Original Article

Ambulance calls and prehospital transportation time of emergency patients with cardiovascular events in Osaka City

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Aim: This study investigated the association between the number of phone calls made to hospitals from ambulances requesting if they can accept prehospital emergency patients with cardiovascular events, and the prehospital transportation time.

Methods: Using ambulance records, we retrospectively enrolled adult patients suffering acute myocardial infarction from 1998 to 2007, and out-of-hospital cardiac arrest of cardiac origin from 2000 to 2007, transported to medical institutions by the emergency medical service in Osaka City.

Results: During the study period, 8,596 patients with acute myocardial infarction without arrest and 9,283 out-of-hospital cardiac arrests of cardiac origin were registered. The hospital arrival time (from patient's call until hospital arrival) increased along with the increasing number of phone calls to hospitals from ambulances for patients with acute myocardial infarction (from 23.2 min with one phone call to 39.7 min with ≥5 phone calls; *P* for trend <0.001), and for those with out-of-hospital cardiac arrest (from 24.4 min with one phone call to 36.6 min with ≥5 phone calls; *P* for trend <0.001). In a multivariable analysis, chronological factors such as weekend and night-time were significantly associated with an increment in the phone calls to hospitals from ambulances.

Conclusions: From ambulance records in Osaka City, we showed that the increased number of phone calls to hospitals from ambulances led to prolongation of the hospital arrival time.

Key words: Acute myocardial infarction, ambulance, hospital arrival time, out-of-hospital cardiac arrest

INTRODUCTION

TRANSPORTATION OF ACUTE myocardial infarction (AMI) and out-of-hospital cardiac arrest (OHCA) patients to hospitals by emergency medical services (EMS) is a major public health problem in the industrialized world.[1] To improve their chances of survival, fast transportation and treatment of these patients is important.[1]

Ambulance diversion is one of the major problems concerning emergency care in the USA.[2,3] In Japan, according to a report of the Fire and Disaster Management Agency (FDMA), the time from a patient's call until hospital arrival has increased year by year, reaching approximately 38 min in 2011.[4] Although on-scene EMS personnel in Japan telephone hospitals to see if they can accept prehospital emergency patients, the association between the number of such phone calls from ambulances and the prehospital transportation time has not been sufficiently investigated.

The Osaka Municipal Fire Department has been collecting ambulance records on all patients transported to hospitals by EMS in Osaka City, Japan, a metropolitan community with approximately 2.7 million inhabitants.[5,6] In this study, we investigated the association between the number of phone calls to hospitals from ambulances, inquiring whether they can accept emergency patients, and what the prehospital transportation time is for those with AMI without arrest, and those with OHCA of cardiac origin.

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METHODS

Study design, population, and setting

THIS RETROSPECTIVE STUDY was an epidemiological analysis based on the ambulance records in Osaka City. The study period was from January 1, 1998 to December 31, 2007 in patients with AMI without arrest, and from January 1, 2000 to December 31, 2007 in those with OHCA of cardiac origin. All adult patients aged ≥18 years suffering from AMI without arrest and OHCA of cardiac origin, transported to medical institutions by EMS, were enrolled in this study. This study was approved by the Ethics Committee of Kyoto University Graduate School of Medicine (Kyoto, Japan). The requirement of giving individual informed consent for the reviews of patients' outcomes was waived by the Personal Information Protection Law and the national research ethics guidelines of Japan.

A diagnosis of AMI without arrest was clinically confirmed by the physicians caring for the patients after hospital arrival. Based on the Utstein style,[7] cardiac arrest was defined as the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation. The arrest was presumed to be of cardiac origin unless it was caused by trauma, drowning, drug overdose, asphyxia, exsanguinations, or any other non-cardiac causes, and was determined by the physicians caring for the patients in collaboration with EMS personnel.

Emergency medical service system and hospitals in Osaka City

Osaka City, the largest metropolitan community in western Japan, has an area of 222 km^2, and its population was approximately 2.7 million in 2000 (population density, approximately 12,000 persons/km^2).[8] The municipal EMS system is basically the same as in the other areas of Osaka Prefecture, as previously described.[5,9,10] The EMS system is operated by the Osaka Municipal Fire Department and is activated by phoning 119. In 2007, there were 25 fire stations (60 ambulances) and one dispatch center in Osaka City.[6] Life support is provided 24 h a day. Usually, each ambulance has a crew of three emergency providers including at least one emergency lifesaving technician, a highly-trained prehospital emergency care provider. Osaka City had 194 hospitals (34,209 beds) in 2007.[6] Ninety of them, including five critical care centers, can accept life-threatening emergency patients from ambulances. During the study period, emergency dispatchers in Osaka City did not make phone calls to hospitals for acceptance, and ambulances crews at the scene selected appropriate hospitals, including critical care medical centers, for emergency patients.

Data collection and quality control

Data were collected using a form that included all core data recommended in the Utstein style reporting guidelines for OHCA,[7] including gender, age, initial cardiac rhythm, witness status, location of arrest, bystander cardiopulmonary resuscitation, activities of daily living before arrest, chronological factors, and the time-course of resuscitation. For AMI patients without arrest, we collected gender, age, location, systolic blood pressure, heartbeat per minute, chronological factors, and the time-course of transportation based on ambulance records. In addition, we merged these data with the number of phone calls to hospitals from ambulances to see whether they could accept emergency patients.

The data form was filled out by EMS personnel in cooperation with the physicians caring for the patient, transferred to the Information Center for Emergency Medical Services of Osaka City, and then checked by the investigators. If the data sheet was incomplete, the relevant EMS personnel were contacted and questioned, and the data sheet was completed.

Statistical analysis

The age-adjusted annual incidence and 95% confidence interval (CI) of AMI without arrest and OHCA of cardiac origin were calculated with the use of 2000 census data and data from a 1985 Japanese population model.[8,11] Trends in categorical and continuous variables were analyzed with Cochrane–Armitage tests and linear tests. The hospital arrival time was also assessed after dividing the episode into three components: from patient's call to contact with a patient; from contact with a patient to departure at the scene; and from departure at the scene to hospital arrival. Furthermore, the distance from scene to hospital by the number of phone calls was assessed. A multivariate analysis was used to assess the factors with ≥2 phone calls to hospitals from ambulances. Potential confounding prehospital factors adjusted for the multivariate analysis included gender, age, witness status (only for OHCA patients), location of the emergency, and chronological factors such as the season, day of the week, and time of day. Statistical analyses were carried out using SPSS statistical package version 16.0J (SPSS Inc., Chicago, IL). All tests were two-tailed, and a *P*-value of <0.05 was considered statistically significant.

RESULTS

DURING THE STUDY period, a total of 1,840,784 emergency patients were documented in Osaka City, and the number increased from 153,431 in 1998 to 206,021 in 2007. Of them, 8,596 adult patients with AMI without arrest were transported to hospitals by EMS from prehospital settings, 8,149 of whom (94.8%) were transported to a

Table 1. Prehospital characteristics of acute myocardial infarction (AMI) without arrest and out-of-hospital cardiac arrest (OHCA) of cardiac origin transported by emergency medical service (EMS)

	AMI without arrest		OHCA with cardiac origin	
	1998–2007		2000–2007	
	(*n* = 8,596)		(*n* = 9,283)	
Patient age, years, mean (SD)	67.4	(13.0)	71.7	(14.7)
≥65 years, *n* (%)	5,156	(60.0)	6,661	(71.8)
Men, *n* (%)	6,025	(70.1)	5,597	(60.3)
Witnessed status, *n* (%)				
Arrest not witnessed	—	—	4,968	(53.5)
Arrest witnessed by bystanders	—	—	3,556	(38.3)
Arrest witnessed by EMS	—	—	759	(8.2)
Location, *n* (%)				
Home	5,982	(69.6)	6,440	(69.4)
Public place	1,230	(14.3)	969	(10.4)
Work place	231	(2.7)	807	(8.7)
Healthcare facility†	378	(4.4)	227	(2.4)
Other	775	(9.0)	840	(9.0)
Good ADL, *n* (%)	—	—	6,313	(68.0)
Bystander CPR, *n* (%)	—	—	2,783	(30.0)
VF, *n* (%)	—	—	1,174	(12.6)
Systolic blood pressure, mmHg, mean (SD)	138.3	(36.2)	—	—
Number of heartbeats per minute, mean (SD)	82.5	(26.2)	—	—
Season				
Spring and summer (April–September)	4,023	(46.8)	3,832	(41.3)
Autumn and winter (October–March)	4,573	(53.2)	5,451	(58.7)
Day of the week				
Weekday (Monday–Friday)	6,168	(71.8)	6,709	(72.3)
Weekend (Saturday–Sunday)	2,428	(28.2)	2,574	(27.7)
Time of day				
9.00 AM–5.00 PM	3,271	(38.1)	3,364	(36.2)
5.00 PM–9.00 AM	5,325	(61.9)	5,919	(63.8)
No. of phone calls to hospitals from ambulances, *n* (%)				
1	7,222	(84.0)	6,480	(69.8)
2	863	(10.0)	1,637	(17.6)
3	277	(3.2)	583	(6.3)
4	117	(1.4)	278	(3.0)
≥5	117	(1.4)	300	(3.2)
Unknown	0	(0.0)	5	(0.1)
Time interval from patient's call until CPR by EMS, min, mean (SD)	—	—	8.6	(3.9)
Time interval from patient's call until hospital arrival, min, mean (SD)	24.2	(9.0)	25.7	(7.3)

†Includes chronic care facilities and medical clinics. —, not applicable; ADL, activity of daily living; CPR, cardiopulmonary resuscitation; SD, standard deviation; VF, ventricular fibrillation.

hospital with a cardiovascular medicine department. In terms of adult patients with OHCAs, 15,556 were registered from January 2000 to December 2007, 9,283 of whom (59.7%) were presumed to be of cardiac origin.

Table 1 shows the prehospital characteristics of patients eligible for the study. The most common place of an emergency was home (69.6%) for these patients. Among patients with AMI without arrest, the mean age was 67.4 years, and males (70.1%) were more frequent. A total of 7,222 (84.0%) patients were transported to a hospital with only one phone call from ambulances, and the mean hospital arrival time (from patients' call until hospital arrival) was 24.2 min.

Table 2. Temporal trends in incidence of acute myocardial infarction (AMI) without arrest and out-of-hospital cardiac arrest (OHCA) of cardiac origin transported by emergency medical service

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*P* for trend
AMI without arrest											
All, *n*	916	864	802	814	847	891	901	916	790	855	
Age-adjusted incidence	34.7	32.3	30.3	29.9	31.0	32.8	33.4	33.6	29.1	30.9	0.790
(95% CI)	(32.4–37.0)	(30.1–34.5)	(28.1–32.5)	(27.8–32.0)	(28.9–33.1)	(30.6–35.0)	(31.1–35.7)	(31.4–35.8)	(27.0–31.2)	(28.8–33.0)	
Men, *n*	625	616	570	590	588	632	611	640	559	594	
Age-adjusted incidence	53.4	52.3	49.1	49.5	49.4	53.4	52.1	53.7	47.0	50.1	0.810
(95% CI)	(49.1–57.6)	(48.1–56.5)	(45.0–53.2)	(45.4–53.6)	(45.3–53.5)	(49.1–57.6)	(47.9–56.3)	(49.5–57.9)	(43.0–51.0)	(46.0–54.2)	
Women, *n*	291	248	232	224	259	259	290	276	231	261	
Age-adjusted incidence	17.6	14.8	13.4	12.9	15.2	15.0	16.8	16.1	13.4	14.5	0.860
(95% CI)	(15.5–19.7)	(12.9–16.7)	(11.6–15.2)	(11.1–14.7)	(13.2–17.2)	(13.1–16.9)	(14.8–18.8)	(14.1–18.1)	(11.6–15.2)	(12.6–16.4)	
OHCA of cardiac origin											
All, *n*	—	—	688	746	984	1,198	1,146	1,395	1,464	1,662	
Age-adjusted incidence	—	—	24.2	25.9	34.6	42.0	40.2	48.2	50.3	56.5	<0.001
(95% CI)	—	—	(22.3–26.1)	(24.0–27.8)	(32.4–36.8)	(39.5–44.5)	(37.8–42.6)	(45.6–50.8)	(47.6–53.0)	(53.7–59.3)	
Men, *n*	—	—	420	462	595	734	667	834	911	974	
Age-adjusted incidence	—	—	35.4	38.8	50.3	62.5	56.9	70.7	77.1	82.6	<0.001
(95% CI)	—	—	(32.0–38.8)	(35.2–42.4)	(46.2–54.4)	(57.9–67.1)	(52.5–61.3)	(65.8–75.6)	(72.0–82.2)	(77.3–87.9)	
Women, *n*	—	—	268	284	389	464	479	561	553	688	
Age-adjusted incidence	—	—	14.7	15.9	22.3	24.9	26.5	31.0	30.0	36.6	<0.001
(95% CI)	—	—	(12.8–16.6)	(13.9–17.9)	(20.2–24.7)	(22.5–27.3)	(23.9–29.1)	(28.2–33.8)	(27.3–32.7)	(33.6–39.6)	

—, not applicable; CI, confidence interval; SD, standard deviation.

Among those with OHCA of cardiac origin, the mean age was 71.7 years, and males (60.3%) and no witnesses (53.5%) were more frequent. Of them, 6,480 (69.8%) patients were transported to a hospital within only one phone calls from ambulances, but the remaining 30.3% needed ≥2 phone calls to hospitals from ambulances, and the mean hospital arrival time (from patients' call until hospital arrival) was 25.7 min.

Temporal trends in the age-adjusted annual incidence of AMI without arrest, and OHCA of cardiac origin transported to hospitals during the study period, were noted in Table 2. In patients with AMI without arrest, the incidence showed no significant change during the study period (*P* for trend = 0.79). However, the incidence of OHCA of cardiac origin increased from 24.2 per 100,000 person-years in 2000 to 56.5 per 100,000 person-years in 2007 (*P* for trend <0.001), and the incidence in both sexes had similarly increasing trends.

Table 3 shows temporal trends in ≥2 phone calls to hospitals from ambulances, and the mean hospital arrival time of patients with AMI without arrest and those with OHCA of cardiac origin during the study period. The proportion of ≥2 phone calls to hospitals from ambulances increased exceedingly from 11.6% in 1998 to 25.3% in 2007 (*P* for trend <0.001) among AMI patients, and from 25.0% in 2000 to 38.4% in 2007 among OHCA patients (*P* for trend <0.001). The mean hospital arrival time (from patients' call until hospital arrival) gradually increased from 23.5 min in 1998 to 25.8 min in 2007 (*P* for trend <0.001), and from 25.3 min in 2000 to 27.6 min in 2007 (*P* for trend = 0.022).

Table 4 shows the association between the number of phone calls to hospitals from ambulances and the hospital arrival time (from patient's call until hospital arrival). The mean hospital arrival time significantly increased with the increasing number of phone calls to hospitals from ambulances in patients with AMI without arrest (from 23.2 min with one phone call to 39.7 min with ≥5 phone calls; *P* for trend <0.001), and in those with OHCA of cardiac origin (from 24.4 min with one phone call to 36.6 min with ≥5 phone calls; *P* for trend <0.001). In patients with AMI without arrest, the mean times from contact with a patient to departure at the scene (from 8.6 min with one phone call to 22.6 min with ≥5 phone calls; *P* for trend <0.001) and from departure at the scene to hospital arrival (from 7.6 min with one phone call to 11.9 min with ≥5 phone calls; *P* for trend <0.001) significantly increased with the increasing number of phone calls to hospitals from ambulances. The distance from scene to hospital also significantly increased with the increasing number of phone calls to hospitals from ambulances (from 3.7 km with one phone call to 7.6 km with ≥5 phone calls; *P* for trend <0.001). These results were similar among those with OHCA of cardiac origin.

The prehospital demographic and chronological factors associated with ≥2 phone calls to hospitals from ambulances are noted in Table 5. Gender, location, and witness status (only for OHCA patients) did not affect the number of phone calls made to hospitals from ambulances. The proportion of ≥2 phone calls to hospitals from ambulances among older patients was lower than among younger patients. Chronological factors such as autumn and winter seasons, weekends, and night-time were significantly associated with ≥2 phone calls to hospitals from ambulances. In particular, night-time (17:00–09:00) was strongly associated with ≥2 phone calls to hospitals from ambulances compared with daytime (09:00–17:00) (adjusted odds ratio, 1.67 and 95% CI, 1.47–1.90 in AMI without arrest; adjusted odds ratio, 1.52 and 95% CI, 1.38–1.68 in OHCA of cardiac origin).

DISCUSSION

FROM THE EXTENSIVE ambulance records of patients with AMI without arrest and OHCA of cardiac origin transported to hospitals by EMS in Osaka City, this study showed that the increased number of phone calls to hospitals from ambulances asking whether they can accept prehospital emergency patients with cardiovascular events led to prolonged prehospital transportation time. In addition, the proportion of multiple phone calls to hospitals from ambulances and the mean hospital arrival time (from patients' call until hospital arrival) increased during the study period year by year. These fundamental data indicate the actual prehospital circumstances among cardiovascular patients transported to hospitals by EMS personnel, and may well provide a valuable clue for improving prehospital care in Japan.

This study showed that the increased number of phone calls to hospitals from ambulances was associated with delayed prehospital transportation time, including the time intervals from contact with a patient to departure at the scene and from departure at the scene to hospital arrival. Why did this occur? One reason that hospitals cannot easily accept emergency patients is due to the dramatic increase in the need for emergency transportation in Japan, including Osaka.[4,6] In addition, ambulances are most often used for patients with mild disease, not for true emergencies.[12,13] The prolongation of the time interval from contact with a patient to departure at the scene would be explained partially by the increased number of phone calls as well as the introduction of advanced procedures by emergency medical technicians at the scene in the Japanese EMS system.[4] In addition, the lengthening of the time interval from departure at the scene to hospital arrival could be explained by the increment of transportation distance because EMS personnel could not

Table 3. Temporal trends in the number of phone calls to hospitals from ambulances and the time from patients' call to hospital arrival among patients with acute myocardial infarction (AMI) without arrest and (OHCA) of cardiac origin transported by emergency medical service

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*P* for trend
AMI without arrest											
≥2 phone calls to hospitals from ambulances, *n* (%)	106 (11.6)	102 (11.8)	92 (11.5)	118 (14.5)	111 (13.1)	137 (15.4)	141 (15.6)	186 (20.3)	165 (20.9)	216 (25.3)	<0.001
Time interval from patient's call until hospital arrival, min, mean (SD)	23.5 (9.8)	23.0 (9.2)	23.0 (8.8)	23.8 (8.9)	23.5 (8.4)	24.2 (8.7)	24.3 (8.3)	25.3 (9.0)	25.4 (9.0)	25.8 (8.7)	<0.001
OHCA of cardiac origin											
≥2 phone calls to hospitals from ambulances, *n* (%)	—	—	172 (25.0)	212 (28.4)	232 (23.6)	308 (25.7)	340 (29.7)	433 (31.0)	462 (31.6)	639 (38.4)	<0.001
Time interval from patient's call until hospital arrival, min, mean (SD)	—	—	25.3 (7.3)	25.2 (6.9)	24.0 (6.9)	24.5 (6.9)	25.5 (7.1)	25.6 (7.0)	26.3 (7.3)	27.6 (7.8)	0.022

—, not applicable; SD, standard deviation.

Table 4. Hospital arrival time and distance from scene to hospital by the number of phone calls to hospitals from ambulances

	No. of phone calls to hospitals from ambulances					
	1	2	3	4	5 and over	*P* for trend
AMI without arrest, mean (SD)						
Hospital arrival time (min) (from patient's call until hospital arrival) (*n* = 8,359)	23.2 (8.5)	28.3 (9.0)	30.6 (7.8)	33.8 (9.5)	39.2 (9.3)	<0.001
From patient's call until contact with a patient (*n* = 8,594)	7.2 (2.7)	7.2 (2.5)	7.4 (2.8)	7.5 (2.4)	7.5 (2.9)	0.046
From contact with a patient to departure at the scene (*n* = 8,588)	8.6 (4.2)	11.9 (5.1)	14.3 (5.3)	16.7 (7.3)	22.6 (10.6)	<0.001
From departure at the scene to hospital arrival (*n* = 8,359)	7.6 (6.5)	9.4 (7.6)	9.1 (5.6)	10.2 (5.4)	11.9 (6.6)	<0.001
Distance from scene to hospital (km) (*n* = 8,596)	3.7 (3.8)	4.2 (3.2)	4.8 (2.8)	5.6 (3.1)	7.6 (4.5)	<0.001
OHCA with cardiac origin, mean (SD)						
Hospital arrival time (min) (from patient's call until hospital arrival) (*n* = 9,242)	24.4 (6.8)	26.3 (6.5)	29.5 (6.9)	32.0 (6.9)	36.6 (8.4)	<0.001
From patient's call until contact with a patient (*n* = 9,274)	7.4 (2.7)	7.5 (2.9)	7.5 (2.8)	7.9 (2.9)	7.8 (2.9)	<0.001
From contact with a patient to departure at the scene (*n* = 9,278)	11.6 (4.4)	12.7 (4.5)	14.6 (4.6)	15.9 (5.1)	20.1 (6.6)	<0.001
From departure at the scene to hospital arrival (*n* = 9,242)	5.7 (3.4)	6.4 (3.3)	7.6 (3.5)	8.4 (3.4)	9.0 (4.3)	<0.001
Distance from scene to hospital (km) (*n* = 9,278)	2.7 (2.1)	3.1 (2.5)	4.0 (2.5)	4.6 (2.7)	5.1 (3.2)	<0.001

AMI, acute myocardial infarction; OHCA, out-of-hospital cardiac arrest; SD, standard deviation.

Table 5. Demographic and chronological factors of acute myocardial infarction (AMI) without arrest and out-of-hospital cardiac arrest (OHCA) with cardiac origin transported by emergency medical service (EMS) according to the number of phone calls to hospitals from ambulances

	AMI without arrest		Crude OR (95% CI)	Adjusted OR (95% CI)	OHCA with cardiac origin		Crude OR (95% CI)	Adjusted OR (95% CI)
	No. of phone calls to hospitals				No. of phone calls to hospitals			
	1 (*n* = 7,222)	2 and over (*n* = 1,374)			1 (*n* = 6,480)	2 and over (*n* = 2,798)		
Sex								
Male	5,052	973	Reference	Reference	3,930	1,665	Reference	Reference
Female	2,170	401	0.96 (0.85–1.09)	1.05 (0.92–1.20)	2,550	1,133	1.05 (0.96–1.15)	1.06 (0.96–1.16)
Age, years								
18–64	2,821	619	Reference	Reference	1,801	821	Reference	Reference
≥65	4,401	755	0.78 (0.70–0.88)	0.79 (0.70–0.90)	4,679	1,977	0.93 (0.84–1.02)	0.89 (0.80–0.99)
Witnessed status								
Arrest not witnessed	—	—	—	—	3,480	1,483	Reference	Reference
Arrest witnessed by bystanders and EMS	—	—	—	—	3,000	1,315	1.03 (0.94–1.12)	1.05 (0.96–1.14)
Location								
Home	5,018	964	Reference	Reference	4,436	1,999	Reference	Reference
Other location	2,204	410	0.97 (0.85–1.10)	1.03 (0.90–1.18)	2,044	799	0.87 (0.79–0.96)	0.92 (0.83–1.02)
Season								
Spring and summer (April–September)	3,407	616	Reference	Reference	2,735	1,094	Reference	Reference
Autumn and winter (October–March)	3,815	758	1.10 (0.98–1.23)	1.12 (0.99–1.26)	3,745	1,704	1.14 (1.04–1.25)	1.14 (1.05–1.25)
Day of the week								
Weekday (Monday–Friday)	5,231	937	Reference	Reference	4,753	1,953	Reference	Reference
Weekend (Saturday–Sunday)	1,991	437	1.23 (1.08–1.34)	1.24 (1.09–1.40)	1,727	845	1.19 (1.08–1.31)	1.19 (1.08–1.30)
Time of day								
9.00 AM–5.00 PM	2,882	389	Reference	Reference	2,537	824	Reference	Reference
5.00 PM–9.00 AM	4,340	985	1.68 (1.48–1.91)	1.67 (1.47–1.90)	3,943	1,974	1.54 (1.40–1.70)	1.52 (1.38–1.68)

—, not applicable; CI, confidence interval; OR, odds ratio.

select appropriate nearby hospitals for AMI and OHCA patients. As a result, delayed prehospital emergency systems, including response, scene, and transportation times for emergency patients with AMI and OHCA, results in poor outcomes.[14–16] To overcome this inappropriate ambulance use, an emergency telephone consultation service triage might be helpful.[17]

The present data underscored that chronological factors were associated with the increased number of phone calls to hospitals from ambulances. These results were consistent with those from the report of the FDMA.[18] Generally, most hospitals cannot find a sufficient number of medical staff to work during weekends or at night. Although we did not obtain the reasons for patient rejection from hospitals in this study, the major reasons according to the FDMA report[18] as to why they cannot accept emergency patients were: "untreatable" (22.9%); "all beds occupied" (22.2%); and "patient operation or treatment" (21.0%). Therefore, improvement of hospital systems is needed. One report helpfully showed that active bed control by hospitalists improved ambulance diversion.[19] Furthermore, the linkage between administrative bodies, hospitals, and the general public would be essential to rebuild regional medical systems so that hospitals can always accept emergency patients.

Furthermore, in our multivariate analysis, witness status had no association with the numbers of phone calls in patients with OHCA with cardiac origin in this area. However, unwitnessed OHCA patients might require more phone calls for hospital acceptance than witnessed patients in other areas. The differences in the EMS systems might affect factors associated with the number of phone calls to hospitals from ambulances, and further studies to assess the prehospital transportation time by the number of phone calls according to area is also needed.

The present study also showed that the incidence of AMI without arrest remained stable, but that the incidence of OHCA of presumed cardiac origin increased in this large urban community year by year. Considering that approximately one-third to half of AMI patients had a sudden cardiac arrest as a first symptom,[20] and that most OHCAs of cardiac origin were caused by AMI,[21–23] the incidence of AMI without arrest transported by EMS personnel should be estimated to increase during the study period. However, we cannot estimate the whole incidence of AMI in this study area because of the lack of data on AMI cases that were not transported by EMS personnel. In western countries such as the UK or North America,[24–27] some published reports have shown that the incidence of AMI has decreased due to primary and secondary prevention since 2000. Although the age-adjusted mortality of cardiovascular events gradually decreased overall in Japan,[28] there are sharp regional differences in AMI incidence across Japan.[29–34] Further study is warranted to investigate trends in the prospective, population-based AMI incidence.

In Japan, there were few comprehensive investigations on AMI and OHCA patients transported to hospitals by EMS personnel, including in-hospital treatments. Because it is well known that shortening the onset-to-treatment time is important to improve outcomes among emergency patients with AMI or OHCA,[35,36] we should also assess the association between time to hospital arrival and patient outcomes. Therefore, we need a registry to evaluate the incidence, pre- and in-hospital treatments, outcomes, as well as reasons why hospitals cannot accept the transportation of AMI and OHCA patients. Such data would contribute to providing detailed information on prehospital cardiovascular patients, shortening their hospital arrival time, and improving their outcomes. At present, we are carrying out a comprehensive investigation including both ambulance records and in-hospital treatments in the designated areas,[37] and will report it in the future.

An important limitation of this study is that we did not obtain information on in-hospital outcomes and treatments, such as percutaneous coronary intervention and coronary artery bypass graft, after hospital arrival. In addition, this study lacks data on past history, lifestyles, and medications that would affect AMI and OHCA occurrence in prehospital settings. Another limitation of this study was that we did not identify the reasons why hospitals were not able to accept the transportation of emergency patients with cardiovascular events.

In a large urban community of this kind in Japan, our study established that the increased number of phone calls to hospitals from ambulances, requesting if they can accept prehospital emergency patients, led to prolonging the prehospital transportation time.

CONFLICT OF INTEREST

NONE.

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