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HELICOPTER EMERGENCY MEDICAL SERVICES (DOCTOR-HELICOPTER) IN FUKUSHIMA PREFECTURE : PRESENT STATE AND PROBLEMS

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Abstract : The purpose of this study is to identify the problems in operating an emergency medical service helicopter with an emergency medicine doctor on board (doctor-helicopter) in Fukushima Prefecture, Japan, which covers wide regions and many rural areas. The study looked at the numbers of flights and patients during the 523 days since the start of the doctor-helicopter service at the Fukushima Medical University Hospital. The items investigated were : number of flights, number of helicopter dispatches per month, number of patients, the hospitals where patients were taken to, the fire department dispatch centers that requested the doctor-helicopter, and the number of times each doctor flew on the helicopter. There were 450 flights. When the service was started, there were a few flights, but they gradually increased. The majority of the flights were to emergency scenes (295), while 75 flights were interfacility transports of critically ill patients, 79 flights were cancelled after take-off, and one flight was for a disaster relief operation. The nature of requests differed greatly depending on the fire department dispatch center requesting the service. The majority of patients were trauma patients (62.2%). Stroke (8.5%) and acute coronary syndrome (5.2%) patients requiring emergency treatment were fewer than anticipated. The final destination hospitals were appropriate hospitals in the region. Because the number of flight doctors is small, the burden on individual doctors is large. A system for early on-site diagnosis and helicopter request by emergency rescue team is required to maintain a high quality of emergency care.

Key words : Helicopter Emergency Medical Services, trauma, destination hospital, flight doctors, rural areas, emergency scene

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INTRODUCTION

Fukushima Prefecture is located in the northern part of Japan which lies within 200 km of Japan's capital of Tokyo. The prefecture stretches 166 kilometers from east to west and 133 kilometers from north to south. It is the third largest prefecture in Japan in land area, with many rural and isolated areas (Fig. 1). It has a land area of 13,782 km² and a population of 2,079,808. It is divided into four regions based on geography, culture, and living sphere: Central Northern (Kenpoku) Region, Central Center/Central Southern (Kenchu/Kennan) Region, Mountain (Aizu) Region, and Coastal (Hamadori) Region (Fig. 1). Each region has one emergency and critical care medical center (ECCMC) and three fire departments (FDs) that conduct pre-hospital emergency care in these regions. However, because the area is large, patient transport by ambulance to an appropriate hospital takes time. Moreover, patients cannot always be accepted without delay at final destination hospitals.

The benefit of a helicopter as an emergency medical service, including a doctor trained in emergency medicine (doctor-helicopter), is that it can transport emergency specialists and nurses to the emergency scene to provide more aggressive prehospital resuscitation, particularly for airway and ventilation management¹⁾. Additional advantages are that an appropriate hospital can be selected from medical points of view, and the patient can be transported in a short time. For these reasons, the use of a doctor-helicopter was one option to improve the quality of emergency medicine in Fukushima Prefecture. Fukushima Medical University

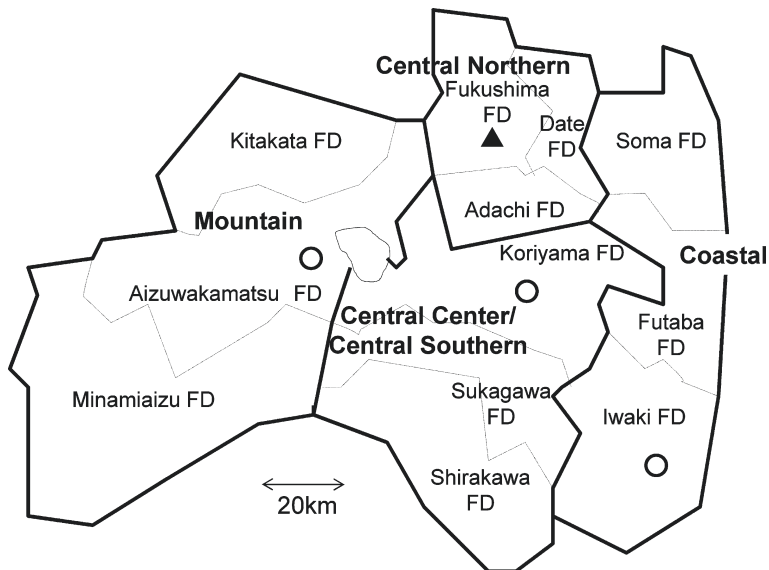


Fig. 1. Fukushima Prefecture

Fukushima Prefecture is divided into four regions: Central Northern Region, Central Center/Central Southern Region, Mountain Region, and Coastal Region. Each region has three fire departments (FD) that provide pre-hospital care. Each region has one Emergency & Critical Care Medical Center (ECCMC)(▲, ○). The base hospital for the doctor-helicopter is Fukushima Medical University Hospital (▲).

Hospital had long desired to have a helicopter, and on January 28, 2008, the doctor-helicopter service was inaugurated. The status of current usage and problems in the operation of this helicopter were investigated.

MATERIAL AND METHODS

The number of flights and patients transported by the doctor-helicopter at Fukushima Medical University Hospital were examined. The study period was the 523 days from January 28, 2008, when the service was initiated, until August 31, 2009. The items investigated were the number of flights and helicopter dispatches per month, the number of patients in the helicopter flights, hospitals where the patients were transported and fire department dispatch centers that made the request when the helicopter was dispatched. The number of flights made by each doctor was also examined.

RESULT

Operation status

There were 450 flights of which 295 were to emergency scenes, 75 were interfacility transports of critically ill patients, 79 were cancelled, and 1 took doctors to outside the prefecture during a disaster. "Cancellation" was defined as abandonment of the flight after the engine was started, after the request was made. All cancellations were for flights taking doctors to emergency scenes. Reasons for the cancellations included: the condition of the patient at the scene was not severe enough to warrant use of the helicopter, the life of the patient could not be saved due to cardiopulmonary arrest (CPA), and poor visibility which made it impossible to fly to the site. The number of flights was low in the early months of the helicopter service, but it has gradually increased (Fig. 2).

Flights to emergency scenes and interfacility transport

1) Requests from fire department dispatch centers

Requests from fire department dispatch centers (Fig. 3) were numerous in Koriyama FD, Sukagawa FD, and Shirakawa FD in the Central Center/Central Southern Regions. There were also many requests from Soma FD and Futaba FD in the Coastal Region. There were few requests from Fukushima FD and Date FD in the Central Northern Region, the Mountain Region, and Iwaki FD in Coastal Region.

2) Conditions of emergency patients and the final destination hospitals

A total of 307 patients were involved in the 295 flights to emergency scenes. The most common conditions were trauma from traffic accidents, occupational accidents, and other reasons (Table 1). CPA was the next most common condition, followed by stroke, intoxication, and acute coronary syndrome (ACS).

About one-third of the patients were taken to the Fukushima Medical University Hospital, and another one-third was taken to three other ECCMCs (Table 2). In other cases,

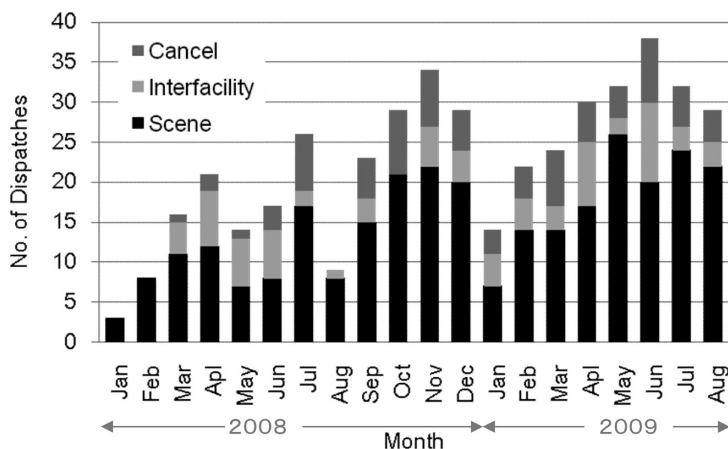


Fig. 2. Number of helicopter dispatches by month ($n=450$)
 This graph shows the helicopter dispatches from January 2008 to August 2009. “Scene” is a direct flight to an emergency scene, “Interfacility” is patient transport from one hospital to another, and “Cancel” is cancellation of a request after the engine had been started or during flight.

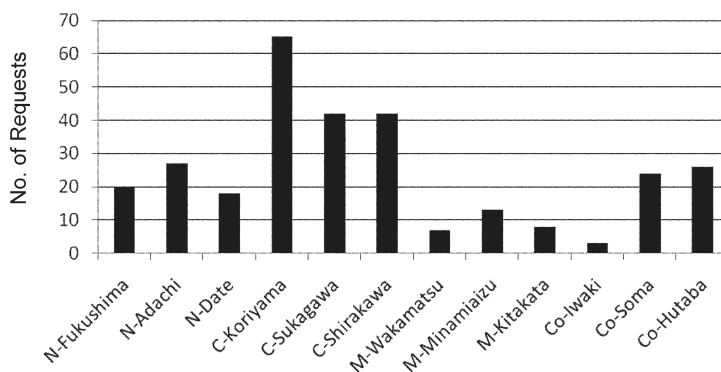


Fig. 3. Fire department making request for helicopter dispatch to emergency scene ($n=295$)
 N : Central Northern Region, C : Central Center/Central Southern Region, M : Mountain Region, Co : Coastal Region. N-Fukushima indicates the Fukushima Fire Department in Central Northern Region.

the patients were transported to appropriate local specialty hospitals. There were no cases in which an appropriate hospital could not be found delaying the transport.

3) Interfacility transports

There were 75 cases of interfacility transport (Table 3). The majority of the cases were ACS, followed by great artery disease, trauma, and stroke.

Number of flights with doctors on board

The flight doctors were full-time emergency specialists (Emergency Specialists), doc-

Table 1. Breakdown of patients' conditions at the time of helicopter dispatches

Patient Condition	No. of Patients (%) (<i>n</i> =307)
Traffic Accident	93 (30.3)
Occupational Accident	54 (17.6)
Other Trauma	44 (14/3)
Cardiopulmonary Arrest	28 (9.1)
Stroke	26 (8.5)
Intoxication	19 (6.2)
Acute Coronary Syndrome	16 (5.2)
Burn	7 (2.3)
Great Artery Disease	4 (1.3)
Others	16 (5.2)

Table 2. Final destination hospital and number of patients transported at time of helicopter dispatch

Destination Hospital	No. of Patients (%) (<i>n</i> =307)
University Hospital*	104 (33.9)
Ohta General Hospital	56 (18.2)
Iwaki Kyouritsu Hospital	22 (7.2)
Aizu Chuo Hospital	21 (6.8)
Others	104 (33.9)

*Fukushima Medical University Hospital (base hospital)

Table 3. Conditions of patients in interfacility transports and numbers of patients

Patient Condition	No. of Patients (%) (<i>n</i> =75)
Acute Coronary Syndrome	25 (33.3)
Great Artery Disease	16 (21.3)
Trauma	10 (13.3)
Stroke	9 (12)
Others	15 (20)

tors on long-term loan from other departments (Other Specialists), senior residents, and emergency specialists from other hospitals (Other Emergency Specialists) (Table 4). The majority of flights involved Emergency Specialists.

DISCUSSION

The doctor-helicopter is an emergency-use helicopter that is sent to emergency scenes

Table 4. Number of flights by each flight doctor

Doctor	No. of Flights
Emergency Specialist A	98 (21.8%)
Emergency Specialist B	86 (19.1%)
Emergency Specialist C	85 (18.9%)
Emergency Specialist D	74 (16.4%)
Emergency Specialist E	39 (8.7%)
Other Specialists (7 doctors)	50 (11.1%)
Senior Residents (2 Doctors)	12 (2.7%)
Other Emergency Specialists	6 (1.3%)
Total	450

“Other Specialist” indicates doctors who have qualifications in specialties other than emergency medicine.

“Other Emergency Specialists” indicate emergency specialists from other hospitals.

in response to requests from fire department dispatch centers or other agencies when emergency medical situations occur at other hospitals. The main role of doctor-helicopters is to transport doctors and nurses to emergency sites¹⁾, so that the maximum on-site emergency treatment can be provided with the minimum medical resources. The ability to respond quickly and appropriately to emergency medical situations and disasters is required of the doctors and nurses who work together on board the doctor-helicopter. In simple terms, a doctor-helicopter is therefore a means to quickly start diagnosis and treatment on site by emergency specialists. Even if an appropriate hospital is far away, patients can be transported to the appropriate hospital in a short time²⁾.

Requests to send the helicopter to emergency scenes are made by fire department dispatch centers based on request criteria. In these cases, fundamentally the flight doctor selects the final destination hospital, usually the regional ECCMC or a central hospital or other appropriate hospital. Interfacility transports are done as a rule by fire/disaster response helicopters, but the doctor-helicopter also responds to interfacility transport requests in extreme emergencies.

Helicopters are generally considered to have a high level of utility in emergency medical settings²⁻⁷⁾, but doubt has been expressed about their effectiveness^{8,9)}. Fukushima Prefecture, however, has many rural areas, and a helicopter is thought to be very effective when patients must be transported long distances to reach a hospital. At distances greater than 10 miles, simultaneously dispatched air transport was faster than ground ambulance in USA¹⁰⁾.

The number of calls was low in the early months of the helicopter service, but it has gradually increased to the current level of about 30 calls per month. However, in August 2008, January and August 2009, the number of flights was extremely limited due to adverse

weather conditions. Inclement weather conditions have also been acknowledged for limitations of doctor-helicopters. In the early months of the service, the proportion of interfacility transports was higher than expected, but after July 2008, the proportion of flights to emergency scenes and the number of cancellations increased. The proportion of helicopter dispatches to emergency scenes was 375 out of 450 (83.3%), indicating that the separation of using doctor-helicopters for emergency scene calls and fire/disaster response helicopters for interfacility transports is functioning well.

A large difference in the number of requests for doctor-helicopter dispatch was seen among fire department dispatch centers. Many requests originated from Koriyama FD, Sukagawa FD, and Shirakawa FD in the Central Center/Central Southern Region. It is thought that the doctor-helicopter is requested, firstly, in those cases that are suspected to be serious and when it is presumed that much time will be required to transport the patient by ambulance. These requests included many in which the request was made before an ambulance arrived at the scene. The ideal case, in which the ambulance and doctor-helicopter arrived at the same time, occurred often. There were also many requests from Soma FD and Futaba FD in the Coastal Region, which do not have nearby ECCMCs. In contrast, there were few calls from Fukushima FD, Date FD, and Adachi FD in the Central Northern Region, which are near the base hospital. This is thought to be because the time required for the doctor-helicopter would be about the same as transport by an ambulance. However, in serious cases, it is more important to take the patient to a hospital appropriate for his or her condition than to transport the patient quickly to the nearest hospital. When a fire department in the area of the base hospital requests a helicopter, in many cases the doctor-helicopter arrives at the scene within minutes, and securing safety by ground personnel often came after the arrival of the helicopter. In the future, through study meetings with organizations that request the doctor-helicopter, it will be necessary to familiarize people to the effectiveness of the doctor-helicopter in emergency medicine and increase its use to an appropriate rate.

In a breakdown of reasons for doctor-helicopter dispatch to emergency scenes, trauma from traffic accidents, occupational accidents, and other causes accounted for 62.3% of the cases. This tendency is similar at other facilities^{11,12)} in Japan. Although helicopters are thought to be highly effective in cases of ACS or stroke requiring emergency measures^{2,3)}, these conditions together accounted for only 13.6% of dispatches. Establishment of a system to identify these conditions at an early stage on telephone calls to emergency services and to quickly request a helicopter is an issue for future study.

In transporting patients from emergency scenes by doctor-helicopter, there are “U-turn” flights, in which patients are transported back to the base hospital, and “J-turn” flights, in which patients are transported to other appropriate hospitals within the region of the emergency scene. In general, it is thought that, after the doctor-helicopter arrives at a scene, the patient is given initial treatment and then transported to the base hospital, where further fundamental treatment is provided¹³⁾. Patient transportation to the base hospital was 72% in the report of Chiba Prefecture¹¹⁾, and was 48% in Hokkaido¹²⁾. But in our cases, patients are transported to Fukushima Medical University Hospital in about one-third of the cases. The

reason for this gap is thought to be that the regional hospital is selected as the most suitable hospital in the region to take the patient in our cases. In serious cases, including trauma and diseases with a high degree of urgency, patients are transported to the regional ECCMC. Patients with ACS or stroke are transported to a specialty hospital in the region, and patients with minor injuries or CPA patients for whom recovery is impossible are transported to a nearby hospital. A concept is being established to transport patients who cannot be treated in each region to Fukushima Medical University Hospital. In the present study, there were no cases in which a hospital could not be found or the patient had to remain at the emergency site, demonstrating that many hospitals are cooperating to support our doctor-helicopter system.

Doctor-helicopters were used for interfacility transports in 16.7% of the cases. Most of these cases had a high level of urgency, and the patient could not receive fundamental treatments in his or her current region. This is thought to reflect a problem in emergency medicine in these regions. Consequently, in most of these cases, the patient was transported to Fukushima Medical University Hospital, where advanced medical treatment is available. Interfacility transports by fire/disaster response helicopters have also increased steadily, which is thought to be a result of the smooth division of activities between doctor-helicopters and fire/disaster response helicopters; doctor-helicopters are used for emergency scene calls and fire/disaster response helicopters for interfacility transports.

Flight doctors and nurses need considerable knowledge and training in aviation medicine. In addition, they must be knowledgeable in various fields of medicine and standard emergency medicine in order to conduct emergency medicine activities at the emergency scene. Therefore, flight doctors must be emergency specialists and are required to participate in "Doctor-Helicopter Training Sessions" sponsored by the Japanese Society for Aeromedical Services. However, only five full-time trained Emergency Specialists currently serve on doctor-helicopters in our department, and the burden on the staff is heavy; finding more doctors to work in the doctor-helicopter is an immediate task. At the same time, doctors on loan from the emergency departments of other medical specialties, senior residents, and emergency specialists from other hospitals also have a strong desire to serve in doctor-helicopters. Therefore, on-the-job, as well as off-the-job training sessions are being conducted for doctors with extensive clinical experience in trauma and other areas. In fact, there were many flights with emergency specialists (84.9%), and the system can adequately handle various conditions at emergency scenes. In addition, emergency specialists are familiar with hospitals in other regions, and can select hospitals in each region that are appropriate to a patient's condition.

Requests for the doctor-helicopter are gradually increasing. However, some fire department dispatch centers making requests do so with the idea that the most important thing is to transport the patient quickly to the nearest hospital, rather than thinking about high-quality medical care that the service can provide. There were few requests for ACS or stroke patients, which require emergency treatment. In the future, it will be necessary to establish a system for early diagnosis at the emergency scene and encourage consideration of the quality of medical care for the patient when requesting a helicopter. For that purpose, it will be

necessary to familiarize fire department dispatch centers about the effectiveness of the doctor-helicopter and to increase the usage of the helicopter to an appropriate rate. It will also be necessary to increase the number of flight personnel, including emergency specialists from other hospitals.

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