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[調査報告]

沖縄県北部地域においてヘリコプターは初期治療開始に要する時間を短縮するか

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Does a Helicopter Shorten the Time Required to Start Initial Treatments in the Northern Area of Okinawa Prefecture ?

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【キーワード】
Okinawa, helicopter, MESH, initial treatment

Abstract

Introduction: "Medical Evacuation Service with Helicopter (MESH)" is the civilian-managed organization which has been engaged in medical services using a helicopter in the northern area of Okinawa Prefecture. Main roles of MESH are not only to transport patients to medical institutions in a short time, but to deliver emergency specialists and nurses to near the emergency scene for earlier medical treatments. The base hospital of MESH also has Doctor-Car, which is equipped with more advanced medical devices than a public ambulance and can be dispatched to the emergency sites with a doctor and a nurse on board. The aim of this study is to clarify whether a helicopter yields earlier starting of initial treatments in compared to ambulances and Doctor-Car. **Methods:** In 236 cases of dispatch to emergency scenes, we retrospectively investigated "Initial Treatment Time (ITT)" which was defined as the interval from an emergency call to an on-board doctor starting initial treatments at rendezvous points. As the comparison group, we simulated two virtual values. One was "expected ambulance transporting time (EAT)" and the other was "expected Doctor-Car time (EDT)". EAT was defined as the hypothetical value representing how much time public ambulance would have needed to transport patient to the nearest hospital, if the helicopter had not been available. EDT was similarly defined as the hypothetical value representing how much time Doctor-Car would have needed to start on-site or en-route initial treatments. **Result:** The average interval of ITT was 26' 47". EAT and EDT were significantly longer than ITT (the paired t-test, $P<0.001$). Conclusion: It was suggested that a helicopter significantly shortens the time required to start initial treatments in this area in comparison to ambulances and Doctor-Car.

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Introduction

The medical circumstances of the northern area of Okinawa Prefecture are insufficient. In this area, natural and wild forest so-called "Yanbaru" abounds and few medical institutions exist. In some areas of Yanbaru, it requires over 45 minutes to transport patients to the nearest hospital, while, in whole of Okinawa Prefecture, the average transporting time overall is 28 minutes[1].

"Medical Evacuation Service with Helicopter (MESH)" is an organization which is engaged in the emergency health service using a helicopter in the northern area of Okinawa Prefecture. Main roles of MESH are not only to transport patients to medical institutions in a short time, but to deliver emergency specialists and nurses to near the emergency scene for earlier medical treatments. When public local fire departments receive emergency calls from citizens, correspondents of fire departments make requests to send the helicopter to the emergency scene based on the request criteria. MESH has a heliport 200m distance from the Northern Okinawa Medical Center, which is the base hospital of MESH, and when the Communication Specialist (CS) of MESH receives requests, a doctor and a nurse quickly move to the heliport and get into a helicopter. MESH has 32 available rendezvous points in the northern area of Okinawa Prefecture and a helicopter flies to the rendezvous point which is the nearest from the emergency scene. Local public ambulances transport patients to the rendezvous point instead of a hospital faraway, and patients can receive earlier medical treatments before being transported to the hospital.

However, emergency medical services that use helicopters, generally called HEMS, usually involve more complicated processes than simple ground transportation. For example, correspondents of local fire departments have to judge whether HEMS is necessary or not, but, in some cases, it is difficult to be decided immediately from limited information. The dispatch request is sometimes made by local ambulance staffs after they arrive at emergency scenes and evaluate patients' status. In addition, a doctor and a nurse have to move to the heliport and aircraft crews should prepare for take-off. It is one of the most important problems how to shorten the interval from emergency call to HEMS team take-off[2]. For these reasons, HEMS cannot usually enable initial treatments to be started earlier than simple ground transportations. Generally speaking, HEMS does not have the time advantage when the transporting time by ambulances is estimated less than 10 minutes[3].

The base hospital of MESH also has Doctor-Car, which is equipped with more advanced medical devices than a public ambulance and can be dispatched to the emergency sites with a doctor and a nurse on board. It is available for pre-hospital cares after sunset or in inclement weather conditions unsuitable for HEMS. It also can be dispatched to the ambulance which is traveling to hospitals, if patients are transported from a distant area. In this way, en-route initial treatments can be started on the ambulance before it arrives at hospitals. Emergency medical service of Doctor-Car does not need any heliports or rendezvous points and it can more rapidly respond to requests than HEMS. Therefore, there may be some cases which Doctor-Car can provide rapider services than helicopters, in particular, when the emergency scene is reachable within relatively short time.

The aim of this study is to clarify whether our HEMS yields a shorter interval between the emergency call and the start of initial treatments in compared to ground ambulances and Doctor-

Car in the northern area of Okinawa Prefecture.

Methods

From June, 2007, when the service was initiated, until June, 2013, MESH accepted 390 requests to dispatch for pre-hospital initial treatments. The details of these have been recorded in the database using the Office Excel 2007, Microsoft Corp.,Redmond, WA, and, it was used for this study.

At first, we retrospectively investigated "Initial Treatment Time (ITT)", which was defined as the interval from an emergency call to HEMS starting initial treatments at rendezvous points. To evaluate ITT, we simulated two virtual comparison values. One was "Expected Ambulance transporting Time (EAT)" and the other was "Expected Doctor-Car Time (EDT)".

We used the following procedures to calculate EAT. If the helicopter was not available, public ambulances would have to transport the patient to the nearest hospital by land route. We assumed that an ambulance would go to the nearest hospital instead of rendezvous points after they picked up the patient. The time required to pick up the patient (PPT: Patient Picking up Time) was defined as the interval between emergency call and ambulance departure from emergency scene. PPT was the real process and it could be derived from the database. On the other hand, the traveling period from the emergency scene to the nearest hospital (TT: Traveling Time) was an unknown quantity, though it was an important factor for the calculation. It was based on the information from public fire station staffs. All local public fire stations have a chart which shows the expected time required to travel from plural representative points in their jurisdiction area to hospitals and it was used for this study. According to parameters above, EAT was calculated as follows.

$$EAT = PPT + TT$$

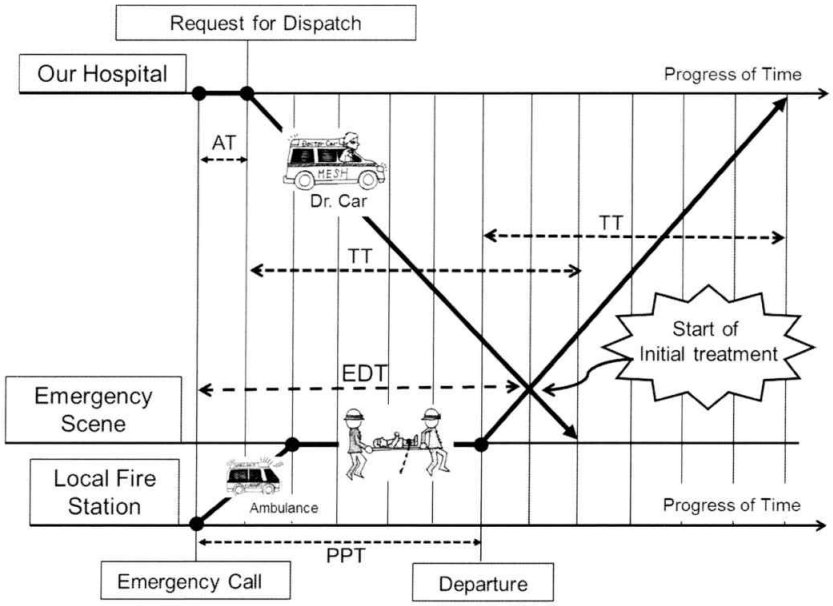
Next, for EDT, we assumed that Doctor-Car would immediately start from our hospital to the emergency scene just after receiving the dispatch request. The departure time of Doctor-Car was an unknown factor, so it was replaced by the time of receiving a request of HEMS. In real missions, it takes a little time to let Doctor-Car depart after receiving a dispatch request, but it was not taken into account in this study. Thus, the activation time (AT) of Doctor-Car was defined as the interval from emergency call to receiving a dispatch request. Simultaneously, local ambulance would pick up the patient and start to transport to our hospital instead of transporting to the rendezvous point. Traveling time (TT) from the emergency scene to our hospital was based on the information from public fire station staffs. The time required to travel from our hospital to the emergency scene by Doctor-Car was considered the same as TT. These two emergency vehicles would travel on a same route to the opposite direction and they would meet each other somewhere on the route. **Figure 1** shows the simulated action of two vehicles and the crossing point of two arrows represents when they would meet each other. According to a method of the railroad diagram, the calculation formula of EDT was as follows.

$$EDT = 0.5 \times (AT + PPT + TT)$$

In some cases, Doctor-Car would arrive at the emergency scene before ambulance staffs finished picking up the patient. In these cases ($PPT > AT+TT$), an on-board doctor and a nurse would start initial treatments at the emergency site and EDT was calculated as follows.

$$EDT = AT + TT$$

Of the 390 requests, 154 cases were excluded from study population for the following reasons. Nineteen cases were canceled. Seven cases were request from remote islands and TT could not be



$$EDT = 0.5 \times (AT + PPT + TT)$$

(if PPT > AT+TT : EDT = AT + TT)

Figure 1 The diagram simulating the movement of Doctor-Car and an ambulance
AT: Activation Time, TT: Traveling Time, PPT: Patient Picking up Time, EDT: Expected Doctor-Car Time

estimated. In 128 cases, PPT did not exist because a helicopter directly arrived at the emergency scene and an on-board doctor started initial treatments there. Thus, 236 cases were available for this study.

We compared ITT with EAT and EDT and the paired t-test (two-sided) was used to test differences among them. A P value was considered statistically significant when $P<0.001$.

Results

For these 236 cases, ITT, EAT, and EDT were 26 minutes and 47 seconds (26' 47"), 53' 13", and the 31' 10" on the average (**Figure 2**) . In a comparison between ITT and EAT, ITT was significantly shorter than EAT in the paired t-test ($P<0.001$). **Figure 3** shows the time effect of HEMS compared to ambulance, which was calculated by subtracting ITT from EAT, and it was 26' 26" on the average. In one case, ITT and EAT were equal, so the time effect of HEMS was zero. ITT was also significantly shorter than EDT in the paired t-test ($P<0.001$). **Figure 4** shows the time effect of HEMS compared to Doctor-Car and its average was 4' 22" . Forty seven dots below the horizontal 00' 00" axis in figure 4 represent the cases which HEMS could not shorten the time required to start initial treatments.

Discussion

MESH is a private organization and its activity costs approximately 100 million yen a year[4]. Its funding depends on the individual fund-raising, the donation of business companies, and support from local public bodies, so it is essential to widely publicize the numerical information of cost-effective benefit of MESH.

It is difficult to discuss whether the time required to operate HEMS is proper or not. Many intuitions have reported the time required to start initial treatments and it varies from 12 to 55 minutes[2)3)5)6)]. Some authors suggest that ideal

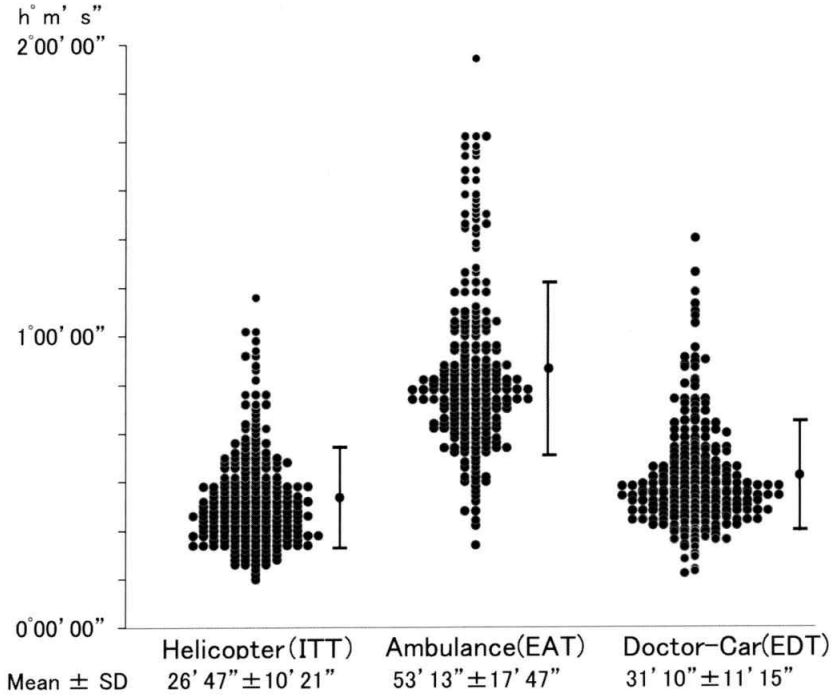


Figure 2　A comparison among three groups (helicopter, ambulance, and Doctor-Car) about the time required to start initial treatments (n = 236)
ITT: Initial Treatment Time, EAT: Expected Ambulance transporting Time, EDT: Expected Doctor-Car Time

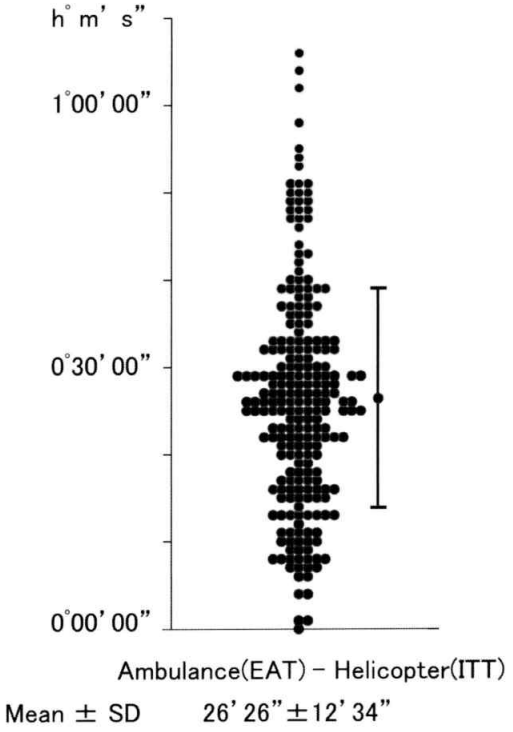


Figure 3　The time effect of helicopters compared to ambulances (n = 236)
The time effect was shown by subtracting ITT from EAT and it was 26' 26" on the average.
EAT: Expected Ambulance transporting Time, ITT: Initial Treatment Time

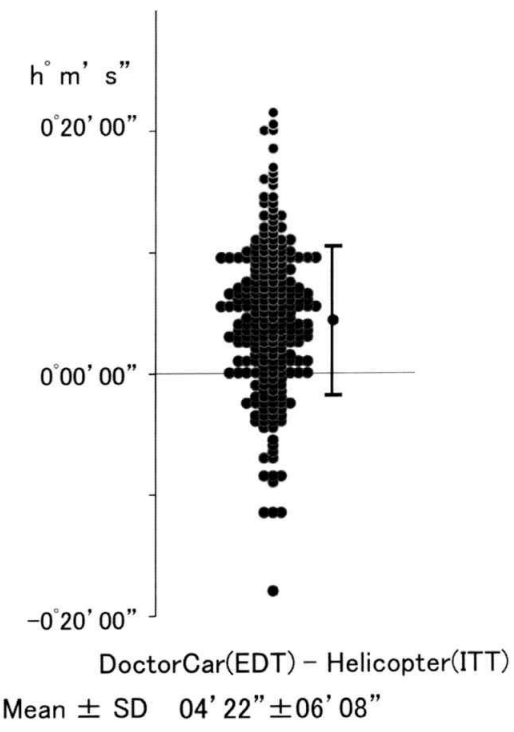


Figure 4　The time effect of helicopters compared to Doctor-Car (n = 236)
The time effect was shown by subtracting ITT from EDT and it was 4' 22" on the average.
EDT: Expected Doctor-Car Time, ITT: Initial Treatment Time

goal of the interval from emergency call to starting on-site medical treatments is less than 20 minutes even in mountainous areas[7]. These data could be one of effective index values in HEMS, but the question whether our time value is proper or not in our region has remained. Emergency vehicles such as public ambulances or Doctor-Car may be good candidates for the comparison group, but it is worried that there is a significant locational bias between the cases of HEMS and land route transfers. In cases which did not require HEMS, emergency scenes tended to be relatively close to the hospital[8)9)].

In this study, we set two imaginary values, such as EAT and EDT. To calculate them, TT is the most important factor and it was based on the information of local fire station staffs. In this area, there are only two emergency hospitals capable of accepting severe emergency patients. Besides, main roads suitable for traveling of emergency vehicles are limited and few traffic jams occur. These circumstances could make TT, EAT, and EDT realistic.

As the result, our HEMS could significantly shorten the starting time of initial treatments in comparison with ambulances and Doctor-Car. The time effect of HEMS was just only about four minutes compared to Doctor-Car (26' 47" vs 31' 10"), but the statistical significant difference was recognized. It should be emphasized that EDT in this study was the shortest time that we could estimate. In actual operations that use Doctor-Car, it would have been longer than this calculated time because it usually requires the time to prepare Doctor-Car, the time to look for an ambulance on a route, the time to find a safe stop place, and the time to get into an ambulance from Doctor-Car.

However, in terms of current drawbacks of HEMS, this study clarified that helicopters were not always able to shorten the starting time of initial treatments. There were 47 cases that patients would have been treated earlier if Doctor-Car had been used instead of a helicopter. Among many factors concerning whether HEMS can shorten the starting time of initial treatments, the distance from a hospital to the emergency scene may be one of the most pertinent factors[5)9)]. We have to establish the standard protocol for dispatch in the choice of helicopter or Doctor-Car.

Finally, our object was to compare the time required to start initial treatments between HEMS, ambulance, and Doctor-Car, but clinical outcome of patients was not designed. Further studies will be necessary to confirm whether our HEMS really improved the prognosis of patients, though the time from incident to initial treatment being started is considered to be influential factors determining patient outcome[10)].

Conclusion

It was suggested that HEMS significantly shortens the time required to start initial treatments in the northern area of Okinawa Prefecture in comparison to ambulances and Doctor-Car. We hope that our study adds a small step toward improving insufficient medical circumstances in this area.

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[調査報告]

沖縄県北部地域においてヘリコプターは初期治療開始に要する時間を短縮するか

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【要　旨】

諸言：MESH（Medical Evacuation Service with Helicopter）は、沖縄県北部でヘリを用いた医療を行う民間組織であり、その主な役割は救急現場に医師や看護師を派遣し、早期の初期治療を開始することである。我々はヘリが早期の初期治療開始に貢献できるか否かを確認した。

方法：実際の救急現場出動236件において、初期治療開始に要した時間（消防覚知から初期治療開始）を後方視的に調べた。比較群として、予想救急車搬送時間（Expected Ambulance transporting Time：EAT）と予想ドクターカー時間（Expected Doctor-Car Time：EDT）の2つの値を設定した。EATは、もしもヘリがない場合、救急車が患者を病院に搬送するのにどのくらい時間を要するかを示す机上の値、EDTはドクターカーを使用したときに現場や路上での診療開始にどのくらい時間を要するかを示す机上の値である。

結果：ヘリは消防覚知から初期治療開始まで平均26分47秒を要していた。これと比べると、EATとEDT はともに有意に長かった。

結論：ヘリは、沖縄県北部において初期治療開始に要する時間を優位に短縮する可能性が示唆された。

【キーワード】
沖縄県、ヘリコプター、MESH、初期治療