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DISPATCH OF HELICOPTER EMERGENCY MEDICAL SERVICES VIA ADVANCED AUTOMATIC COLLISION NOTIFICATION

Hisashi Matsumoto, MD, PHD,*† Kunihiro Mashiko, MD, PHD,*†§ Yoshiaki Hara, MD,*† Takanori Yagi, MD,*† Kazuyuki Hayashida, MD,*† Kazuki Mashiko, MD,*† Nobuyuki Saito, MD,*† Hiroaki Iida, MD,*† Tomokazu Motomura, MD,*† Hiroshi Yasumatsu, MD,*† Daisuke Kameyama, MD,*† Atsushi Hirabayashi, MD,*† Hiroyuki Yokota, MD, PHD,† Hirotoshi Ishikawa,‡§ and Takaji Kunimatsu§

*Shock and Trauma Center, Hokusoh HEMS, Nippon Medical School, Chiba Hokusoh Hospital, Chiba, Japan, †Department of Emergency and Critical Care Medicine, Nippon Medical School, Tokyo, Japan, ‡Japan Safe Driving Center, Ibaraki, Japan, and §Nonprofit Organization of Emergency Medical Network of Helicopter and Hospital, Tokyo, Japan

Reprint Address: Hisashi Matsumoto, MD, PHD, Shock and Trauma Center, Hokusoh HEMS, Chiba Hokusoh Hospital, 1715 Kamakari, Inzai, Chiba Prefecture, 270-1694, Japan

☐ **Abstract—Background: Advanced automatic collision notification (AACN) is a system for predicting occupant injury from collision information. If the helicopter emergency medical services (HEMS) physician can be alerted by AACN, it may be possible to reduce the time to patient contact. Objective: The purpose of this study was to validate the feasibility of early HEMS dispatch via AACN. Methods: A full-scale validation study was conducted. A car equipped with AACN was made to collide with a wall. Immediately after the collision, the HEMS was alerted directly by the operation center, which received the information from AACN. Elapsed times were recorded and compared with those inferred from the normal, real-world HEMS emergency request process. Results: AACN information was sent to the operation center only 7 s after the collision; the HEMS was dispatched after 3 min. The helicopter landed at the temporary helipad 18 min later. Finally, medical intervention was started 21 min after the collision. Without AACN, it was estimated that the HEMS would be requested 14 min after the collision by fire department personnel. The start of treatment was estimated to be at 32 min, which was 11 min later than that associated with the use of AACN. Conclusions: The dispatch of the HEMS using the AACN can shorten the start time of treatment for patients in motor vehicle collisions. This study demonstrated that it is feasible to automatically alert and activate the HEMS via AACN.** © **2016 Elsevier Inc.**

☐ **Keywords—trauma system; helicopter emergency medical services; automatic collision notification; intelligent transportation system**

INTRODUCTION

In most developed countries, emergency medical services (EMS) use of helicopters is common. Generally, these services are called "air ambulance" or "helicopter emergency medical services" (HEMS). In Japan, HEMS crew configuration includes onboard physicians who are dispatched to the scene to provide medical treatment expeditiously (1–3). Japan's approach of including physicians in the HEMS crew differs from that in the United States, but is similar to many European HEMS programs (4–7). Needless to say, medical interventions should be initiated as soon as possible in cases of severe trauma (8–10). To achieve this goal, various types of medical intervention should be initiated before arrival at the emergency department (ED).

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Automatic collision notification (ACN) is an intelligent transportation system (ITS) that provides the car's location using airbag sensors in the car, along with a global positioning system (GPS). Automakers have been developing this technology as advanced ACN (AACN). This system has been designed to enable early recognition of vehicle collisions and prediction of the degree of occupant injury based on collision information, such as impact direction, speed, delta-V (difference in velocity change), number of occupants, rollover, and other data (11,12).

If HEMS with an onboard physician can be alerted by the AACN, it may be possible to reduce the time for HEMS contact. This might lead to improved rates of survival for severe trauma patients. The purpose of this study, therefore, was to validate the feasibility of early HEMS dispatch via AACN.

METHODS

Japanese HEMS System

As a national project under the direction of the Ministry of Health, Labor and Welfare, the Japanese HEMS system was developed based on ADAC in Germany, REGA in Switzerland, and the London HEMS in the United Kingdom (4−7). Since 2001, the HEMS system has been established at 47 bases across Japan; however, nationwide coverage has not yet been achieved. In this system, a helicopter is specially configured for EMS, and helicopter personnel include an onboard physician and nurse. Helicopter personnel are alerted by a direct call from the dispatch center at the fire department (FD) or by an emergency medical technician (EMT) at the scene, and the helicopter is airborne within a few minutes after receiving the call. The helicopter lands at the scene or at a designated temporary heliport, such as a public park, athletic field, or schoolyard nearest the scene. The physician and flight nurse conduct airway management, fluid resuscitation, administration of drugs, and some surgical interventions at the scene or in an ambulance parked at the temporary heliport. Then, the patient is transported to the hospital by helicopter or ambulance. The Japanese HEMS system was founded by the central and local governments with a budget of approximately $1.6 million per year per base hospital. There are no accurate data regarding the percentage of responses that need physician-level care; however, 19.9% of all HEMS missions nationwide were dispatched to the scene of traffic accidents in 2013.

Car Crash Test

A full-scale car crash test was conducted with the use of HEMS and a test car equipped with an AACN system to develop a new approach for a HEMS alert system, according to the experimental flow shown in Figure 1. The study was planned and conducted in collaboration with the Specified Nonprofit Organization of Emergency Medical Network of Helicopter and Hospital (HEM-Net); Toyota Motor Corporation; the Japan Automobile Research Institute (JARI) to conduct the crash test; the Tsukuba FD located nearby JARI; and HELPNET, a private emergency call center. The trauma center of the author's facility is a base hospital for the HEMS base and receives approximately 1,200 requests annually.

The car (Toyota Crown Majesta) equipped with an AACN system was collided head-on against a wall at 50 km/h (32 miles/h) at the JARI crash test facility. Two dummies (HYBRID-III AM50 as a passenger with a seat belt and HYBRID-III AF05 as a driver without a seat belt) were seated in the vehicle. Immediately after the collision, the helicopter with an onboard physician and a nurse on standby at the HEMS base was alerted via the operation center of HELPNET based on the AACN information (Figure 2). The algorithm of AACN developed by Toyota Motor Corporation in collaboration with Wake Forest University was adopted to predict the injury severity of the occupants (13). The helicopter took off from the base hospital while Tsukuba FD personnel were dispatched to the scene and transported the patient (a dummy) to a temporary helipad that was prepared near the crash test facility at JARI. The helicopter landed after the FD ensured the safety of the site, and the medical staff started treatment in the ambulance before transporting the patient to the base hospital by helicopter (Figure 3A).

The actual times were recorded for each segment of the Tsukuba FD and the HEMS response. The estimated times (typical mean times in real life) were set at 5 min for notification of the FD and 7 min for the arrival of EMT personnel at the scene of the collision. These times were based on routine emergency cases in which the HEMS was requested via the FD without use of AACN (Figure 3B). Then, the recorded elapsed time from the test was compared with the estimated time after the full-scale test.

RESULTS

The actual times are shown in Table 1. HELPNET received information via the AACN 7 s after the collision, and the "119" call (corresponding to "911" in the United States) from the HELPNET operator to the Tsukuba FD was made 1 min later. Then, the HEMS was requested via the hotline of the HEMS base 3 min later. The HEMS departed 7 min after the accident and arrived at the temporary helipad 18 min afterward (11 min flight time). Medical intervention was finally started 21 min after the collision.

Without AACN, the times were estimated to be 5 min before the 911 call would be received by the Tsukuba FD