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Significance of Prehospital Care Provided By a Doctor Car in Eastern Shizuoka

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Abstract | **Original Research Article**

Background: There have been several reports concerning the dispatch of physician-staffed ambulances and rapid car, with the activities of these vehicles described in detail. Accordingly, we retrospectively analyzed the activities of our doctor car (DC) in order to clarify whether or not the DC is indeed useful for prehospital care. ***Methods:*** From February 2016 to November 2018, a medical chart review was retrospectively performed for all patients transported by the DC to our hospital, and these patients were included as subjects in the present study. The exclusion criterion was transportation to local medical facilities by a normal ambulance equipped with only emergency medical technician (EMT)s after medical management by staff of the doctor helicopter (DH). We compared the vital signs on contact and on arrival at our hospital to investigate the usefulness of the DC separately among subjects with and without cardiopulmonary arrest (CPA). ***Results:*** During the investigation period, there were 89 dispatches of the DC, including 12 subjects with CPA. **T**he average systolic blood pressure on contact tended to be greater than that at hospital arrival, and percutaneous oxygen saturation on contact tended to be lower than on arrival at hospital among the 77 subjects without CPA. The median GCS on contact was lower than that on arrival. Among the 77 subjects without CPA, 74 obtained a survival outcome. ***Conclusion:*** Prehospital medical care provided by the DC tended to improve consciousness and oxygenation of patients without CPA, suggesting that the DC may be useful for improving patients' outcomes.

Keywords: doctor car; vital sign; SPO_2.

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BACKGROUND

Local governments in Japan have established the emergency medical system (EMS) as a public service, and anyone can summon an ambulance free of charge by dialing 119. Most local governments use a one-tier emergency system, with the fire department usually dispatching an EMS team of three emergency medical technicians (EMTs) in an ambulance after receiving a 119 call [1]. Since 2013, some EMTs (who can secure a venous route, secure an airway with instruments and inject adrenaline for patients in cardiac arrest) have been allowed to inject adrenaline for patients with anaphylactic shock, infuse glucose to patients with hypoglycemia and secure a venous route for patients with unstable circulation [1,2]. However, their prehospital activities are still limited compared with physicians'. The Ministry of Health, Labour and Welfare established a physician-staffed helicopter emergency medical service (HEMS) in 1999, which had not previously existed in Japan, and called it the "doctor helicopter" (DH). The results of a trial in two prefectures demonstrated the efficacy of the HEMS, so the Ministry of Health, Labour and Welfare continued to promote the HEMS [3]. The HEMS has provided early transportation, early medical intervention and medical staff delivery to the scene for prehospital variety of diseases [3-9]. By January 2019, 53 DHs had been deployed in 43 prefectures across Japan. The indications for air evacuation in Japan are decided upon the receipt of the 119 (emergency) call based on the judgment of the EMTs when they receive the dispatch request or are put in contact with the patient. However, the Japanese HEMS can fly only in good weather during the daytime. Accordingly, the HEMS cannot respond to dispatch requests in bad weather or at night or fill overlapping dispatch requests. Some areas have started to send a medical team including a medical doctor by ambulance or a fast car from local hospitals to the scene to provide early medical intervention, similar to the HEMS [2,10,11]. Our hospital is a DH base and also has two ambulances that carry a doctor and nurse to provide medical care. One of these ambulances is designated for either neonates or pregnant women for interhospital transportation. The other provides prehospital medical treatment at the scene when the DH cannot respond to a dispatch request during bad weather

or at night time or in cases of overlapping requests [2]. Since 2016, when the number of emergency physicians increased in our department, we have reinforced the use of ambulances for prehospital care, calling these vehicles doctor cars (DCs) (Figure 1). There have been several reports concerning the dispatch of physician-staffed ambulances and rapid car, with the activities of these vehicles described in detail [11-14]. Accordingly, we retrospectively analyzed the activities of our DC in order to clarify whether or not the DC is indeed useful for prehospital care.

METHODS

The protocol of this retrospective study was approved by the review board of Shizuoka Hospital, Juntendo University, and all examinations were conducted in accordance with the standards of good clinical practice and the Declaration of Helsinki.

Shizuoka Hospital, Juntendo University, which is a hospital with 577 beds and a medical emergency center in eastern Shizuoka Prefecture, located near Tokyo, serves a population of approximately 1,230,000. The DH in eastern Shizuoka parks at our hospital and mainly treats patients with severe trauma, acute coronary syndrome, stroke, cardiopulmonary arrest, drowning, decompression sickness, intoxication and unstable vital signs. The indications for the dispatch of the DC are the same as for the DH, but the DC is dispatched when the DH is not available or in case of a mass casualty event requiring multiple doctors and nurses at the scene.

From February 2016 to November 2018, a medical chart review was retrospectively performed for all patients transported by the DC to our hospital, and these patients were included as subjects in the present study. The exclusion criterion was transportation to local medical facilities by a normal ambulance equipped with only EMTs after medical management by staff of the DH. We collected data on each subject's sex, age, final diagnosis, vital signs (Glasgow Coma Scale [GCS], systolic blood pressure, heart rate, and percutaneous oxygen saturation) on DC staff contact and on arrival at our hospital, details of medical treatment and the survival rate. We compared the vital signs on contact and on arrival at our hospital to investigate the usefulness of the DC separately among subjects with and without cardiopulmonary arrest (CPA).

The statistical analyses were performed using a paired Student's *t*-test for systolic blood pressure, heart rate and percutaneous oxygen saturation. The GCS was only compared for the median value. A p-value of <0.05 was considered to indicate a statistically significant difference. All of the data are presented as the mean ± standard deviation.

RESULTS

During the investigation period, there were 23 dispatches of the DC in 2016, 34 in 2017, 46 in 2018 and 103 in total. By contrast, the DH was dispatched 1018 times in 2016, 1175 in 2017 and 1221 in 2018. Reasons for dispatch of the DC were bad weather in 48 cases, overlapping requests of the DH in 38 cases, mechanical trouble with the DH in 8 cases, mass casualty event in 6 cases and outside of the operating time for the DH in 3 cases. Among the 103 dispatches, 6 were cancelled after EMTs checked the patient at the scene because the patient's condition was mild. Eight cases were transported by standard ambulances equipped with only EMTs to local medical facilities after a medical examination by staff of the DC and were all deemed to be in a stable condition. After excluding these 14 cases, 89 were ultimately included as subjects, including 12 subjects with CPA.

The final diagnoses of all subjects are shown in Table 1, and the details of all medical examinations and treatments are shown in Table 2.

The results of our analysis of the change in vital signs between contact with the staff of the DH/DC and arrival at the hospital among subjects without CPA is shown in Table 3. There were no significant differences in the heart rate between these two points. However, the average systolic blood pressure on contact tended to be greater than that at hospital arrival, and percutaneous oxygen saturation on contact tended to be lower than on arrival at hospital, although neither of these differences was statistically significant. The median GCS on contact was lower than that on arrival. Among the 77 subjects without CPA, 74 obtained a survival outcome.

The results of the analysis of the change in vital signs between contact and arrival at the hospital among subjects with CPA are shown in Table 4. There were no significant differences in the heart rate or percutaneous oxygen saturation between these two points. However, the average systolic blood pressure on contact tended to be greater than that at hospital arrival, although not to a statistically significant extent. Two of 12 subjects obtained return of spontaneous circulation, although all subjects with CPA ultimately died.

Figure legend
Upper; outside, Lower; inside

Fig-1: A doctor car in Juntendo Shizuoka Hospital

Table-1: Final diagnoses of subjects

Cardiopulmonary arrest	12
Anaphylaxis	4
Trauma - All blunt	51
Endogenous disease	18
Acute coronary syndrome	3
Stroke	3
Convulsion	3
Acute lung injury	3
Hyperventilation	1
Hypoglycemia	1
Wernicke encephalopathy	1
Diabetes ketoacidosis	1
Abdominal aortic aneurysm	1
Septic shock	1
Exogenous disease	4
Hypothermia	1
Suffocation	1
Near drowning	1
Burn	1

Table-2: Examinations and treatment for all subjects

Drip infusion	77
Oxygen	77
Ultrasound	58
Drug	47
Midazolam	6
Fentany	l4
Vecuronium	4
Adrenaline	3
Tranexamic acid	3
Methylprednosine	2
Diazepam	2
Nicardipine	2
Pentazocine	2
Metoclopramide	2
Glucose	1
Measuring serum glucose	30
Tracheal intubation	23
Electrocardiogram	8
Thoracostomy	4
Open thoracotomy	4
Central venous catheter	3

Table-3: Findings for subjects without CPA (n=77)

	On contact	On arrival	p value
Glasgow Coma Scale	14 (15,12)	15 (15, 12)	
Systolic blood pressure (mmHg)	134.3 ± 35.6	127.5 ± 25.7	0.1
Heart rate (beats per minute)	94.0 ± 23.1	91.8 ± 20.3	n.s.
SPO_2 (%)	95.9 ± 12.8	97.1 ± 11.4	0.09

CPA: cardiopulmonary arrest, n.s.: not significant

Table-4: Results of the analysis for subjects with CPA (n=12)

	On contact	On arrival	p value
Glasgow Coma Scale	3 (3)	3 (3)	n.s.
Systolic blood pressure (mmHg)	0 ± 0	17.6 ± 44.1	0.1
Heart rate (beats per minute) SPO2 (%)	11.8 ± 30.0	29.4 ± 55.3	n.s.
Cause (trauma)	5/12	41.6%	
Drip infusion	12/12	100%	
Tracheal intubation	12/12	100%	
Open thoracotomy	4/12	33.3 %	
Drug (adrenaline)	12/12	100%	
Return of circulation	2/12	16.6 %	
Survival rate	0	0 %	

CPA: cardiopulmonary arrest, n.s.: not significant

DISCUSSION

This is the first study to demonstrate that prehospital medical care provided by the DC tended to improve consciousness and oxygenation of patients without CPA.

Previous studies have indirectly shown the usefulness of physician-staffed cars [11, 15, 16]. A rapid response car with doctors (RRC) as a supplement to the ambulance helicopter in a mixed urban/rural region in Norway performed advanced medical treatment that would otherwise not have been provided for 224 patients among 752 RRC missions[15]. For 181 of these patients, the availability of the RRC was crucial as a substitute for HEMS because the helicopter could not be used due to low visibility or non-operational reasons due to maintenance. However, they did not show any marked improvement in the vital signs or patient outcomes following treatment by the RRC. Abe et al. reported a severe trauma case that occurred at a remote location, in which the patient's life was saved by securing a venous route and receiving tracheal intubation in a DC dispatched from a local medical facility, treatments that could not have been provided

by EMTs in Japan [10]. However, this was only one case report, and the evidence was too weak to demonstrate conclusively the efficacy of the DC system. Sato et al. reported that the door-to-implementation of extracorporeal membrane oxygenation time was significantly shorter in the RRC than in the EMT-staffed ambulance because of earlier successful intubation and intravenous adrenaline administration provided by the RRC [16]. However, these authors also failed to describe the outcome of the patients who were treated by the RRC.

In our study, the average systolic blood pressure on contact tended to be greater than that at hospital arrival. The staff of the DC administered sedatives to patients who required tracheal intubation or restless patients, pain killers to patients with pain and depressors to patients with hypertension. In addition, staff of the DH or DC tried to minimize the infusion of ringer fluid for traumatized patients under the permissive hypotensive theory [17]. These interventions may reduce the blood pressure during transportation.

The present study showed that the prehospital medical care provided by the DC tended to improve consciousness and oxygenation of patients without CPA. Improvement of oxygenation may be induced by tracheal intubation, thoracostomy for pneumothorax and the administration of anticonvulsants for convulsion or adrenaline for anaphylaxis. The lack of statistical significance may have been due to the small number of subjects and/or all of the subjects already having received a high volume of oxygen from EMTs who made contact with the patients earlier than the staff of the DH. The cause for an improvement in consciousness disturbance may be due to an improvement of oxygenation for patients with hypoxia, the administration of glucose for patients with hypoglycemia or anticonvulsants for those with convulsions. Accordingly, this study directly suggested that the prehospital management provided by the DC resulted in improvement of vital signs of patients without CPA.

The present study also showed that outcome of the subjects with CPA was poor even when they received aggressive treatment by the staff of the DC. The patients with CPA due to endogenous disease received the same medical treatment as EMTs, including tracheal intubation or the administration of adrenaline via a venous route from EMTs in Japan. Of note, the prognosis of patients with blunt trauma who enter cardiac arrest is extremely poor [17]. In France, some traumatized patients with CPA managed by a physician-staffed mobile intensive-care unit showed a favorable outcome; however, this report excluded most patients who did not obtain return of spontaneous circulation at the scene [18]. Accordingly, most patients with CPA may not receive any additional benefit from the medical treatment provided by the staff of the DC.

The major limitations of this study include its retrospective nature and small patient population. We also did not compare the outcomes of these patients with those who were transported by standard ambulances staffed by EMTs. Therefore, future prospective studies involving a greater number of patients with a comparison with standard ambulances staffed by EMTs are needed to further assess the significance of our findings.

CONCLUSION

Prehospital medical care provided by the DC tended to improve consciousness and oxygenation of patients without CPA, suggesting that the DC may be useful for improving patients' outcomes.

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Conflict of Interest

The all authors declare no conflicts of interest in association with this study.

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