**Current Status of Prehospital Care of Patients with Acute
Myocardial Infarction in Tokyo:
Analysis of 3-year Experience with Coronary Care Unit Network**

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To clarify the current status of prehospital care of patients with acute myocardial infarction (AMI) in the Tokyo metropolitan area, the availability of the coronary care unit (CCU) network during the past 3 years (January 1982 through December 1984) was analyzed, examining: 1) final diagnosis, 2) circumstances at the onset of AMI, 3) course of transportation to CCU, 4) time elapsed before admission, 5) severity of AMI, and 6) prognosis of patients. Of 6,939 patients admitted to CCU by means of the CCU network, 2,408 patients (34.7%) had AMI. The patient's decision time was, on the average, 12 hr 3 min, longer when the course of transportation to CCU was more complicated. The fatality for AMI was 17.2%. Causes of death were pump failure in 52.8%, arrhythmias in 62.8% and mechanical failure such as cardiac reupture in 8.5%. Patients with complicated AMI were admitted earlier and had a higher fatality than those without complications.

Thus, 1) community oriented programs are required to more fully inform the population at risk of AMI to shorten the patient's decision time, and 2) more effective means to treat patients with pump failure and to prevent the development of pump failure need to be established.

Key words:

CCU network
Prehospital care
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CRUDE mortality for ischemic heart disease has increased significantly in Japan. In 1984, the crude death rate due to ischemic coronary heart disease was 46.7 per 100,000 compared with 7.4 per 100,000 in 1933 (Fig. 1). Forty to sixty percent of the deaths due to acute

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Fig.1. Changes in the mortality for ischemic heart disease and acute myocardial infarction in Tokyo.

myocardial infarction (AMI) have been reported to occur early after the onset of symptoms, mainly due to lethal arrhythmias. Early prehospital cardiopulmonary resuscitation (CPR) has been shown to result in good survival rates²⁻⁴. Furthermore, early prehospital treatment of patients with AMI has been reported to reduce the later incidence of cardiogenic shock and hospital mortality⁵.

In Tokyo, a Coronary Care Units (CCU) network has been established to treat patients with AMI by admitting them to CCU as promptly as possible. The CCU network is operated through 21 hospitals with the help of Ambulance Units through the Control Room of the Tokyo Fire Department⁶. The tasks of this system are: 1) to admit all patients suspected of having AMI and 2) to perform telephone consultation. The purpose of this study was to clarify the current status of prehospital care of patients with AMI in Tokyo by analyzing the availability of the CCU

network during the past 3 years.

METHODS

From January 1982 through December 1984, 6,939 patients were admitted to CCU using the CCU network in Tokyo. In these patients, the following variables were examined: 1) final diagnosis of these patients, 2) circumstances at the onset of symptoms, 3) course of transportation to CCU, 4) time elapsed before admission to CCU, 5) severity of AMI, and 6) prognosis of patients.

RESULTS

Of 6,939 patients admitted to CCU by means of the CCU network from January 1982 through December 1984, 2,408 patients (34.7%) had AMI (Table I). Another one-third of patients were admitted with a diagnosis of unstable angina,

TABLE I FINAL DIAGNOSIS OF PATIENTS ADMITTED BY MEANS OF CCU NETWORK

	1982	1983	1984	Total
Acute myocardial infarction	822	938	648	2,408
Number of deaths	168	141	104	413
(%)	(20.4)	(15.0)	(16.0)	(17.2%)
Angina pectoris and other cardiac emergencies	934	1,005	803	2,742
Others	663	670	453	1,786
Total	2,419	2,613	1,904	6,936

TABLE II THE TIME INTERVAL FROM ONSET OF AMI TO ADMISSION TO CCU AND FATALITY

	Number of patients	Number of death	Fatality (%)
0 ~ 2 Hr	664	131	19.7
2 ~ 6 Hr	502	75	14.9
6 ~ 12 Hr	192	33	17.2
12 ~ 24 Hr	188	33	17.6
> 24 Hr	307	37	12.1
Unknown	555	104	
	2,408	413	17.2

TABLE III COURSE OF TRANSPORTATION AND THE TIME INTERVAL FROM ONSET OF AMI TO ADMISSION TO CCU

	All patients	Patients admitted within 24 hr
1. Ambulance → CCU	7° 52' ± 24° 03' (n = 494)	2° 56' ± 3° 47' (n = 451)
2. Private physician → ambulance → CCU	19° 11' ± 77° 12' (n = 151)	4° 59' ± 5° 22' (n = 136)
3. Private physician → ambulance → general hospital → ambulance → CCU	22° 51' ± 66° 52' (n = 150)	4° 46' ± 4° 50' (n = 39)
4. Car or ambulance → private physician → car or ambulance → CCU	37° 35' ± 383° 52' (n = 466)	5° 37' ± 5° 29' (n = 369)
5. Walking or car → CCU	34° 44' ± 117° 38' (n = 178)	5° 35' ± 5° 00' (n = 132)
6. Walking → private physician → CCU	16° 31' ± 27° 54' (n = 97)	6° 49' ± 6° 29' (n = 77)
7. Unknown	48° 24' ± 407° 38' (n = 502)	6° 28' ± 5° 52' (n = 345)

congestive heart failure, Adams-Stokes syndrome, aortic aneurysm or cardiac tamponade. Thus, two-thirds of all patients had an absolute indication for admission to CCU. The mean age was 62.3 years, 652 patients (26.0%) being in the range of 60 to 69 years, 627 patients (26.0%) in the 70 to 79 year range, and 490 patients (20.3%) in the 50 to 59 year range. The male to female ratio was 3 : 1.

Of 2,408 patients admitted with diagnosis of

AMI, 1,607 patients (66.7%) experienced acute symptoms at home. Acute symptoms of AMI developed during sleep in 342 patients (14.2%), during meals in 297 (12.3%), while drinking in 179 (7.4%), at rest in 135 (5.6%) and in rest rooms in 111 (4.6%). The remaining 801 patients (33.3%) had symptoms of AMI outside the home.

Six hundred and sixty-four patients with AMI (27.6%) were admitted to CCU within 2 hr after

Fig.2. The time interval between the onset of symptoms of acute myocardial infarction and admission to coronary care units.

TABLE IV KILLIP'S CLASSIFICATION, FATALITY AND CAUSES OF DEATH

	Number of patients	Number of deaths	Fatality	Causes of death		(%)
Killip I	1,348	79	5.9	Arrhythmia	28	6.8
II	438	87	19.9	Pump failure	218	52.8
III	186	66	35.5	Mechanical failure	35	8.5
IV	193	135	69.9	Others	105	25.4
Unknown	243	46		Unknown	27	
	2,408	413	17.2		413	

the onset of symptoms, while 1,116 patients (48%) were admitted within 6 hr after onset (Table II). Patients for whom the interval between the onset of symptoms and admission to CCU was shorter had a higher fatality. Of 2,038 patients in whom the course of transportation to CCU was determined, only 494 patients (24.2%) were directly transferred to CCU from their home by ambulance (Table III). Seeking medical help by doctor's house call and/or office visiting resulted in a longer time lapse before admission to CCU. When the patients were transferred to CCU with the help of the Ambu-

lance Units, the interval between the onset of symptoms of AMI and admission to CCU, the decision time (i.e., the interval between the onset of acute symptoms and a patient's decision to seek medical help), and the hospital emergency delay (i.e., the time spent in the emergency room) were 9 hr 21 min, 5 hr 52 min, and 52 min, respectively (Fig. 2). Without the help of the Ambulance Units, the total interval, decision time, physician delay, and hospital emergency delay were 21 hr 17 min, 14 hr 56 min, 4 hr 8 min, and 2 hr 13 min, respectively.

Fatality and causes of death are shown in

Fig.3. The relationship between Killip's classification and the total time from the onset of acute myocardial infarction and admission to coronary care units.

Table IV. The total number of deaths was 413 (17.2%). Fatality for Killip class I to IV in this study was 5.9%, 19.9%, 35.5% and 69.9%, respectively. Causes of death were pump failure in 218 patients (52.8%), arrhythmias in 28 patients (6.8%), mechanical failure such as cardiac rupture in 35 patients (8.5%), and secondary complications in 105 patients (25.4%).

The relationship between Killip's classification and the interval between the onset of symptoms and admission is shown in Fig. 3. Patients with complicated AMI were admitted earlier than those without complications, which may explain the higher fatality for patients admitted early after the onset of AMI.

DISCUSSION

The goals of treatment for AMI are 1) to prevent deaths due to lethal arrhythmias such as ventricular fibrillation and ventricular standstill which occur early after the onset of AMI, and 2) to limit infarct size, preventing the development of pump failure and other complications. Therefore, it is extremely important to shorten the prehospital phase of AMI, placing patients under a monitoring system as soon as possible. In this study, patient with AMI comprised one-third of all patients admitted by means of the CCU network and another one-third of patients consisted of those with unstable angina and other

cardiac emergencies, which is accordance with previous reports.⁷ Wennerblom et al. reported that of 214 patients suspected by the ambulance staff center of having AMI in Gothenburg, Sweden, a final diagnosis of AMI was made in 65 patients (30.3%), whereas 55 patients (25.7%) had unstable angina, arrhythmias, congestive heart failure or valvular heart disease. The remaining 94 patients (44%) had cardiac neurosis, pneumonia or other disorders.⁷

The overall time from the onset of acute symptoms of AMI until arrival in CCU has been divided into: 1) patient decision time, i.e., the interval between the onset of acute symptoms and a patient's decision to seek medical help, 2) medical decision time, i.e., the interval between the start of medical consultation and the initiation of travel to the hospital, 3) transportation time, i.e., the transport time to the hospital whether by ambulance or by car, and 4) emergency room time, i.e., the interval from arrival in the emergency room until arrival in CCU.⁸⁻¹⁰ Moss et al. reported that in Rochester, N.Y., the overall time from the onset of symptoms to admission to CCU was 5 hr 6 min and patient's decision time was 3 hr 20 min, which was two-thirds of the overall time.⁹ Schroeder et al. reported that the delay from the onset of chest pain to arrival at the hospital was 7 hr 36 min and the decision time to seek medical help 5 hr 7 min, which was also two-thirds of the total

time, whereas the transportation time was only 17 min.¹⁰ Furthermore, an additional 3 hr elapsed in the case of patients who visited the doctor's office or had a house call and then were sent to the emergency room.¹⁰

This study demonstrated that irrespective of whether or not patients were transferred directly to the CCU by ambulance, the patient's decision time comprised one-half to two-thirds of the overall time from the onset of symptoms to arrival at the CCU. When patients were transferred to CCU without the help of the Ambulance Units, a physician delay of 4 hr 8 min was observed, and additional time was spent in the emergency room. Therefore, in order to admit patients with AMI to CCU as soon as possible after the onset of symptoms, several points must be emphasized. First, the patient's decision time has to be shortened. Thus, community oriented programs are required to more fully inform the population at risk of AMI. Second, earlier hospitalization by physicians of patients with chest discomfort is required, minimizing the medical decision time and the emergency room time. Third, the importance of early prehospital CPR has to be emphasized, since it has been shown that early prehospital CPR results in good survival rates.²⁻⁴

This study also showed that the fatality for pump failure such as cardiogenic shock is still high, necessitating future research in this field. Since treatment of refractory heart failure and cardiogenic shock with digitalis, diuretics, vasodilators,¹¹ inotropic agents, and mechanical circulatory support such as intraaortic balloon pumping¹² and positive end-expiratory pressure breathing¹³ is often unsatisfactory, management with an artificial heart and/or cardiac transplantation is required. Furthermore, to limit the ultimate extent of myocardial infarction and prevent the development of pump failure, several interventions including coronary thrombolysis and percutaneous transluminal coronary angioplasty have been performed in patients with AMI as well as animal models of myocardial infarction.¹⁴⁻¹⁶ However, these interventions have to be performed early after the onset of AMI before irreversible injury develops, again emphasizing the importance of early treatment of patients with AMI.

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