Recent Morbidity Trends in Myocardial Infarction in Japan: Investigation of Death Certificates and the Survival Rates at Coronary Care Units

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To elucidate recent trends in the mortality and morbidity of myocardial infarction (MI), we investigated death certificates and changes in the survival rate of MI patients at coronary care units (CCUs), which may affect the death rates.

(1) For all cases of MI, acute heart failure (AHF), heart failure (HF) as underlying cause, and hypertension as underlying cause with HF or AHF (categorized as hypertensive heart disease) on death certificates in two rural and two urban populations between 1981 and 1984, medical records were reviewed and case histories obtained from interviews with patients' families to validate the diagnosis. The number of MI deaths on the death certificates was not underestimated because some MI deaths were misdiagnosed as AHF, HF and hypertensive heart disease and some MI death certificates were misdiagnosed.

(2) Survival of MI patients at CCUs improved in several major cities, Tokyo, Osaka, Wakayama and Asahikawa between 1978 and 1984; a total of 4318 MI deaths were estimated to be averted by CCUs in 1984 compared with the number of deaths in 1978. Therefore, improvement of MI cases at CCUs may be one of the factors attenuating the rise in death rates in all of Japan.

VITAL statistics, morbidity surveillance data and physicians' impressions conflict with regard to recent trends of myocardial infarction (MI) in Japan. Vital statistics point to a declining trend in age-adjusted death rates for ischaemic heart diseases throughout Japan.¹ It was reported from morbidity surveillance that there were rising trends in MI incidence rates in urban populations but not in rural populations during the past two decades.² Physicians generally have the impression that the number of MI patients

has increased.

To explain these discrepancies, two investigations were conducted. One investigated the cases of MI, acute heart failure (AHF), heart failure (HF) as underlying cause, and hypertension as underlying cause with AHF or HF from death certificates to validate the diagnosis. A considerable number of MI death cases have so short a clinical course that they provide no definite clue for being diagnosed as MI. These cases are likely to be diagnosed as AHF or HF on death certificates.

The other investigation was of changes in the number of coronary care units (CCUs) and of MI patients admitted to CCU hospitals and the case fatality rates in order to elucidate the improved survival of MI patients, which may

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TABLE I COMPARISONS OF THE DIAGNOSIS ON DEATH CERTIFICATES AND THE DIAGNOSIS BY THE STANDARDIZED CRITERIA, 1981-1984

Population	Death Certificate		Standardized Criteria				
			MI	SD ₂₄	(SD ₁)	Others	MI + SD ₁
Akita (rural residents)	MI	N = 4	1	3	(1)	0	2
	AHF	22	0	6	(3)	16	3
	HF	36	0	0	(0)	36	0
Ibaraki (rural residents)	MI	20	4	12	(6)	4	10
	AHF	31	2	10	(7)	19	9
	HF	13	0	2	(0)	11	0
Osaka (suburban residents)	MI	5	3	0	(0)	2	3
	AHF	20	0	14	(6)	6	6
	HF	45	0	6	(3)	39	3
Osaka (urban employees)	MI	5	3	1	(0)	1	3
	AHF	4	0	3	(1)	1	1
	HF	5	1	1	(1)	3	2
Total	MI	34	11	16	(7)	7	18
	AHF	77	2	33	(17)	42	19
	HF	99	1	9	(4)	89	5

MI = Myocardial infarction; AHF = Acute heart failure; HF = Heart failure; SD₂₄ = Sudden death within 24 hours from the onset; SD₁ = Sudden death within one hour from the onset

affect mortality trends.

SUBJECTS AND METHODS

The investigation of death certificates was conducted with four populations, Akita (rural residents, population 8,000), Ibaraki (rural residents, population 17,000), Osaka (suburban residents, population 7,000) and Osaka (employees of sixteen urban companies, population 6,000) which had been under surveillance for cardiovascular diseases.³

All deaths from MI, AHF, HF as underlying cause and hypertension as underlying cause with AHF or HF between 1981 and 1984 were studied. For all of these cases, medical records were reviewed and case histories were obtained from interviews with patients' families. Diagnose of MI were made by three or four physicians in our laboratory according to the criteria of Joint ISFC and WHO.⁴ Sudden death was defined as a death within 24 hours after the onset of clinical symptoms which failed to be categorized as MI or another disease.

To evaluate the improved survival of MI patients at CCUs, the following data were gath-

ered: the number of CCU hospitals and CCU beds in Tokyo from the Tokyo Public Health Bureau and in all Japan from the Ministry of Health and Welfare,⁵ the number of MI patients admitted to CCU hospitals from the Tokyo CCU Network⁶ and the case-fatality rates of MI at CCUs in Tokyo, Osaka, Asahikawa and Wakayama from Takano,⁶ Fukui,⁷ Shibata⁸ and Arita,⁹ respectively. From these data, the number of survivors from MI at CCU throughout Japan in 1978 and 1984 was estimated to clarify to what extent the death rate from MI was affected by improved survival.

RESULTS

1. Investigation of death certificates

Table I shows the comparison of the diagnosis on the death certificates and that made using the standardized criteria. Both AHF as underlying cause and hypertension as underlying cause with AHF on death certificates were categorized as AHF. The same classification was made for HF.

The diagnoses by the standardized criteria were categorized MI, sudden death and others. Of the sudden deaths, deaths within one hour

after the onset were also presented in parentheses because the probability of MI was relatively high.¹⁰ The number of MI diagnoses on death certificates was 4 in Akita, 20 in Ibaraki, 5 in Osaka (suburban residents) and 5 in Osaka (urban employees). Of these, the number of MI cases diagnosed by the standardized criteria was 1, 4, 3 and 3, respectively. Defining one-hour sudden deaths as suspected MI, the number of MI or suspected MI cases is 2, 10, 3 and 3, respectively. Therefore, fifty to sixty percent of the MI deaths from the death certificates were categorized as MI or suspected MI by the standardized criteria.

The number of AHF diagnoses on death certificates was 22 in Akita, 31 in Ibaraki, 20 in Osaka (suburban residents) and 4 in Osaka (urban employees). Of these, the number of MI or suspected MI cases by the standardized criteria was 3, 9, 6 and 1, respectively. These data indicate that ten to thirty percent of AHF deaths from the death certificates were regarded as MI or suspected MI by the standardized criteria. HF on the death certificate, however, was less likely to be MI or suspected MI.

TABLE II THE NUMBER OF CCU HOSPITALS AND CCU BEDS IN TOKYO AND TOKYO CCU NETWORK, 1982-1983

	<i>Tokyo</i> ¹	<i>Tokyo CCU Network</i> ²
CCU hospitals	70	21 (30.0%)
CCU beds	250	122 (48.8%)

1) From Tokyo Public Health Bureau

2) From Takano

() = Percentage of CCU hospitals (or CCU beds) in Tokyo CCU Network to those in Tokyo

Because there were no distinct differences in the death certificate diagnoses among the populations, these figures were added up. The total number of MI diagnoses on the death certificates was 34, while those of MI or suspected MI by the standardized criteria was 42. These numbers were not significantly different from each other.

2. Investigation of the improved survival of MI

In 1984, the total number of CCU hospitals and CCU beds in Tokyo was 70 and 250, respectively. Of these hospitals, 21 (30.0%) with 122 CCU beds (48.8%) belong to the Tokyo CCU Network (Table II). These hospitals include major university hospitals and large hospitals. Between 1978 and 1984, there was an increase in the number of CCU hospitals and CCU beds in Japan from 304 to 499 and from 1194 to 1828, respectively (Table III). In 1984, the percentage of CCU hospitals to all hospitals (except for those for tuberculosis, leprosy and psychiatric patients) was 10.1% in Tokyo and 5.9% throughout Japan. That of CCU beds was 2.61% in Tokyo and 0.17% in all Japan. There was a higher prevalence of CCU hospitals and CCU beds in Tokyo compared with the national level.

At the Tokyo CCU Network, an average of 880 MI patients were admitted annually to the hospitals (with a total of 122 CCU beds) in 1982-1983. Defining hospital turnover rate as the number of MI patients admitted to CCU hospitals per CCU bed per year, the rate for the Tokyo CCU Network was $880/220 = 4$. Multiplying the number of CCU beds in all of Japan by the hospital turnover rate for the Tokyo CCU Network, the number of MI patients at CCUs in all of Japan was estimated. The values were 8612 in 1978 and 13186 in 1984 (Table IV).

TABLE III THE NUMBER OF CCU HOSPITALS AND CCU BEDS IN TOKYO AND IN ALL JAPAN

	Year	All* hospitals	CCU hospitals	All beds*	CCU beds
All Japan	1978	7524	304 (4.0%)	805,663	1194 (0.15)
	1984	8502	499 (5.9)	1,056,960	1828 (0.17)
Tokyo	1984	695	70 (10.1)	95,741	250 (2.61)

* = Excluding those for tuberculosis or psychiatric patients

() = Percentage of CCU hospitals (or CCU beds) to all hospitals (or all beds)

TABLE IV THE ESTIMATED NUMBER OF SURVIVORS FROM MI AT CCU IN ALL JAPAN

Year	Number of ¹ MI	Survival ² rate (%)	Number of survivors
1978	8,612	80	6,890
1984	13,186	85	11,208

1) Calculated from the hospital turnover rate at Tokyo CCU Network and the number of CCU beds in all Japan

2) From Shibata, Arita, Fukui and Takano

TABLE V THE NUMBER OF MI DEATHS AND THE DEATH RATE IN ALL JAPAN IN 1978 AND 1984

Year		Actual ¹ figure	Estimated figure
1979	MI death	26,700	—
	MI death rate per 100,000	23.0	—
1983	MI death	31,100	35,418 ²
	MI death rate per 100,000	26.0	29.6

1) From Annual reports of Health and Welfare Statistics Association

2) Calculated by adding the 4318 survivors to the actual deaths

There were several reports on case-fatality rates for MI at CCUs: 20.3% in 1976–1980 and 19.8% in 1981–1985 from Shibata; 18.7% in 1975–1980 and 13.7% in 1981–1985 from Arita; 21.9% in 1975–1978 and 15.6% in 1984–1985 from Fukui; and 17.2% in 1982–1984 from Takano. According to these reports, the case-fatality rate was estimated to be about 20% in 1978 and about 15% in 1984. This indicated that the percentage of MI patients at CCUs who survived for at least the acute phase was 80% in 1978 and 85% in 1984. Multiplying the number of MI patients at CCUs by the survival rate, the estimated number of survivors in all of Japan would be 6890 in 1978 and 11208 in 1984 (Table IV). Therefore, a total of 4318 MI deaths were averted at CCUs in 1984, compared with 1978.

Table V shows the number of MI deaths and the death rate per 100,000 in all of Japan in 1979 and 1983. The figures for 1979 and 1983

were substituted for the data for 1978 and 1984, respectively, because these data were not available. The death rate in 1983 was only 13.0% higher than that in 1975. If all 4318 survivors had died, the number of MI deaths and the death rate in 1983 would have been 35394 and 29.7%, respectively. The death rate would have been 28.7% higher than that in 1979.

DISCUSSION

According to the vital statistics, there was no increasing trend in age-adjusted death rates of MI in spite of physicians' impressions of an increased number of MI patients. One of the reasons for the discrepancy is the increase in the aged population in recent years. Another reason is the inconsistency of diagnosis of MI among physicians, especially in cases of sudden death which were suspected to be MI but provided no definite clue for this diagnosis. These cases may sometimes be diagnosed as AHF or HF as underlying cause on death certificates. When hypertension as underlying cause and AHF or HF as secondary or tertiary cause are noted on death certificates, the case is categorized as hypertensive heart disease for vital statistics. In 1983, the age-specific death rates for HF including AHF were similar to those for MI in patients under 70 years old but were higher for the older age groups in all of Japan (Fig. 1).

If some aspects of MI cases are misdiagnosed as AHF, HF or hypertension with AHF or HF, and others are diagnosed correctly for death certificates, the death rate of MI will be underestimated. To test this hypothesis, we investigated all cases of MI, AF, HF, and hypertension with AHF or HF on death certificates between 1982 and 1985 in four rural and urban populations. The diagnosis on the death certificates was compared with that reached using the standardized criteria. About half of the AHF deaths and less than half of the HF deaths (including hypertension with AHF or HF) were diagnosed as MI or suspected MI by the standardized criteria. On the other hand, only half of the MI cases on the death certificates were regarded as MI by the standardized criteria. Thus, there was no distinct difference in the number of MI diagnoses on the death certificates and MI plus suspected MI using the standardized criteria. So, the death rates from MI from the vital statistics were not as underestimated as we expected. This report did not deal with mortality trends in

myocardial infarction in Japan before 1978 because the data were not published. It was reported that there were declining trends in the death rate for ischemic heart disease for men and women aged under 60 between 1958 and 1978. However, this does not necessarily lead to the conclusion that there was the same trend in the mortality of MI. There is a possibility that AHF, HF and hypertensive heart failure were misdiagnosed as MI on death certificates so that the death rate of MI was overestimated in the past.

There are many clinical reports on the fall in case-fatality rates of MI with the increased number of CCU hospitals and developments in treatment. There are however, few data on to what extent the improved survival rates have affected the death rates of MI in selected communities or all of Japan. Using the data on case-fatality rates at CCUs in Tokyo, Osaka, Asahikawa and Wakayama and the hospital turnover rate at the Tokyo CCU Network, the number of MI patients at CCUs in all Japan and the rise in the number of survivors were estimated.

A total of 4318 MI deaths would have been averted in 1984 at CCU compared with the deaths in 1978. This estimation, however, is based on following conditions: (i) That the hospital turnover rate for MI at the Tokyo CCU Network was the same as that at CCU in all Japan and that the rate did not change between 1978 and 1984; (ii) That there was no change in the severity of MI cases admitted to CCU hospitals between 1978 and 1984; (iii) That the fall in case-fatality rates for MI at CCUs in Tokyo, Osaka, Asahikawa and Wakayama was observed to the same extent at CCUs in all Japan; (iv) That all of the 4318 survivors would have died if they had not been admitted to CCU hospitals. In fact, the last condition is improbable because there may be improvements in the prognosis of MI cases in general hospitals without CCU.

This report did not deal with the number of MI patients and case-fatality rates in general hospitals without CCU because there are no

reliable data available. At any rate, improvements of MI cases at CCUs may be one of the factors attenuating the rise in death rates for MI in all Japan. In urban areas like Tokyo where seventy CCU hospitals are located, no increasing trend in age-adjusted or age-specific death rates for MI has been reported. This trend can be partially explained by the improved survival through CCU or therapeutic developments even when slight rising trends in MI incidence rates are observed in urban middle-aged employees.¹¹

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