

부산·경남 지역에서 전원 의뢰된 중증외상 분석을 통한 119 구급대의 환자 분류와 이송병원 선정에 대한 고찰

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— Abstract —

Field Triage of Severely Injured Patients and Transportation by the EMS Rescue Group of Busan and Kyungnam, Korea: Is It Appropriate?

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Purpose: The objective of this study was to determine the appropriateness of Emergency Medical Service's (EMS's) triage and transport of severely injured patients in Busan and Kyungnam, Korea.

Methods: The medical records of the Emergency Medical Information Center were retrospectively reviewed from January 1, 2010 to December 31, 2010. We identified the number of patients that should have been transferred from a secondary to a tertiary hospital according to the EMS field triage protocol.

Results: In a total of 472 cases requests to be transferred to a third hospital were made through the Emergency Medical Information Center. Of these, 207 patients(43.9%) should have been transferred to a tertiary hospital according to the EMS field triage protocol. Among them, thirty-three(15.9%) patients satisfied step 1, 15(7.0%) satisfied step 2, and 117(56.5%) satisfied step 3. Twenty-three(11.1%) patients satisfied both steps 1 and 3.

Conclusion: We found the triage by the EMS in the transfer of severely injured patients to a tertiary hospital to be inappropriate and re-education of EMS personnel regarding the EMS field triage protocol is needed. Because many patients are transferred from a secondary to a third hospital, we suggest changing the EMS field triage protocol to expand the severe injury criteria. A need exists to authorize secondary hospitals to transfer severely injured patients directly because there are no trauma centers in Korea. (J Trauma Inj 2012;25:145-151)

Key Words: Field triage, Multiple trauma, Trauma center

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I. Introduction

Trauma was the sixth leading cause of death in 2009 and is the first cause of death in children 1~9 years old in Korea, according to the National Statistical Office. The preventable trauma death rate was 40.5% in 1999 and 32.6% in 2007 according to the National Statistical Office of USA. Pedro(1) et al, reported in 2007 that the preventable trauma death rate was 2.5% in developed countries with an established trauma care system, including the USA. Thus, Korea's preventable trauma death rate is very high compared with that in developed countries.

The chain of trauma survival consists of injury prevention, pre-hospital care and transportation, hospital trauma care and rehabilitation. Of these, field triage and transportation of injured patients to the appropriate hospital have an effect on mortality and morbidity.(2) This system includes establishment of a trauma center, transportation of severely injured patients to the trauma center, active resuscitation and operative treatment.(3)

According to one study, short-term mortality of severely injured patients transferred from a regional hospital to a trauma center is three times greater than that of patients directly transferred to a trauma center.(4) Among severely injured patients, the mortality of those transferred to a trauma center is lower than that of patients admitted to a regional hospital.(5) Several reports indicate that direct transport to a trauma center reduces the preventable trauma death rate in severely injured patients.(4,6,7)

There have reports from the USA that transport of severely injured patients to a higher level trauma center reduces the preventable trauma death rate.(8,9) However, there are few studies concerning the appropriateness of transportation of severely injured patients in Korea. Here, we analyze field triage of severely injured patients and transportation by the emergency medical service (EMS) in Busan and Kyungnam, Korea.

II. Materials and Methods

We targeted severely injured patients who were requested to be transferred from a secondary to a tertiary hospital through the emergency medical information center. A secondary hospital refers to a hospital which can support licensed physicians in pediatrics, obstetrics, and gynecology, general surgery and other supporting medical services. In

our paper, we chose secondary hospital instead of level II and III trauma center. A tertiary hospital refers to a hospital which can support fully departmentalized and equipped with the service capabilities needed to support certified medical specialists and other licensed physicians rendering services in the field of medicine, paediatrics, obstetrics and gynecology, surgery, their subspecialties and ancillary services. In our paper, we chose tertiary hospital instead of level I trauma center. A trauma center is a hospital equipped to provide comprehensive emergency medical services to patients suffering traumatic injuries. Trauma centers vary in their specific capabilities and are identified by "Level" designation. Higher levels of trauma centers will have trauma surgeons available, including those trained in such specialties as Neurosurgery and Orthopedic surgery^[3] as well as highly sophisticated medical diagnostic equipment. Lower levels of trauma centers may only be able to provide initial care and stabilization of a traumatic injury and arrange for transfer of the victim to a higher level of trauma care.

Our research period was from January 1, 2010 to December 31, 2010. Because there are no authorized trauma centers in Korea, we instead chose tertiary hospitals. We defined severely injured patients by EMS field triage protocol of the American College of Surgeons Committee on Trauma classification criteria. This classification recommends transportation to a trauma center according to physiological state, anatomical state, and mechanism of injury. Thus, in step 1, we determined whether patients should be transported to a trauma center according to Glasgow Coma Scale (GCS), systolic blood pressure and respiratory rate. In step 2, we determined whether patients should be transported to a trauma center based on pelvic bone fractures or two or more proximal long-bone fractures. In step 3, we determined whether patients should be transported to a trauma center based on a pedestrian or bicycle traffic accident. In step 4, we chose the hospital according to the history and condition of the patient. However, we excluded step 4 because EMS rescuers may not be able to obtain a patient's history in cases of decreased consciousness and may not choose the appropriate hospital (Fig. 1).(10) We identified the number of severely injured patients among the injured patients requested to be transferred from a secondary to a tertiary hospital and the number of patients corresponding to each step and category. We evaluated the reasons for transportation from a secondary hospital using a

multiple response analysis. We determined injury time, arriving time to secondary hospital, and time of request through the emergency medical information center. We expressed nominal variables as percentages and continuous random variables as medians and quartiles. SPSS version 18.0(SPSS Inc., Chicago, IL, USA) was used to analyse the data.

III. Results

A total of 472 injured patients were requested be transferred from a secondary to a tertiary hospital through the emergency medical information center. Among them, 207 (43.9%) were defined as severely injured patients by EMS

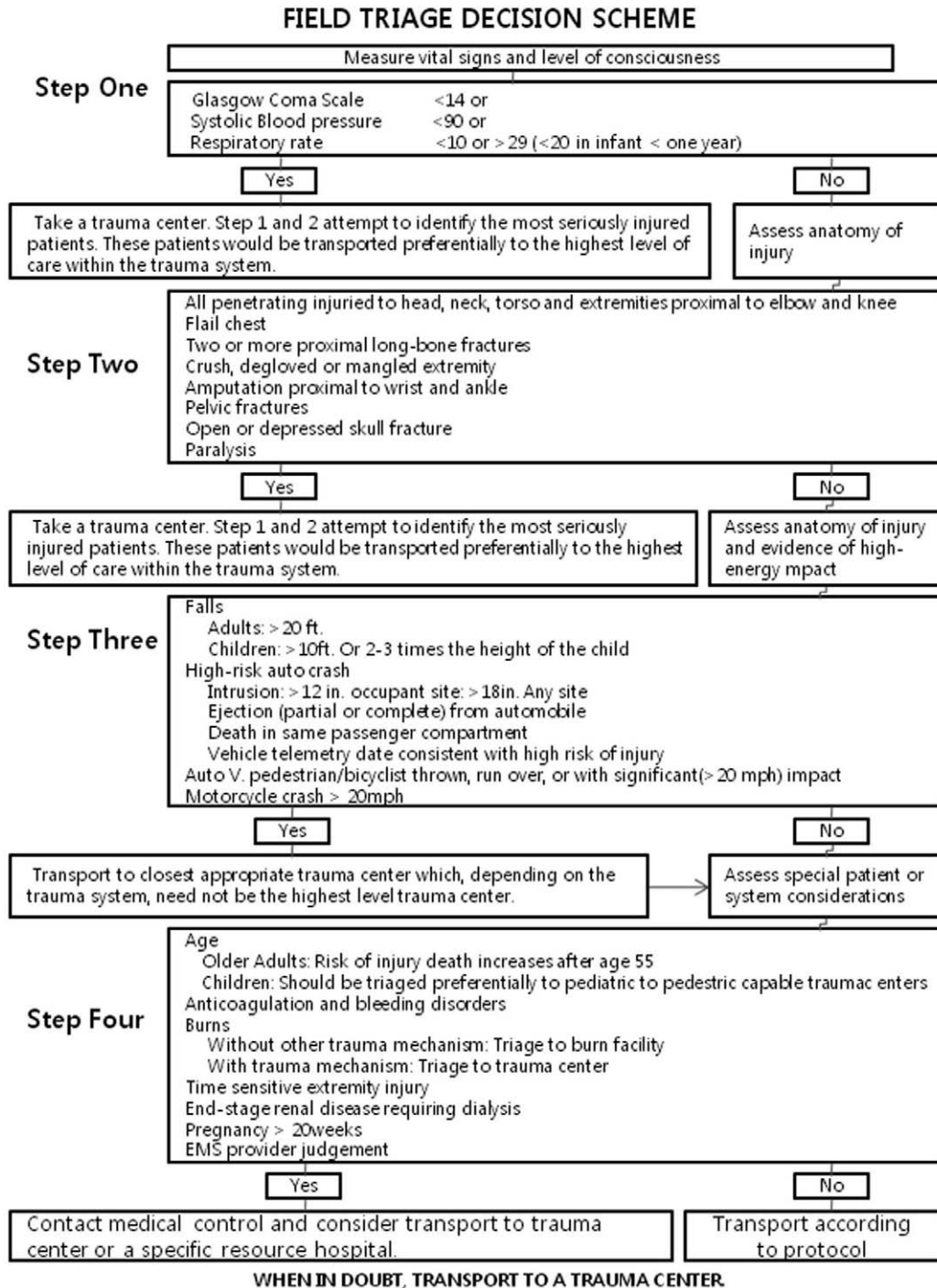


Fig. 1. Field triage decision scheme

field triage protocol of the American College of Surgeons Committee on Trauma. In total, 159(76.8%) were men and 48(23.2%) were women. The median age was 41.5 years

Table 1. Sex and age in referred severe trauma patients

	No. (%)	Age (years), median (range)
Male	159 (76.8)	41.00 (21.00~54.75)
Female	48 (23.2)	48.00 (21.00~63.50)
Total	207 (100.0)	41.50 (21.00~56.00)

Table 2. Classification of patients according to the severe trauma patient's criteria

	No. (%)
Step 1	33 (15.9)
Step 2	15 (7.2)
Step 3	117 (56.5)
Step 1 and step 2	6 (2.9)
Step 1 and step 3	23 (11.1)
Step 2 and step 3	12 (5.8)
Step 1, step 2 and step 3	1 (0.5)
Total	207 (100.0)

Table 3. Details according to the step 1, step 2 and step 3

	No. (%)
Step 1	
Glasgow coma score < 14	45 (71.4)
Systolic blood pressure < 90 mmHg	10 (15.9)
GCS < 14 and SBP < 90 mmHg	8 (3.9)
Total	63 (100.0)
Step 2	
Penetrating injuries	4 (11.8)
Flail chest	1 (2.9)
Two or more proximal long-bone fracture	1 (2.9)
Crush, degloved, or mangled extremity	2 (5.9)
Pelvic fracture	19 (55.9)
Open and depressed skull fracture	3 (8.8)
Paralysis	4 (11.8)
Total	34 (100.0)
Step 3	
Falls	17 (8.2)
High-risk auto crash	2 (1.0)
Pedestrian traffic accident	76 (36.7)
traffic accident	6 (2.9)
Motorcycle traffic accident	66 (39.5)
Total	167 (100.0)

(range, 21~56 years) (Table 1). Thirty-three(15.9%) patients satisfied step 1, 15(7.0%) satisfied step 2, and 117(56.5%) satisfied step 3. Twenty-three(11.1%) patients satisfied both steps 1 and 3(Table 2).

In step 1, 45(71.4%) patients had a GCS<14, 10(15.9%) were hypotensive and eight(12.7%) satisfied both criteria. In step 2, 19(55.9%) patients had a pelvic bone fracture and four(11.8%) had a penetrating injury. In step 3, 76 (45.5%) patients were in a pedestrian traffic accident, 66 (39.5%) were in a motor vehicle accident, and 17(10.2%) fell down (Table 3). 106(39.8%) patients were transported due to the lack of a specialist and 89(33.5%) were transported due to the lack of an appropriate department (Table 4). The mean time from injury to arriving the secondary hospital was 25 min (range, 16.5~30 minutes), and that from arriving the secondary hospital to requesting a tertiary hospital was 65 min (range, 34.75~124.25 min). The mean time from injury to requesting a tertiary hospital was 111 min (range, 63.25~181.25 min) (Table 5).

Table 4. Reason of referred patient from sendary medical facility b multiple response analysis

	No. (%)
Lack of specialist	106 (39.8)
Lack of department	89 (33.5)
Lack of patient's room	2 (0.8)
Lack of operating room	5 (1.9)
Lack of medical device	1 (0.4)
Want to go hometown	11 (4.1)
Preserver's wish	43 (16.2)
Etc.	9 (3.4)
Total	266 (100.0)

Table 5. Arriving time, requesting time and total time

	Minutes, median (range)
Arriving time	25.00 (16.00~30.00)
Requesting time	65.00 (34.75~124.25)
Total time	111.00 (62.35~181.25)

Arriving time: time from injury onset to arriving secondary medical facility

Requesting time: time from arriving secondary center to requesting Busan medical information center

Total time: time from injury onset to requesting Busan medical information center

IV. Discussion

The prognosis of severely injured patients is dependent on transfer time: short transfer times increase the survival rate and lower the incidence of complications.(11,12) However, transfer of severely injured patients to appropriate hospitals is problematic. An inter-hospital transfer requires a significant amount of time due to the lack of special trauma centres and an efficient transfer system in Korea: this has a negative influence on severely injured patients.(13) In our study, although EMS rescuers should transfer severely injured patients to the appropriate hospital based on the field triage protocol, 43.9% of severely injured patients who requested it through the emergency medical information center were transferred. It is very important for severely injured patients to be treated, particularly in the first hour after the trauma as a requisite for a successful outcome.(11) However, we found that an average of 111 min elapsed between injury and arrival at the tertiary hospital. In a study by Jung,(14) severely injured patients arrived at a tertiary hospital from a secondary hospital 2 hours and 3 minutes after their accidents. Such delays in arriving at the trauma center increase the preventable trauma death rate.(15) In a study by Garwe,(4) the 2-week mortality risk in transferred patients was almost three-fold that of patients transported directly to a Level I trauma center. So, it is essential for severely injured patients to undergo active resuscitation at an early stage. In particular, it is important for EMS rescuers to understand the severity of multiple trauma patients so they can be transported to the trauma center quickly, since the condition of such patients deteriorates rapidly due to multiple organ injuries.(13) The percentage of patients who satisfied steps 1 or 3 was 92.8%. Patients who satisfy the step 2 criteria are classified by anatomical state, whereas patients who satisfy steps 1 and 3 can be classified by vital signs and history. Thus, EMS rescuers could decide to go directly to a trauma center, but they took patients to a secondary hospital, which wastes time. Approximately 6.5% of EMS rescuers are first-class rescuers and 32.2% are second-class among all EMS rescuers in Korea, which is very low compared with those in other developed countries.(16) Thus, there is a need to develop and educate EMS rescuers with the standardised field service guide. In developed countries including the USA, it is known that if a severely injured patient is treated at a level I trauma center from the early stage, it

decreases their length of stay in the intensive care unit and increases survival rate. According to Sampalis,(7) the mortality rate of patients transferred between hospitals is 8.9% but that of patients transferred directly to a trauma center is 4.8%. The length of stay in the intensive care unit for patients transferred between hospitals is 16.0 days but that of patients transferred directly to a trauma center is 13.2 days. When EMS rescuers decide that patients are severely injured, it is better to transfer patients directly to a trauma center than to transfer patients to the closest hospital. This is why developed countries use a helicopter or airplane transfer system to transfer patients quickly.(18)

Therefore, to decrease mortality rates it is important that EMS rescuers determine the severity of a patient's injuries using a field triage protocol and transfer them to the appropriate hospital.

The possible reason to transfer a patient to a secondary hospital instead a tertiary hospital is inappropriate determination of EMS rescuers. That may consist of nearness and accessibility. It is necessary to develop and educate EMS rescuers regarding the standardised field service guide and assess quality control. If patients who can be treated at a secondary hospital are transferred, they supersaturate the trauma center, leading to untimely treatment of patients. Thus, it is necessary to educate EMS rescuers regarding the criteria for transferring patients directly to a trauma center and to exchange opinions between the EMS rescuers and doctors at the trauma center.(19) The preventable trauma death rate in Korea in 1999 was 40.5%.(20) According to a study in Turkey in 1974, the preventable trauma death rate can be lowered to 4.2% by means of a proper trauma system.(21) Five years later, they reported that the preventable trauma death rate of patients transferred from other hospitals was 43%, and that of patients transferred directly to a trauma center was only 1.2%.(22) In a study of preventable trauma death rate between hospitals, that in tertiary hospitals was 28.9% compared to 46.5% in first or secondary hospitals.(20) According to Lee, despite a regional emergency medical center, there are many cases in which patients are transferred to other hospitals, such as the lack of an intensive care unit and delay of an emergency operation.(13) Thus, it is necessary to establish trauma centers with a sufficient number of intensive care units and surgical teams. According to Jung, the preventable trauma death rate is 52.3% in emergency rooms, 13.9% at the pre-hospital stage and 18.3% at the

inter-hospital stage.⁽²⁰⁾ We know that there are effects on preventable trauma death rate at the inter-hospital stage. In our study, the lack of a specialist and the appropriate department comprised 67.4% of the reasons for transfer of patients from a secondary to a tertiary hospital. Thus, it is necessary to establish trauma centers with a sufficient number of intensive care units and surgical teams and rooms, due to insufficient specialists at secondary hospitals and intensive care units and operating rooms in tertiary hospitals. Additionally, delayed transfer comprises 40% of cases at the pre-hospital stage, and inappropriate hospital choice comprises 42.9% at the inter-hospital stage.⁽²³⁾ The preventable trauma death rate decreases when an emergency physician boards with an EMS rescuer to classify injury severity at the pre-hospital stage.⁽²⁴⁾ Thus, development of a standardised field service guide and education of EMS rescuers in its use are necessary, together with continuous quality control assessment. Because of the problems at the inter-hospital stage, it is necessary to prepare guidelines regarding EMS rescuers' handling of injured patients. For example, a transfer system law (Emergency Medical Treatment and Labour Act) enacted rules and penalties regarding transfer of injured patients to another hospital.⁽²⁵⁾

Some limitations to our study should be mentioned. First, there are many reports of differences in mortality between level I trauma centers and others, but we instead chose tertiary hospitals in Busan and Kyungnam because there are no level I trauma centers in Korea. Thus, comparisons with studies in other countries were not possible because although tertiary hospitals have the ability to treat injured patients, they do not specialise in such cases.

Second, we have no knowledge of the mortality rate of patients transferred from a secondary hospital or from the scene of an accident, so we were unable to make comparisons with the prognoses of other patients.

Third, we targeted injured patients who were requested to be transferred by the emergency medical information center from a secondary to a tertiary hospital. Those who were transferred without a request by the emergency medical information center or after direct calls from the secondary hospital were excluded. Therefore, this study does not represent all severely injured patients transferred from secondary to tertiary hospitals.

Fourth, we could not find whether or not any resuscitation or treatment the patients received in secondary hospital before transfer to tertiary hospital in the medical records of

the emergency medical information center, so we were unable to predict between any resuscitation or treatment in secondary hospital and prognosis.

Fifth, we gather information of injured patients from emergency medical information center. But there are possibility of mistake because information of injured patients were extracted from sheet of investigation on scene and secondary hospital. So there are possibility of mistake.

V. Conclusion

We found inappropriateness in triage by EMS in the transfer of severely injured patients to a third hospital in Busan and Kyung-nam, Korea. It is important for EMS rescuers to classify injured patients using a field triage protocol and to minimise transport time from the accident scene to the appropriate hospital. Thus, it is necessary to develop and educate EMS rescuers regarding the standardised field service guide and assess quality control continuously. It is also essential to establish a trauma center that can treat severely injured patients appropriately and to develop a helicopter transport system to minimise transport time.

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