Original Article

Application of a First Impression Triage in the Japan Railway West Disaster

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On April 25, 2005, a Japanese express train derailed into a building, resulting in 107 deaths and 549 injuries. We used "First Impression Triage (FIT)", our new triage strategy based on general inspection and palpation without counting pulse/respiratory rates, and determined the feasibility of FIT in the chaotic situation of treating a large number of injured people in a brief time period. The subjects included 39 patients who required hospitalization among 113 victims transferred to our hospital. After initial assessment with FIT by an emergency physician, patients were retrospectively reassessed with the preexisting the modified Simple Triage and Rapid Treatment (START) methodology, based on Injury Severity Score, probability of survival, and ICU stay. FIT resulted in shorter waiting time for triage. FIT designations comprised 11 red (immediate), 28 yellow (delayed), while START assigned six to red and 32 to yellow. There were no statistical differences between FIT and START in the accuracy rate calculated by means of probability of survival and ICU stay. Overall validity and reliability of FIT determined by outcome assessment were similar to those of START. FIT would be a simple and accurate technique to quickly triage a large number of patients.

Key words: simple triage and rapid treatment, injury severity score, probability of survival

I n the emergency department, "triage" refers to the methods used to assess a patient's severity of injury or illness within a short time after their arrival, assign priorities, and transfer each patient to the appropriate department for treatment. As there are various degrees of disasters, it is unlikely that one can apply all the same techniques to patients injured in events that differ markedly. We believe that triage should be driven by real-time events and constraints of the evolving scenario. Different settings must drive different management options [1, 2].

Currently, the Simple Triage and Rapid Treatment

(START) is the most universal physiological trauma severity scoring system, and has been rapidly adopted internationally. Use of the START coded values can allow rapid characterization of neurologic, circulatory, and respiratory distress and assessment of the severity of serious head injuries [3, 4]. The Hospital of Hyogo College of Medicine has been conducting annual drills for possible disasters according to our guidelines for disaster medicine, and our staff is trained to use START to triage patients in emergency department.

At 9:19 AM on April 25, 2005, a Japan Railway express train on JR West's Fukuchiyama Line in Hyogo Prefecture derailed [5]. The crash resulted in 107 deaths and 562 injuries. Since our hospital was located approximately 4.8km (3 miles) from the acci-

dent site, 113 of the injured people were admitted to our hospital within a few hours of the crash; 39 of them required intensive care.

The large number of patients complicated our daily routines and drills, and exceeded our one triage officer's ability to treat the patients in a routine fashion using START. To handle the chaotic situation, we decided to simplify the triage protocol based on general inspection and palpation, which was referred as "First Impression Triage (FIT)".

The aim of this study is to assess the similarities between FIT and START regarding triage decisions, and determine the reliability and accuracy of FIT compared with START in comparison with preexisting methods. Although our scoring system is purely empirical without any mathematical foundation, it correlates well with clinical outcomes in subjects with multiple injuries. FIT, at least at the disaster site, enabled us to triage the injured patients more quickly. This report may be an additional reliable triage strategy when performed by an experienced emergency physician. We would emphasize the importance of flexibility, adaptability, and innovation required in the disaster setting, which might be achieved by annual drills for planning, rehearsing, and exercising various disaster scenarios.

Methods

Hospital setting and subjects.   The study was conducted at the Hospital of Hyogo College of Medicine. Approvals were obtained from the Hyogo College of Medicine institutional review boards. The records of all 113 patients who visited our hospital were studied retrospectively. Patient records were reviewed and compared with our original algorithm.

Triage procedures.   Triage was performed in the ER, and the senior healthcare professional categorized patients with colored tags based on acuity of illness or injuries and survivability; those requiring "immediate" care were tagged red, "delayed" care were yellow, "minor" care were green, and "expectant" care or "dead" were black. On patient's arrival, an emergency physician performed initial assessment with FIT. Then, after transferring to a designated area, patients were retrospectively reassessed with the preexisting the modified START.

1. FIT: The FIT procedure is shown in Fig. 1.

FIT allows a triage officer to triage a patient in less than a minute by assessing 3 parameters, including the victim's complexion, response to verbal stimuli, and respiratory pattern; a physician examined arterial pulse and skin turgor on palpation. All victims who were able to walk were separated from non-ambulatory victims with green tags. Respiratory pattern was diagnosed as tachypnea, bradypnea, and normal respiration, based on the primary impression of the expert emergency physician. Also, arterial pulse was diagnosed as rapid, slow, weak and normal without mathematical count. The physical examination of skin was assessed for pallor or sweating. Evaluation of consciousness was evaluated by eye response based on the Glasgow Coma Scale [6]. Victims who do not open their eyes, or open their eyes in response to painful stimuli, were categorized with a yellow tag. All of these criteria are categorized in a primary survey described in the guideline of advanced trauma life support [7] and the Japan Advanced Trauma Evaluation and Care (JATEC) Guideline [8].

2. Modified START: The modified START method is shown in Fig. 2. After directing the walking wounded to a designated area, we evaluated respiratory status to determine whether the rate was less than 9 or more than 30 breaths/min. Next, circulatory status was assessed by measuring and assessing whether systolic blood pressure was less or more than 80 mmHg, instead of 2 sec of capillary refilling time (CRT). Neurological evaluation (level of consciousness) was assessed using the Glasgow Coma Scale compromising 3 tests; eye, verbal, and motor responses.

Outcome assessment.   We compared FIT and START in terms of outcomes and triage levels based on values of the AIS-90 system of Injury Severity Score (ISS) [9], probability of survival (Ps) [10] and requirement of ICU admission (whether or not they are admitted to the ICU). Accuracy rate, sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) for the patients who were assigned triage levels of red or yellow by either or both triage methods were evaluated.

Statistical analysis.   The data were analyzed with SPSS software (SPSS, Inc. Chicago, IL, USA). To identify significant pairwise differences in mean START and by FIT test scores, Fisher's test was used. $p < 0.05$ was considered to be significant for all tests.
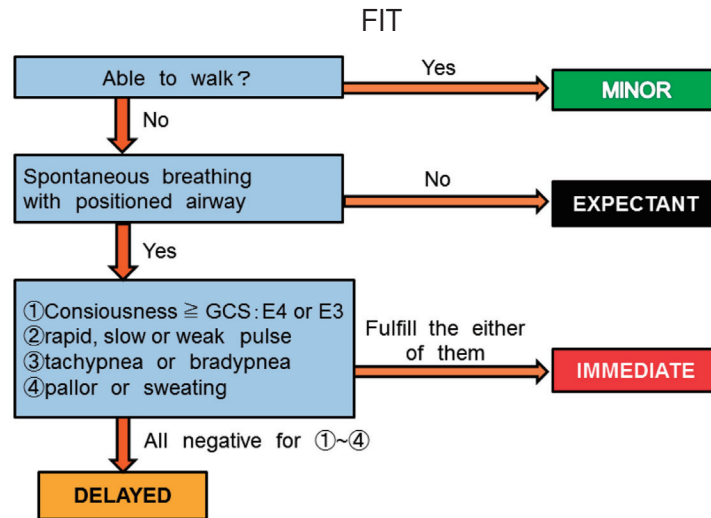
FIT

Fig. 1   Flowchart of FIT procedure, evaluating solely based on expert's quick general inspection and palpation of the patients' radial arteries. At hospital, cardiopulmonary rescue will be performed in case of expectant.
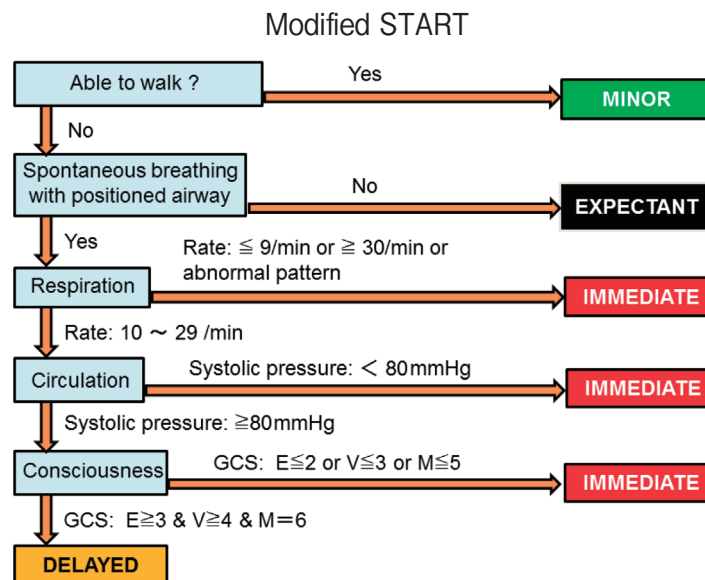
Modified START

Fig. 2   START procedure in our department which has been routinely used in annual drills. Scoring was based on the original START criteria using 4 triage categories (immediate, delayed, minor, and deceased) based on need for urgent intervention. All three START parameters were assessed.

Results

Validity of FIT and modified START regarding triage levels.   Of the 131 patients who were admitted to our hospital, 92 were triaged as green in both FIT and START. Eleven patients were triaged as yellow and 28 were as red in FIT, while 6 patients were determined to be red and 32 patients to be yellow in START. The concordance rate between FIT and START was 76.9%.

Validity of FIT and modified START regarding ISS.   The agreement between FIT and START was determined by ISS score. ISS makes possible a valid numerical description of the overall

Table 1   The patient number triaged by FIT or modified START

START \ FIT	Black	Red	Yellow	Total
Black	0	1	0	1
Red	0	4	2	6
Yellow	0	6	26	32
Total	0	11	28	39

severity of injury in persons. We calculated ISS score for each patient and determined as follows; ISS≥15 to be "truly red by ISS" and ISS<15 to be "truly yellow by ISS". Then, we compared the triage levels made by FIT and START with triage levels made based on ISS. The accuracy rates of FIT and START were 68.4% and 84.2%, respectively. The accuracy rate of START was significantly higher than that of FIT. PPV represented the ratio of the patients with ISS≥15 among patients of red tag. 40.0% by FIT and 83.3% by modified START. NPV, the ratio of the patients with ISS<15 among the patients of yellow tag, were similar in both FIT and modified START (Fig. 3).

Validity of FIT and modified START regarding Probability of Survival (Ps).   Next, we compared FIT and START regarding probability of survival. Ps is a well-known indicator of severity of trauma. We determined the Ps score of <50 as "truly red in Ps" and Ps score ≥50 as "truly yellow in Ps". The accuracy rates of FIT and START were 89.5% and 81.6%, respectively. The evaluation of the patients' outcome in terms of Ps could be made in a similar accuracy manner in both FIT and START. PPV and NPV for Ps were similar in both FIT and START methods (Fig. 4).

Validity of FIT and modified START regarding ICU stay.   An appropriate decision is deemed to have been made if a patient is allocated to an acuity rating that is suitable for his or her condition. One parameter is whether the patient required ICU care. We determined to be "truly red in ICU stay" and "truly yellow in ICU stay" when the patient required ICU care or not, respectively. The accuracy rates of FIT and START were 94.7% and 84.2%, respectively. The PPV for ICU stay was 50.0 in RAT and 0 in START, respectively (Fig. 5).

ISS	AR	Sens.	Spec.	PPV	NPV
FIT	68.4%	40.0%	78.6%	40.0%	78.6%
START	84.2%	50.0%	96.4%	83.3%	84.4%

Fig. 3   Validity of FIT and START regarding Injury Severity Score (ISS). AR, accuracy rate; Sens., sensitivity; Spec., specificity; PPV, positive predictive value; NPV, negative predictive value.

Ps	AR	Sens.	Spec.	PPV	NPV
FIT	81.6%	80.0%	81.8%	40.0%	96.4%
START	89.5%	60.0%	93.9%	60.0%	93.9%

Fig. 4   Validity of FIT and START regarding Probability of Survival (Ps).

Required ICU stay			
FIT	START	5
FIT	START	0
FIT	START	1
FIT	START	0

Required ICU stay			
FIT	START	26
FIT	START	4
FIT	START	1
FIT	START	1

ICU stay	AR	Sens.	Spec.	PPV	NPV
FIT	84.2%	83.3%	84.4%	50.0%	96.4%
START	94.7%	100%	93.8%	0.0%	100%

Fig. 5   Validity of FIT and START regarding ICU stay.

Discussion

Triage is derived from the French word "*trier*", meaning "to choose among several". In emergency medicine, triage means classifying patients based on their medical condition with the overall objective "to do the greatest good for the greatest number" [11]. Currently, START is the best and most universal physiological trauma severity scoring system. This method was developed in 1983 by the staff members of Hoag Hospital and Newport Beach Fire Department located in California. Use of START can allow rapid characterization of neurologic, circulatory, and respiratory distress and assessment of the severity of serious head injuries to identify potential life threatening emergencies.

Our hospital conducts annual disaster drills. We have adopted the START triage system as our standard routine triage method. Our routine triage manual had estimated the number of patients to be around 30. However, this unexpected accident resulted in overcrowding in the emergency department of our hospital by accepting 113 patients within 1 h, which caused prolonged waiting time and increase of patients' risk by delaying access to care and reducing the ability of

ER staff to provide patient care with high quality. Bostick *et al.* reported that a triage officer was under severe time pressure when required to treat more than 25 patients an hour, and it became impossible for the officer to satisfactorily carry out the task when the number of patients rose above 30 per h for 2 or more consequent hours [12]. Accordingly, we needed to shorten the triage time and applied a novel FIT procedure, allowing first response to triage a patient in fewer than 30–60 sec. Since the most seriously injured victims require more immediate care, FIT allows providers to quickly identify those critically injured, so that appropriate resources can be allocated to them first. The difference between FIT and START is that a palpable radial pulse replaces capillary refill or measurement of blood pressure as the tool used to estimate volume status [13]. Although our scoring system using FIT is purely empirical without any mathematical foundation, it correlates well with clinical outcomes in subjects with multiple injuries.

Effective triage must incorporate not only health status but also moral, ethical, and legal perspectives, limited sources, and competing healthcare demands. Clinically experienced doctors, who can assess patients in the minimum amount of time in regard to their need for treatment, are required in our FIT. Several reports suggest putting an experienced doctor into triage, so that they can promptly identify potential emergencies and ailments, and initiate timely investigation and treatment at this stage [14, 15]. Since we failed to assess the expedition to triage using these methods due to chaotic situation, we conducted a follow-up study to simulate FIT and START using patients visiting our emergency unit. START method took 5 min for triage 10 ER patients, while FIT required less than 2 min to triage 10 patients.

Kahn *et al.* reported that the overall accuracy of START was 44.6% [3]. In addition, a single didactic 2–hour educational session using slides and videos on START dramatically improved mean post-test scores (from 55% correct to 75% correct), suggesting that even well-educated pre-hospital providers often mis-triage unless they have specific START training [16]. Thus, START is not always considered to be the best triage method [17]. There is no single correct way to perform the task of triage and it is unlikely that one can apply all of the same tech-

niques to events that differ markedly.

This investigation has several limitations. The primary limitations of this study are those associated with retrospectively collected data. More notably, the study methodology could not discern whether errors in assignment of triage categories resulted from failure of the triage algorithm as a tool or failure of emergency personnel to apply it correctly. In addition, our triage using START was performed retrospectively using the patients' records. Although a capillary refill test is conducted to check the victims' circulatory function in original START, we retrospectively used blood pressure and heart rate. To evaluate consciousness, we used GCS instead of testing if the victim can follow simple commands. Thus, there may be discrepancies between START and modified START which we applied in this study.

In conclusion, we performed a retrospective, observational study before and after implementation of FIT and START. The FIT method can be performed more quickly than START, because time-consuming processes, such as counting respiratory rate or measuring blood pressure, are omitted. In general, the accuracy rates of triage levels were comparable between START and FIT. The triage system should be designed to identify patients who most likely benefit from the care available under austere conditions. The importance of early and rapid triage is clear, and the desirability of functioning as closely as possible to the daily routine emergency medical services has been expressed. Our novel FIT method performed by experienced physicians in terms of general inspection and palpation might be another approach in mass emergency treatment.

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