upper-class resident or on-duty staff; the patient's problems were resolved while consulting with other departments and by transferring the patient to another department where surgery could be performed or an intensive care unit (ICU). Considering the golden time for treating critical trauma patients is 1 hour,(3) such a step-wise treatment necessarily increases the trauma-related mortality rate because of the increase in the ER retention time. In fact, the preventable trauma-related mortality rate in 2010 was quite high (35.2%) owing to the lack of a trauma system.(4)

Since 2013, when a severe trauma patient is admitted to the ER at Korea University Guro Hospital, emergency medicine doctors and nurses perform the primary evaluation and resuscitation procedures based on ATLS (Advanced Trauma Life Support) under the supervision of a trauma specialist after which the emergency surgery status is determined and a computed tomography (CT) scan is immediately performed for patients who do not need emergency surgery. Depending on the CT findings, a resident or specialist corresponding to the trauma area is contacted and the emergency surgery or angiography status is finally determined. When emergency surgery is not necessary, intensive treatment is performed after immediately transferring the patient to the ICU.

This study was designed to investigate the effectiveness of a single trauma specialist by comparatively analyzing the ER retention time, ICU treatment period, and mortality rate of multiple trauma patients including those with hemoperitoneum before and after the time when the trauma specialist in our hospital began practicing.

II. Materials and Methods

1. Study Subjects and Period

Multiple patients with trauma including hemoperitoneum admitted to our hospital were retrospectively investigated after dividing them into 2 groups: Group 1 included patients admitted from January 2011 to December 2012, and Group 2 included patients admitted from January 2013, when the trauma specialist in the hospital was hired and started seeing patients in the ER, to December 2014. Because of its size and location, the abdomen is most frequently damaged by any trauma (blunt or stab/penetrating injury), and 10% of trauma-related deaths are directly associated with abdominal injury. Therefore, diagnosis and treatment of abdominal trauma are considered to be important even by skilled specialists.(5)

We comparatively analyzed each group's general characteristics, vital signs, stability status, Injury Severity Score (ISS), Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), Trauma and Injury Severity Score (TRISS), ER retention time, ICU treatment period, and mortality rate.

ER retention time was investigated in further detail to include the time elapsed from admission of a patient

to the time when an on-duty resident or trauma specialist first saw the patient, the time elapsed before a an order for hospitalization was issued, the time elapsed before a procedure such as surgery or intervention was started, and the total ER retention time.

Brain-damaged patients with no possibility of resuscitation or patients dead on arrival (DOA) were excluded from the study even if they had hemoperitoneum.

2. Patient Selection within the Active Period of the Trauma Specialist

After the trauma specialist started to work in 2013, ER trauma patients who were hemodynamically unstable or had an abdominal injury should, in principle, be treated in the ER by a trauma specialist regardless of the severity level. However, a single trauma specialist cannot care for all trauma patients every day throughout the year. When the trauma specialist was off duty, first an on-duty surgery resident cared for patients as before and determined whether surgery or another procedure was needed after contacting on-duty specialists in other divisions. Therefore, we included only patients with multiple trauma, including hemoperitoneum, who were hospitalized after treatment in the ER by the trauma specialist for the period including 2013 and 2014.

3. Statistical Methods

Statistical analysis was performed by using R: a language and environment for statistical computing, and the Shapiro-Wilk normality test was performed for continuous variables to test normality and analyze data. Data with a normal distribution are expressed as mean±SD, whereas data not distributed normally are expressed as median and interquartile range. Fisher's exact test was performed for noncontinuous variables. Statistical significance was determined when $p<0.05$.

III. Results

1. General Characteristics of Patients

A total of 31 patients with trauma including hemoperitoneum were included in the study: 16 patients in Group 1 (not seen by the trauma specialist) and 15 patients in Group 2 (seen by the trauma specialist).

Table 1. General characteristics of patients.

Parameters	Group1 (N=16) N (%) Median [interquartile range]	Group2 (N=15) N (%) Median [interquartile range]	*p*-value*
Age	50.3±21.2	41.4±15.7	0.197
Gender			
Male	11 (31.3)	10 (66.7)	1.000
Female	5 (68.7)	5 (33.3)	
Mechanism of injury			
Blunt injury	12 (75.0)	11 (73.3)	1.000
Penetrate injury	4 (25.0)	4 (26.7)	
Vital sign			
Stable	10 (62.5)	9 (60.0)	1.000
Unstable	6 (37.5)	6 (40.0)	
ISS	9.5 [4.5;18.5]	17.0 [7.0;23.0]	0.392
GCS	15.0 [12.0;15.0]	15.0 [13.0;15.0]	0.886
RTS	7.84 [6.38;7.84]	7.84 [7.00;7.84]	1.000
TRISS			
more than 90%	13 (81.3)	11 (73.4)	0.791
10%~90%	2 (12.5)	2 (13.3)	
Less than 10%	1 (6.2)	2 (13.3)	

* The *p*-values were estimated by Shapiro-Wilk normality test or Fisher's exact test.
ISS: injury severity score, GCS: glasgow coma scale, RTS: revised trauma scale, TRISS: trauma and injury severity score

The following results are given for Groups 1 and 2, respectively. The mean age of each group was 50±21 and 41±16 years, respectively, and the male-to-female ratio was 11:5 and 2:1, respectively, which were not statistically different between the 2 groups.

Regarding injury mechanisms, there were 12 and 11 blunt injuries including traffic accidents, simple collisions, and falls, and 4 and 4 penetrating injuries; there were no statistical differences between the 2 groups (p=1.0).

There were 10 and 9 cases with stable vital signs and 6 and 6 cases with unstable vital signs (not statistically different). An unstable vital sign was defined as systolic blood pressure on arrival at ER below 90 mmHg or mean arterial pressure below 65 mmHg.(6)

The median ISS were 9.5 and 17.0. The median GCS was 15.0 and the median RTS was 7.84 for both groups. TRISS score, which calculates the survival rate from the ISS and RTS scores, was compared in 3 separate groups. There were no significant differences between the groups in any of these scores (Table 1).

2. ER Retention Time

The median ER retention times were 294.5 and 266.0 minutes, which were not statistically significantly different (p=0.649).

A more detailed evaluation of the ER retention time revealed that the times between patient admission to the ER and arrival of an on-duty resident or specialist were 82.5 and 75 minutes, which were not statistically significantly different (p=0.553). The times between admission to the ER and the start of a procedure such as surgery or intervention were 294.5 and 266.0 minutes, and the times taken to issue an order for hospitalization were 196.5 and 147.0 minutes; although the duration was slightly decreased in Group 2, the difference was not statistically significant (p=0.295, p=0.089) (Table 2).

3. Treatment Results

The median pRCBC and FFP transfusion amount after admission were 6.5 vs. 5.0 units unit (p=0.937) and 5.5 vs. 3.0 units (p=0.936), respectively; there were no statistically significant differences between the 2 groups. The treatment period in the ICU was 0.5 vs. 2.0 days (p=0.162); although the duration was somewhat longer when the trauma specialist was present, the difference was not statistically sig-

Table 2. Length of stay in the ER.

	Group 1 (N=16) Median [interquartile range]	Group 2 (N=15) Median [interquartile range]	p-value*
Time to doctor's arrival	82.5 [48.0;148.0]	75.0 [35.0;139.5]	0.553
Time to admission order	196.5 [125.5;311.5]	147.0 [81.0;184.5]	0.089
Time to do the main procedure (operation, intervention)	311.0 [210.0;495.0]	266.0 [146.0;384.5]	0.295
Total length of stay in the ER	294.5 [194.5;385.0]	266.0 [146.5;384.5]	0.649

* The p-values were estimated by Shapiro-Wilk normality test.
ICU: intensive care unit, ER: emergency room

Table 3. Care results.

	Group 1 (N=16) Median [interquartile range]	Group 2 (N=15) Median [interquartile range]	p-value*
Packed RBC transfusion (unit)	6.5 [4.0;12.0]	5.0 [3.0;36.5]	0.937
FFP transfusion (unit)	5.5 [1.5;17.5]	3.0 [1.0;36.5]	0.936
Length of ICU stay (days)	0.5 [0.0;2.5]	2.0 [1.0;6.0]	0.162
Length of hospital stay (days)	11.0 [6.0;18.0]	8.0 [4.5;13.0]	0.462
In hospital mortality	3/16 (18.6%)	4/15 (26.7%)	0.923

* The p-values were estimated by Shapiro-Wilk normality test.
RBC: red blood cells, FFP: fresh frozen plasma, ICU: intensive care unit

nificant. The total retention time was 11.0 vs. 8.0 days (p=0.462), a difference that was also statistically insignificant. The mortality rate during the hospital stay was 3 (18.6%) vs. 4 (26.7%); although it appears to have increased when the trauma specialist was present, the difference was not statistically significant (Table 3).

IV. Discussion

This study compared the 2-year period when a single trauma specialist rather than a trauma team was present in the ER of Korea University Guro Hospital with the same duration before the trauma specialist was appointed. Other studies comparing treatment results of severe trauma patients before and after a severe trauma team was introduced in other domestic or foreign hospitals have reported significantly reduced retention times in the ER and even decreased mortality rates of trauma patients.(7-9)

In this study, the number of subjects in each group was similar, and there were no significant differences in any of the general characteristics. Regarding ER retention time, the time between admission to the ER and an order for hospitalization decreased when the trauma specialist was present, but it was statistically insignificant. The time taken for a resident or specialist from a department other than emergency medicine to see the patients, the time until surgery or intervention, or the total ER retention time did not significantly decrease. However, we found that a higher proportion of cases were notified to a trauma specialist when an on-duty resident first saw patients than when the trauma specialist did. Even when the trauma specialist was present, the calls seemed to go to the on-duty resident of each department as before since a system was not established in which a trauma specialist sees patients first as in a major trauma center with a severe trauma team. Since the trauma specialist saw patients immediately after being contacted by the on-duty resident, the hospitalization order time decreased somewhat. However, because the time taken to contact the specialist was almost the same as before, the decrease was statistically insignificant. A single trauma specialist could not completely replace the existing serial reporting system connecting interns, residents, and specialist. Whereas the time taken until surgery or intervention and the ER retention time were the same when the trauma specialist was present, the ER retention time was shorter than it was before the trauma specialist was present. The reason is because there were cases in which surgery or intervention was performed as vital signs deteriorated or the biochemical findings changed on the ward after hospitalizing patients for conservative treatment only after an on-duty specialist heard of the notification from a resident during the period when the trauma specialist was absent. On the other hand, even though the trauma specialist was not the first to see all trauma patients in the ER, the trauma specialist treated almost all patients and determined the surgery status, the ER retention time and the time until surgery were the same. This result alone is enough to justify the existence of the trauma specialist. Although we investigated the time until a CT scan was performed after the arrival of patients, these values were excluded from the results because there were cases for which surgery was performed without a CT scan due to unstable vital signs and cases of transfer from other hospitals after a CT scan.

There were no significant differences in the ICU retention time, total retention time, and mortality rate during hospitalization. This result appears to show the limitation of a single trauma specialist compared with a severe trauma team.

In conclusion, rather than expecting that a single trauma specialist would be a big help in treating severe trauma, establishing a severe trauma team, constructing an appropriate system, preparing standardized guidelines, and operating it systematically would contribute to decreasing the ER retention time of severe trauma patients, making quick decisions on the treatment regime, and lowering the mortality rate.(7)

Regarding the limitations of this study, first, this was a retrospective study with a small number of patients. Since the hospital is located in the middle of Seoul, there were very few massive traffic accidents, and thus the number of severe trauma patients including hemoperitoneum was limited. Because the period with the trauma specialist was limited to 2

years, it was difficult to increase the patient number, and thus the investigation had to rely on medical records. Second, since the subjects were severe trauma patients including hemoperitoneum, injuries to other areas differed among the patients. There is a possibility that the injuries to other areas influenced the results. Third, during the period before the trauma specialist was active between 2011 and 2012, each patient was treated by a different on-duty specialist. Therefore, some patients may have been treated by a doctor who was not a trauma specialist but had sufficient knowledge and experiences of trauma, whereas other patients may have been treated by a doctor whose specialty is only remotely related to trauma and thus provided inadequate treatment; that is, the treatment of patients during that period may have been inconsistent.

In the future, we are planning a study on the mortality rate of severe trauma patients after a severe trauma team is in operation as the training of trauma specialists that began in March 2015 and expansion of the facility, including the ICU and OR, are completed and to monitor the qualitative improvement of the trauma system of Korea University Guro Hospital resulting from the trauma training center. We will emphasize once again the importance of a severe trauma team and a trauma system.

V. Conclusion

We found that a single trauma specialist could not significantly reduce the ER retention time and mortality rate of patients with severe trauma including hemoperitoneum. Since trauma treatment requires quick transfer, treatment of complex injuries, surgery, and intensive care, the mortality rate is expected to significantly decrease when a well-established trauma system and well-trained severe trauma team are in place.

REFERENCES

1) Michael FR, Chris C, Stephen S. Resources for optimal care of the injured patient 2014 ; 37-8.
2) http://news.mk.co.kr/newsRead.php?year=2014&no=1485652
3) Mun SH, Chung KS. Characteristics of multiple trauma and quality assurance of trauma care; J Kor Soc Emerg Med 1994; 5: 34-47.
4) Lee KH. Optimal trauma care system in Korea; J Korean Med Assoc 2013; 56: 748-50.
5) S. Di Saverio, G. Tugnoli, F. Catena, L. Ansaloni, N. Naidoo. Trauma Surgery 2014; 2: 1-2.
6) Shin S, Kyung KH, Kim JW, Kim JJ, Hong SK. The importance of the trauma surgeon: A reflection on the management of hemodynamically unstable pelvic trauma patients; J Korean Soc Traumatol 2009; 22: 254-9.
7) Kwon CH, Park CM, Park YT. A comparison of the effectiveness of before and after the trauma team's establishment: Treatment outcomes and lengths of stay in the emergency department; J Korean Soc Traumatol 2011; 24: 75-81.
8) Khetarpal S, Steinbrunn BS, McGonigal MD, Stafford R, Ney AL, Kalb DC et al. Trauma faculty and trauma team activation: Impact on trauma system function and patient outcome; J Trauma 1999: 47: 576-81.
9) Lee SH, Cho SJ, Yeom SR, Ryu JH, Jung JW, Han SK et al. Effect of the mergency trauma team's management on the treatment of patients with multiple severe trauma. J Korean Soc Traumatol; J Korean Soc Traumatol 2009: 22: 172-8.