Activation intervals for a helicopter emergency medical service in Japan

Title

Activation Intervals for a Helicopter Emergency Medical Service in Japan

Yuko Ono, MD[1,2]*, Mariko Satou, MD[1], Yukihiro Ikegami, MD, PhD[1], Jiro Shimada, MD, PhD[1], Arifumi Hasegawa, MD, PhD[1], Yasuhiko Tsukada, MD[1], Chiaki Nemoto, MD[1], Kazuaki Shinohara, MD, PhD[2], and Choichiro Tase, MD, PhD[1].

1. Emergency and Critical Care Medical Center, Fukushima Medical University, Fukushima, Japan

2. Emergency and Critical Care Medical Center, Ohta General Hospital Foundation, Ohta Nishinouch Hospital, Koriyama, Japan

*Corresponding Author: Yuko Ono, MD

Emergency and Critical Care Medical Center, Fukushima Medical University

1 Hikarigaoka, Fukushima 960-1295, Japan

Tel: 81-024-547-1581

Fax: 81-024-547-3399

E-mail: windmill@fmu.ac.jp

Abstract

Introduction

Prehospital time is crucial for treating acute disease; therefore, it is important to activate Helicopter Emergency Medical Services (HEMS) promptly. We investigated the differences in the activation intervals (the time elapsed from receiving the emergency call to the time of HEMS request) under various conditions to evaluate the current status of HEMS-related prehospital triage in Japan.

Methods

We retrospectively investigated activation intervals under exogenous (trauma, n=553; intoxication, n=56; and burns, n=32) and endogenous conditions (acute coronary syndrome [ACS], n=47, and stroke, n=173) between January 31, 2008 and January 31, 2012 by reviewing flight records.

Results

Activation intervals were trauma (14.3 ± 11.5 min), intoxication (10.3 ± 8.6 min), burns (15.0 ± 13.1 min), ACS (17.9 ± 14.6 min), and stroke (19.1 ± 13.1 min). One-way analysis of variance (ANOVA) showed a significant difference between exogenous and endogenous groups ($P < .001$). Post-hoc analysis using Tukey's honestly significant difference test showed significant differences between ACS and intoxication ($P < .05$), stroke and intoxication ($P < .001$), and stroke and trauma ($P < .001$).

Conclusions

Endogenous conditions had longer activation intervals, which may reflect a lack of mechanisms assessing their severity. We are considering developing new triage criteria for dispatchers.

Text

Introduction

Helicopter Emergency Medical Services (HEMS) are one of the best methods of providing immediate lifesaving medical treatment at incident scenes. HEMS in Japan are called Doctor-Helicopter Services, and each one is staffed with specially-trained physicians and nurses. Since 2001, these systems have been implemented in Japan[1]. As part of this project, HEMS have been used since January 28, 2008, in the Fukushima prefecture, a region located approximately 200 km north of Tokyo, the capital city of Japan. HEMS have played an increasingly important role in prehospital emergency medical care in Japan.[1, 2]

Many studies have commented on the usefulness of HEMS for managing acute conditions, such as trauma,[3-5] burns,[6] intoxication[7], acute coronary syndrome (ACS)[8] and stroke.[9, 10] Immediate definitive treatment and specialized care are necessary for such patients, and the actions taken during prehospital time are crucial. Under the current Japanese system, only the fire departments (FD) and ground emergency medical system (EMS) personnel can request HEMS if patients need specialized care and rapid transportation. The activation interval (defined as the time elapsed between receiving the emergency call and the time of the HEMS request) depends on the dispatcher's triage assessment. The activation interval is thus considered to be proportional to the difficulty in evaluating the severity of a patient's condition. However, little is known about the activation interval differences between the calls for each acute condition. Therefore, we investigated the differences in the activation intervals for representative exogenous (trauma, intoxication, and burns) and endogenous conditions (ACS and

stroke). This report aimed to evaluate the current status of HEMS related to prehospital triage in Japan.

Methods

We performed a retrospective analysis of prospectively collected data from official flight records. All of the patients in this study were transported from the scene of the incident by the Fukushima HEMS between January 31, 2008, and January 31, 2012. Cases of inter-facility transport were excluded because there is no decision on the part of the dispatcher about utilizing HEMS transport, no involvement of prehospital EMS personnel, and no triage assessment. We compared the activation intervals of representative exogenous conditions (trauma, intoxication, and burns) with those of endogenous conditions (ACS and stroke). These conditions were analyzed because the sample number and uniformity were assured and because numerous reports mentioned the utility of HEMS under such conditions.[3-10] The statistical analyses were performed using SPSS 17.0 (Japan Inc.). The differences amongst these 5 conditions were assessed using one-way analysis of variance (ANOVA). Tukey's honestly significant difference tests were used for post-hoc analysis. *P* values of $< .05$ were considered to be statistically significant. This study was approved by the Institutional Review Board of the authors' institution.

Results

We identified 1,580 patients who were transported by the Fukushima HEMS during the study period. Figure 1 shows the percentage of patients who were transported.

Approximately one-third of the HEMS requests were for trauma (n = 553, 35.0%), and there were relatively few requests for the remaining exogenous (intoxication, n = 56, 3.5% and burns, n = 32, 2.0%) and endogenous conditions (ACS, n = 47, 3.0% and stroke, n = 173, 11.0%) studied. Cardiopulmonary arrest (CPA) (n=139, 8.8%) was defined as the state that ensued after HEMS was dispatched in response to a life-threatening condition, but the patient never achieved the return of spontaneous circulation despite advanced life support provided at the scene. Policies exist that prohibit transporting such patients in the Fukushima HEMS; therefore, these patients were transported by ground ambulances to hospitals near the scene. The "other" endogenous conditions category (n=34, 2.2%) included aortic dissection, hematemesis, myocarditis, infectious disease, etc. The "other" exogenous conditions category (n=14, .9%) included heat stroke, electrocution, suffocation, drowning, etc. The "miscellaneous" category (n=329, 20.8%) included psychogenic disease, patients without a confirmed diagnosis, dispatches (e.g., a Disaster Medical Assistance Team), etc. The CPA category was not analyzed because it was off-label (ineligible to use) for the Fukushima HEMS. The "other" endogenous conditions, the "other" exogenous conditions, and the "miscellaneous" categories were not analyzed because the sample number and/or uniformity were not assured in this study. Cancellation (n = 203, 12.8%) was defined as abandoning the flight after a request had been placed and the engine had been started. The Fukushima HEMS has allowed dispatchers to request Doctor-Helicopter Services before evaluating the patient if severe illness or injury was suspected based on the emergency call. However, the flights were cancelled if the patient's condition was not deemed severe enough to warrant using HEMS after the ground EMS personnel's evaluation at the scene, if the patient's condition was deemed

as too severe for survival, or if poor visibility made it impossible to fly to the site.

Table 1 shows the activation intervals for representative acute conditions. We found significant differences between the groups with exogenous and endogenous conditions (one-way ANOVA, F = 8.097, $P < .001$) and performed post-hoc analysis using Tukey's honestly significant difference tests. We identified significant differences between ACS and intoxication ($P < .05$), stroke and intoxication ($P < .001$), and stroke and trauma ($P < .001$). The endogenous conditions had longer activation intervals than the exogenous conditions.

Discussion

The most important role of HEMS is the rapid transportation of an air medical team to the scene of an incident to provide immediate, lifesaving medical treatment, such as fluid resuscitation, drug administration, and tracheal intubation. EMS personnel can undertake such prehospital interventions in the United States. However, EMS personnel in Japan are not trained for or allowed to perform such interventions. As an alternative, HEMS in Japan allows patient management by a specially trained physician and nurse at the scene. Therefore, HEMS in Japan are expected to play a more important role in prehospital emergency care than their counterparts in the United States.

The HEMS in Japan operate according to a "filter model," which requires the FD and ground EMS personnel to evaluate the severity of the patient's condition and transportation needs before requesting HEMS.[1] Therefore, it is important for them to triage patients and request HEMS without delay. The dispatch criteria for the Fukushima HEMS are as follows: (1) a need for specialized care, (2) a life-threatening

(or possible life-threatening) injury or illness, and (3) a need for an immediate diagnosis or lifesaving treatment by physicians. Any one of these three criteria is sufficient for HEMS dispatch. Because these criteria are subjective, the activation interval is primarily determined by the dispatcher's training and triage competence.

This study revealed significant differences in the activation intervals between ACS and intoxication ($P < .05$), stroke and intoxication ($P < .001$), and stroke and trauma ($P < .001$). We suspect the following reasons for these differences. First, the concepts of a high-energy mechanism of injury in trauma cases, and information about lethal doses or substances in intoxication cases help the dispatcher to make triage decisions. The dispatcher can deduce the severity of a patient from such information even when receiving an emergency call. ACS and stroke do not have such concepts to consider, which makes triage more difficult. Second, there are definitive clinical indicators to help evaluate severity in cases of trauma and burns. The Centers for Disease Control and Prevention (CDC) Guidelines for Field Triage of Injured Patients, [11] and American Burn Association Burn Center Referral Criteria, [12] which are both also popular concepts in Japan, specified the patients who need specialized care. Evaluation scales, such as the Cincinnati Prehospital Stroke Scale, which is based upon combination of physical findings (facial droop, arm drift, and speech clarity), may help the dispatcher identify stroke patients, [13] and sudden onset physical conditions, such as chest pain, jaw pain, diaphoresis, shortness of breath and prehospital electrocardiogram, may help the dispatcher identify the ACS patients.[14] However, these physical findings do not always correspond to severity, which may cause the dispatcher to hesitate before requesting HEMS. Furthermore, these physical findings are not specific and may result from other medical conditions. Frendl DM and colleagues reported that EMS personnel using the

Cincinnati Prehospital Stroke Scale did not improve the identification of stroke patients and on scene time. [15] The physical findings (anatomical assessments) in cases of trauma and burns directly corresponded to severity, which should allow the dispatcher to request HEMS faster. The severity of the endogenous condition is more difficult to determine, as opposed to the severity of exogenous conditions. Therefore, it is more difficult for the dispatcher to judge when HEMS should be requested under endogenous conditions than under exogenous conditions.

One solution to this problem is to increase the use of "keywords requests". This system allows the dispatcher to request HEMS before evaluating the patient at the scene if certain keywords are mentioned in the emergency call (i.e., the patient ejected from a vehicle, penetrating trauma, a sudden onset of chest tightness, hemiplegia, or coma). The appropriate use of keywords can help to reduce hesitation by the dispatcher, decrease the activation interval, and increase the number of HEMS requests. The Fukushima HEMS had allowed dispatchers to request in a similar manner (i.e., before evaluating the patient at the scene if severe illness or injury was suspected according to the emergency call), but there were no definite criteria, and each dispatcher had requested HEMS according to his own judgment. A prospective study is needed to investigate methods of changing the activation intervals and the number of HEMS requests in Fukushima, Japan, after establishing official criteria for the keywords requests; we are considering conducting such a study. Although it is recognized that this triage method will result in over-triage and over-cancellation of HEMS, a certain amount of over-triage is deemed necessary. Giannakopoulos and colleagues[16] have reported that a low HEMS activation threshold prior to evaluating patients at the scene (Primary Launch Criteria) resulted in a 43.5% flight cancellation rate and 4.0%

under-triage. They concluded that this combination of over-triage (cancellation) and under-triage were acceptable and that the additional costs of cancelled missions were within an acceptable range. The cancellation rate in this study was only 12.8%. A lower over-triage rate can increase the risk of an under-triage rate. According to the American College of Surgeons, an under-triage rate of 5.0-10.0% is considered unavoidable and is associated with an over-triage rate of 30.0-50.0%.[17] We are now considering official keywords for HEMS requests to decrease the activation threshold and to try to increase simultaneous HEMS and ground EMS personnel dispatches. A larger number of minor injuries or illnesses will be assessed at the scene, but further evaluations of the patients' severity and choosing the most appropriate hospital for treatment are important tasks that should be performed by the medical flight team. All cancellations should be performed according to policies and procedures in effect. Such a system may reduce the activation intervals and enable early lifesaving treatment by medical flight teams, increase the HEMS request rate, and allow FD and ground EMS personnel to better use Japanese HEMS and dispatches.

This study has several limitations. First, this is a retrospective study with a small sample size, which increases the risk of bias. Second, Fukushima prefecture has both rural/isolated and urban areas, but the differences between various areas were not considered in this study. Additional studies with larger sample sizes are necessary for further analysis. In spite of these limitations, this study describes the current status of HEMS-related prehospital triage in Japan and provides important information that can be used to improve prehospital triage. In conclusion, endogenous conditions have longer activation intervals than exogenous conditions, which may be because of the lack of physical and clinical indicators that help to evaluate the severity of endogenous

conditions. As a result, we are considering developing new dispatch criteria for HEMS to make it easier for dispatchers to evaluate the severity of a patient and to reduce hesitation in requesting HEMS.

Conflicts of Interest

The authors report no conflicts of interest or financial support for this manuscript.

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Figure Legends

Figure 1

The percentage of Patients Transported by HEMS in Fukushima, Japan

HEMS, Helicopter Emergency Medical Services; ACS, acute coronary syndrome; CPA, cardiopulmonary arrest.

Table 1

HEMS Activation Intervals in Fukushima, Japan

HEMS, Helicopter Emergency Medical Services; ACS, acute coronary syndrome

*$P < .05$ compared with intoxication

†$P < .001$ compared with trauma

§$P < .001$ compared with intoxication

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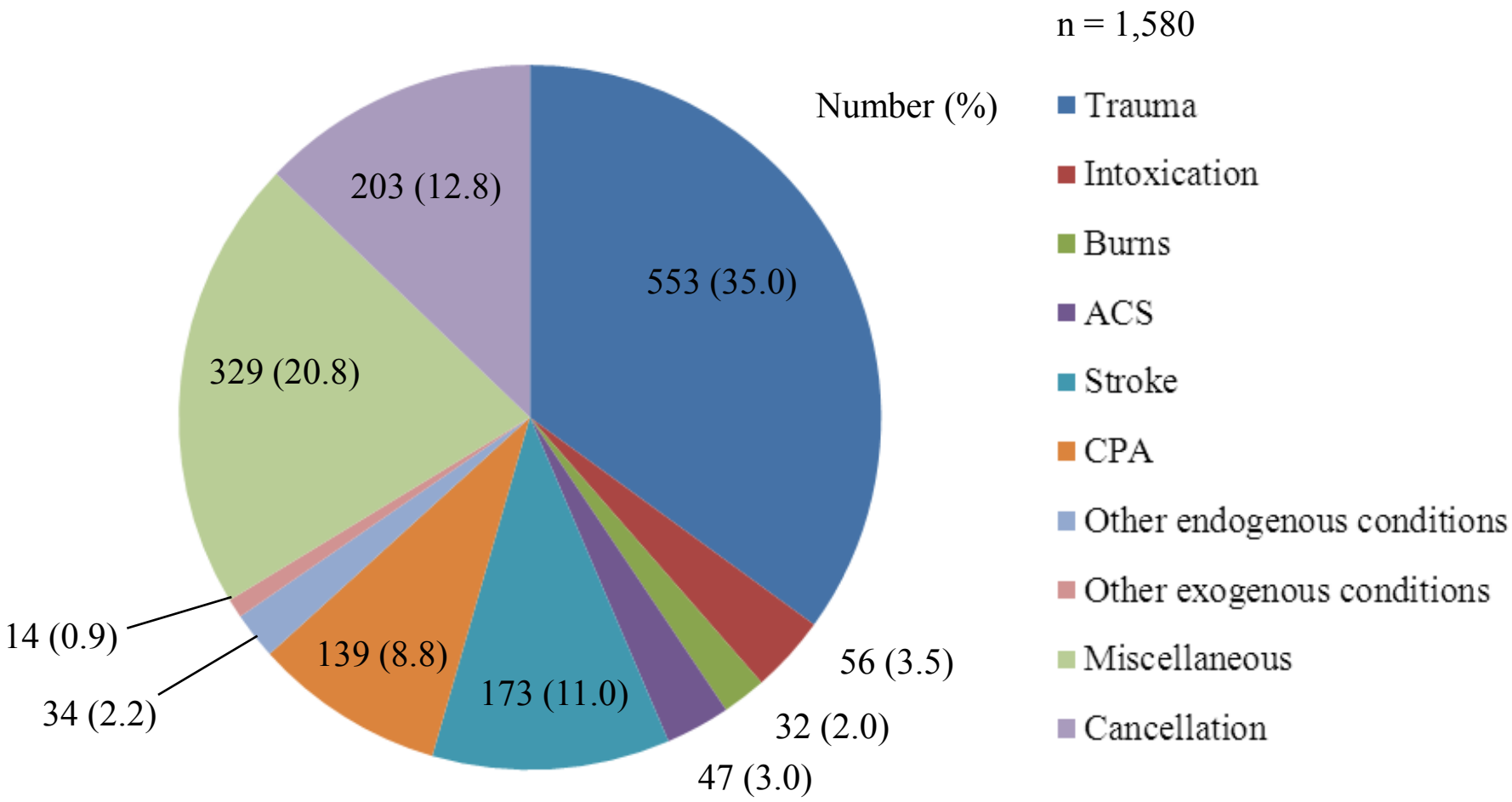
Figure1.

The percentage of patients transported by HEMS in Fukushima, Japan



HEMS, Helicopter Emergency Medical Services;
ACS, acute coronary syndrome; CPA, cardiopulmonary arrest.

Table 1. HEMS Activation Intervals in Fukushima, Japan

Condition	Mean ± SD (95% CI)
Trauma (n = 553)	14.3 ± 11.5 (13.3-15.3)
Intoxication (n = 56)	10.3 ± 8.6 (8.0-12.6)
Burns (n = 32)	15.0 ± 13.1 (10.2-19.7)
ACS (n = 47)	17.9 ± 14.6 (12.9-21.5) *
Stroke (n = 173)	19.1 ± 13.1 (17.1-21.1) † §

HEMS, Helicopter Emergency Medical Services;
ACS, acute coronary syndrome;
*$P < .05$ compared with intoxication
†$P < .001$ compared with trauma
§ $P < .001$ compared with intoxication