

MOBILE C.C.U.

By Isamu Miura* and Saichi Hosoda†

INTRODUCTION

The major part of deaths due to myocardial infarction occur at the early stage following the manifestation of the disease and before the patients are hospitalized. It is, therefore, very contradictory to initiate the treatment of the patients only after they have been hospitalized, leaving blank the stage before hospitalization when mortality is high.

On the other hand, transportation of patients with this disorder involves not a little risk. For transportation of patients with acute myocardial infarction, it is essential to adequately make the prophylactic treatment and the selection of timing of transportation, so as to warrant safe transportation.

Pantridge and Geddes¹ provided an ambulance which carried the resuscitation equipment and the staff from cardiac department, and called it the mobile C.C.U. (viz., M.C.C.U.) It may be considered to be a really reasonable system which matches the peculiar nature of the disease called myocardial infarction.

Although it is true that the incidence of myocardial infarction is on the gradual increase in Japan, too, yet it still belongs to the group of new diseases in this country, and hence, the therapeutic measures for it are behind those taken in other countries. Further, the transportation of emergency cases is left up to the Fire Defense Board, and physicians and major hospitals being mostly incooperative, it is not getting the full support in the current medical system; hence, it is not so suitable for smoothly treating cardiac attacks which are of special nature and highly emergent nature such as myocardial infarction. For this reason, hospitalization of these patients to the C.C.U. is likely to be delayed, and limited in number.

In setting up the C.C.U. in the Heart Institute, Japan, in August, 1967, we introduced the M.C.C.U. system for purposes of expediting hospitalization of the patients under the aforesaid situation in Japan².

This is the only system of this kind hitherto available in this country.

METHODS

Our M.C.C.U. comprises two ambulances which carry a battery-operated portable electrocardiograph, electrocardiogram-monitoring Braun tube oscilloscope, D-C defibrillator, external pacemaker, esophageal electrode, hand respirator, oxygen bombs (3 × 500 ml.) and other resuscitating drugs and apparatus.

The emergency team is composed of:

1. 3 cardiac surgeons and 3 cardiologists.
2. 12 nurses who have received special training.
3. 5 drivers.

One or more of the members of the respective groups are aboard each ambulance; the ambulance gets on mission at the request of any practitioner, in principle, and the following are made:

1. Diagnosis and emergency treatment.
2. Prophylactic treatment and decision of the time of transportation.
3. Transportation of patient and treatment on the ambulance.

The staff is in charge of 4 C.C.U. beds at our hospital, 22 beds at general ward and pacemaker clinic.

The admission to the C.C.U. is made on the following criteria:

1. Acute myocardial infarction (within three days after attack).
2. Suspicion of myocardial infarction and severe angina.
3. Severe arrhythmia including heart block.
4. Acute cardiac insufficiency.

On the above-mentioned criteria, we have been operating the C.C.U. as the "I.C.U. for cardiac attacks chiefly comprising myocardial infarction".

RESULTS

I. BREAKDOWN OF INPATIENTS AT THE C.C.U. AND THEIR ROUTES TO ADMISSION

840 patients were admitted to the C.C.U. at the Heart Institute, Japan, in the period of about 40 months, from August 25, 1967, to December 21, 1970. The three patients who died after treatment at home and on the ambulance (of acute myocardial infarction, respectively) are included in the patients admitted to the C.C.U.

Table I shows the final diagnoses of admitted patients. Acute myocardial infarction was found in 330 patients, viz., 39.3%, of the 840 admitted patients.

TABLE I
FINAL DIAGNOSIS OF ADMITTED PTS. IN C.C.U.
(1967.8.25—1970.12.21)

Diagnosis	No. of Pts.	%
Acute myc. Infarction	330	39.3
Subacute myc. Infarction	92	10.9
Angina	124	14.7
Arrhythmia	147	17.5
Circulat. Failure	57	6.8
Dissect. Aneurysm	10	1.2
Others	80	9.5
TOTAL	840	100

As of December 21, 1970, 94 patients have died (including those who died at home) out of 317 patients admitted for acute myocardial infarction, except for the patients under hospitalized treatment, at a hospital mortality of 30%.

The bed utilization rate is about 80%, except for the very early stage of the operation of the C.C.U., and the absolute number of patients admitted for acute myocardial infarction and the ratio of them to all patients admitted tended to increase till 1969.

The routes by which the patients were brought to the C.C.U. are shown below:

1. Mobile C.C.U. - - - 604 patients, 72%.
2. Public ambulance - - - 122 patients, 14%.
3. Others - - - - 114 patients, 13%.

It is, however, ignorable that, out of the 330 patients with acute myocardial infarction, 63 patients, viz., 19%, were once admitted to emergency medical institutes, and then re-transported to our C.C.U. This fact means that, so long as the treatment of cardiac attacks is concerned, the receiving system is very poor at present, and not a few patients are transferred from one clinic to another, and are losing opportunities of recovery.

*Cardiac Department, Heart Institute, Japan, Tokyo Women's Medical College Tokyo.

†Cardiac Department, Kosei Hospital, Tokyo.

II. STATUS OF OPERATION OF M.C.C.U.

The M.C.C.U. was called out 19.7 times per month on an average. 9 patients with myocardial infarction (including patients with acute and subacute ones) were admitted per month on an average, which corresponded to 46% of all call-outs.

The number of call-outs and the number of patients admitted for myocardial infarction increased in the second and the third year of C.C.U. operation, but somewhat decreased in 1970.

Seasonally, the most frequent call-outs were received in November and December, which were found to be about two times as frequent as the call-outs received in August.

On a criterion that the area for emergency treatment means such a range of area where the ambulance can reach within 15 minutes, the area for emergency treatment by the M.C.C.U. of the Heart Institute, Japan (which is located mostly at the center of Tokyo) covers an area of about 10 kilometers in diameter, viz., 8 Wards in the center of Tokyo with 2.2-million inhabitants, and this population equals about 20% of the population in Tokyo. The utilization rate was high in this district, being rated at about 70%.

III. PERIOD FROM CARDIAC ATTACK TO HOSPITALIZATION (acute myocardial infarction):

Fig. 1 shows the periods from cardiac attack to the beginning of treatment on 317 patients with acute myocardial infarction, classed by the routes to hospitalization, and the relations to mortalities in the respective periods.

Cardiac attack occurred in 17 patients, viz., 5.3%, after they had been admitted to our C.C.U. The treatment could be initiated within four hours after attack on 110 patients, viz., 48%, of the 230 patients (72.5%) who were hospitalized to our C.C.U. by the M.C.C.U. On the other hand, the treatment could be set out within four hours on 23 patients, (viz., 33%), of the 70 patients (22.1%) who were hospitalized for acute myocardial infarction by public ambulance and other routes. Out of the 17 patients in whom cardiac attacks occurred under hospitalized treatment, five, viz., 29% showed ventricular fibrillation¹, cardiac standstill² and serious shock² at about the time when the attacks occurred, and as the results of treatment given, they were recovered and discharged, with one exceptional case. The hospital death rate remained 6% in this group.

The treatment could be initiated within four hours after cardiac attack on 133 patients, viz., 42%, and in four hours to 12 hours on 96 patients, viz., 30%, and the hospital mortality was found to be 35% and 34% in

these groups hospitalized at an early stage of attack, and proved to be higher than the mean hospital mortality of 30%. On the other hand, the hospital mortality was found to be 20% in 71 patients (22%) on whom the treatment could be started in 12 hours-72 hours.

IV. RESULT OF RESUSCITATION AND PROGNOSIS:

Out of 230 patients who were treated by the M.C.C.U. for acute myocardial infarction, 13 (5.7%) received resuscitation of the heart before hospitalization, with resuscitation made 19 times in total. This frequency of resuscitation corresponds to 22% of 86 times of resuscitation made in total on the 230 patients throughout their treatment course. The resuscitation was made 11 times at the patient's home, once in the garden of the patient's home, and 7 times on the ambulance. In two cases out of the 19, the resuscitation was made for ventricular tachycardia accompanied with Adams-Stokes symptom, for ventricular fibrillation in seven cases, and for cardiac arrest in five cases, viz., these 14 cases (74%) could be considered to have electric failure.

In the other five cases, the resuscitation was made chiefly for serious bradycardia accompanied with serious shock condition or cardiac arrest. Further, out of the 13 patients, seven, viz., 54%, were found to have symptoms of circulatory failure. There were four cases where transportation could be considered to have induced cardiac arrest or ventricular fibrillation.

As the result of resuscitation, heart beat could be restored in 16 cases, viz., 84% of the 19 cases (10 out of the 13 patients). Out of the 10 patients who were hospitalized after resumption of heart beats, three died shortly after admission. All of the three were in a serious shock condition accompanied with pulmonary edema. Defibrillation could be successfully made on one patient twice at his home, but the patient died of ventricular fibrillation that repeatedly recurred after admission.

Six patients (46%) survived for not less than 24 hours. Two of them, however, died of cardiac insufficiency at our C.C.U. One patient followed a favorable course, but suddenly died in a general ward five days later. The cause of the death was found to be rupture of the myocardium.

Only three, viz., 23% of the 13 patients were recovered to the extent that they could be discharged.

DISCUSSION AND CONCLUSION

The deaths that arise within an hour after attack are said to be rated at 40-63% of all mortalities due to myocardial infarction³⁻⁵. In practice, however, it takes a considerably long time to hospitalize a patient, and as a matter of consequence, the patients who die before hospitalization count a tremendous number. Even today, when the C.C.U. is popular worldwide, only very small part of the patients can reach the C.C.U.

The time spent, causing delayed hospitalization, comprises:

1. Time from patient subjectively becoming aware of attack till calling for a physician.
2. Time from the visit by a physician to diagnosis.
3. Time from calling for ambulance to hospitalization.

And it is said that not less than four hours are spent in the meantime⁶, but for the following additional reasons that prevail in Japan, hospitalization may be considered to be further delayed.

1. Because the knowledge of the public about myocardial infarction is poor, the time under (1) above is further prolonged.
2. Because the level of diagnosing ability of practitioners is low in general, and hence, the risk at the early stage of cardiac attack is not well known, the time under (2) and that under (3) above are prolonged.

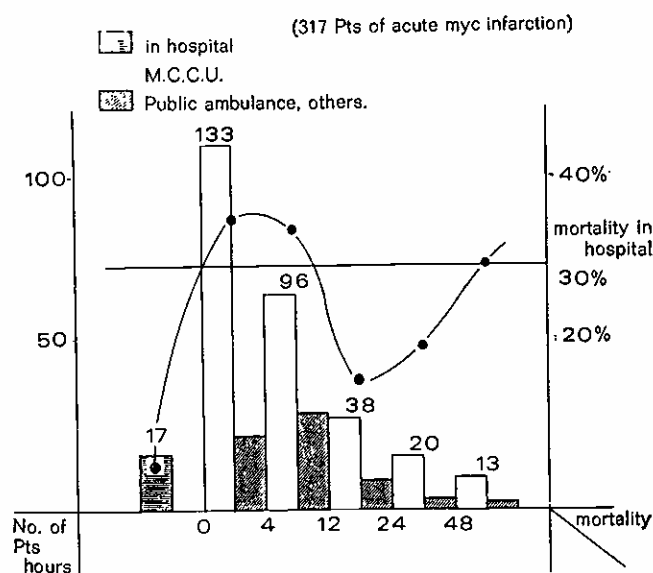


Fig. 1. Period from attack to routes of hospitalization.

3. On the other hand, transportation of patient tends to be hesitant for the reason that it is a severe disease.
4. General practitioners are not in close contact with major hospitals.
5. Major hospitals and specialists are indifferent to or uncooperative with the public ambulance service.

For the above-mentioned reasons, it may be the present situation in Japan that only a small group of relatively mild patients who could fortunately get rid of the crisis at an early stage of cardiac attack are hospitalized to major hospitals where the C.C.U. is available. In Japan where the rate of utilization of the C.C.U. is yet low, it is essential for the C.C.U. staff to make the therapeutic activity on the spot, and popularization of the M.C.C.U. involves possibilities of largely reducing the times cited under 2-5 above through keeping in close contact with general practitioners and thus reducing possibilities of patients being transferred from one clinic to another.

It was shown by Nixon⁷ that such a risk is involved in transportation of patients that 13% of all mortalities due to acute myocardial infarction occurs during transportation. McNeily et al⁵ showed that, out of 414 patients who died after hospitalized for coronary attack, 102 patients, viz., 25% were found already dead at the time of admission. Out of the 230 patients treated by us for acute myocardial infarction, fatal episode occurred in four patients, viz., 1.7% when they were transported from the bed at their homes, and seven patients, viz., 3.1% received resuscitation on the ambulance. The number of resuscitations made before hospitalization was rated at 22% of all resuscitations made throughout the period.

Because the time spent before transportation and the time required for transportation are very short when looked at from the whole course, the risk which may be caused by or arise in transportation of patient may be considered to be unexpectedly high. And the only means to warrant safe transportation is nothing but the transportation of patient by the staff from cardiac department, viz., the M.C.C.U. system.

The direct effect of the M.C.C.U. may, in short, be the life saving by resuscitation of the heart, but before speaking of it, it is necessary to discuss the cause of deaths that occur at the early stage of cardiac attack.

Pantridge et al⁸ disclosed that the incidence of ventricular fibrillation within four hours after cardiac attack is 15 times as high as that in 4-12 hours. Bonduant⁶, citing various reasons, surmised that the true cause of cardiac arrest encountered at the early stage of myocardial infarction would comprise chiefly electric failure.

If, as stated in the foregoing, arrhythmia—ventricular fibrillation in particular—could be the principal cause of death at an early stage of the disease, such an attempt as the M.C.C.U. which positively covers the early stage of the attack may be evaluated high enough for purposes of largely cutting down the mortality due to myocardial infarction. If, however, there exists an irreversible pump failure behind ventricular fibrillation, the M.C.C.U. only prolongs the life of a patient, and its value will be cut down by half.

In relation to this possibility, Kuller⁹ and Spiekerman¹⁰ stated that not so marked lesions are found in the myocardium in 53-62% of the patients who die of acute coronary attack. In short, there are not a few such patients who can be surmised to well survive only if there is no acute episode.

Out of the 17 patients who showed attacks under hospitalized treatment by us, five had fatal episodes immediately after manifestation of the attack, but the mortality under hospitalized treatment remained 6%.

Further, out of 19 cases of circulatory arrest that occurred before hospitalization, 14 cases, viz., 74%, were found to have originated in electric failure, and out of the 13 patients, six, viz., 46% were found to have no symptoms of circulatory failure.

Fig. 2 comparatively shows the results of resuscitation made before, and those made after hospitalization. It is clear that the rate of resumption of cardiac beats is higher in the group given resuscitation before hospitalization.

Needless to say, there is no room for saving life on patients who may die in units of seconds and minutes. It may be reasonable to regard about an hour after manifestation of attack as the limit to the possibility of saving life. McNeily⁵ showed that, out of 596 patients who died of coronary attack before hospitalized, 182 patients, viz., 30%, survived for not less than an hour after manifestation of the attack, and these patients can be the candidates.

To summarize the aforesaid data, it is found that a considerably large part of the patients who die at an early stage of cardiac attack is within the range of reach by the M.C.C.U., and not a few of them have the myocardium in a good condition worth life saving work, and this encourages us.

Pantridge et al⁸ stated that the rapid increase in the utilization of the M.C.C.U. year after year demonstrated the usefulness of the system. Also at the Heart Institute, Japan, the number of patients admitted for acute myocardial infarction increased after the foundation of the C.C.U. and introduction of the M.C.C.U. to 10 times the previous number. There is no doubt about the necessity and usefulness of the M.C.C.U., but there is a question in its economical aspect because the M.C.C.U. system requires five drivers, whereas it is utilized only less than 20 times a month, and aggravation of the traffic condition is limiting the range of activity.

On the other hand, the transportation service for emergency cases is entirely left to the hands of fire men who have no ability to differentiate diseases, and this is a serious defect involved in the service, making the service poor in the content. The statistics made by the Tokyo Fire Defense Board¹¹ show that as many as 2,314 cases were transported by the public ambulance service for cardiac attacks in the first six month

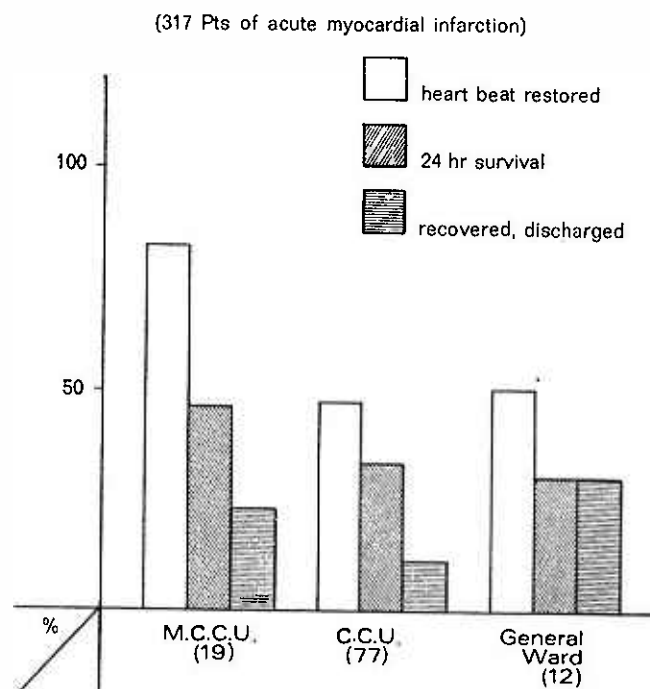


Fig. 2. Result of Cardiac resuscitation.

period of 1971, but only 242 of them were admitted to major hospitals where the C.C.U. is available. Further, there were 220 patients who were not transported chiefly for reasons of severe symptoms, and a majority of them died. Physicians attended only 10% of them.

Along with the promotion of common utilization of the M.C.C.U. by many C.C.U.'s, it is necessary in the future to try to make systematic utilization of the M.C.C.U. by keeping in close contact with general practitioners and tying up with the public ambulance service. And it is further necessary to utilize the M.C.C.U. system not only for acute myocardial infarction but also for all cardiac attacks.

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