Effect of Intensive Care on Mortality Rate of Patients With Myocardial Infarcts

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EFFECTIVE organization of the facilities, services, and staff of a hospital around the medical and nursing needs of the patient may be as significant in recovery from a disease as is the application of a new type of medical therapy. Acceptance of this concept has led hospitals to organize new means of providing patient care. One of the new patterns of hospital organization is called progressive patient care.

Progressive patient care attempts to tailor services to the needs of individual patients by grouping them according to their degree of illness and their requirements for care. The elements usually associated with this concept in the general hospital are intensive care, intermediate care, self-care, long-term care, outpatient care, and home care (*1*). The staff serving each group of patients is selected and trained to provide the services needed by the particular group.

In the intensive care unit are concentrated critically and seriously ill patients regardless of diagnosis. These patients are under close observation of nurses selected for their special skills, training, and experience. All necessary lifesaving emergency equipment, drugs, and supplies are immediately available. Patients requiring a moderate amount of nursing care are concentrated in the intermediate care unit. They rarely require emergency care or frequent observation. The self-care unit is for self-sufficient patients who are ambulatory, who require therapeutic or diagnostic services, or who are convalescing. In the long-term care unit are patients requiring prolonged skilled medical and nursing care. Outpatient care is for ambulatory patients requiring diagnostic, curative, preventive, and rehabilitative services. Home care is for those who can be adequately cared for in the home through the extension of certain hospital services.

Many questions regarding progressive care remain unanswered and much additional research is needed, especially concerning the effect of intensive care on patient recovery. To obtain data on this subject, a study of patients with myocardial infarcts was undertaken at Manchester (Conn.) Memorial Hospital. Mortality rates of patients with myocardial infarcts hospitalized in an intensive care unit were compared with rates of patients treated in this hospital for myocardial infarction before the intensive care unit was organized. The data also permitted testing the effect of anticoagulant therapy on the mortality rates of patients with a proved diagnosis of myocardial infarction.

The Setting

The Manchester (Conn.) Memorial Hospital, established in 1920, is a nonprofit community hospital of 237 beds designed to serve the hospital needs of Manchester and its environs. On

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April 1, 1957, the administrator and medical staff introduced three progressive patient care elements: an intensive care unit, an intermediate care unit, and a self-care unit.

At the time of this study the intensive care unit consisted of 27 beds divided into four subunits. Two subunits each contained one 4-bed room plus an adjacent single room; one contained one 4-bed room, one 2-bed room, and one single room; and the last comprised five 2-bed rooms used as a flexible zone. Each subunit was completely equipped with emergency supplies, special equipment, and routine and emergency drugs. An intercommunication system enabled the nurse to talk with persons outside the unit while continuing both auditory and visual observation of her patients.

Patients were assigned to the intensive care unit only when they were critically or seriously ill and required close nursing observation and attention. A nursing team headed by a professional nurse planned the care of all patients. The other team members were professional nurses, licensed practical nurses, and nurse aides.

Patients were admitted directly to the unit without the usual time-consuming admitting office procedures. Since most critically ill patients were cared for in this unit, its nurses became especially alert to recognize significant signs and symptoms.

Procedure

One of the many advantages claimed for progressive patient care is that "complications related to patient care are reduced" (*2*). If this is true, it should have the further effect of reducing the mortality rate. The study was designed to test this claim for a specific diagnosis, myocardial infarction.

All patients with an unequivocal diagnosis of myocardial infarction admitted to the hospital during the calendar years 1955–56 and 1958–59 are included in the study. Since Manchester Memorial Hospital established the intensive care unit in 1957, the myocardial infarction patients in the 1955–56 group received treatment under the conventional system of patient care available during those years, while the 1958–59 group received treatment in an organized intensive care unit. The patients in the intensive care group were admitted at least 9 months after the unit was organized, when procedures for the unit were well established. Myocardial infarction patients were selected because (*a*) therapy of choice for myocardial infarction had not changed radically during the 5-year period between 1955 and 1960 and (*b*) a relatively objective measure, an electrocardiogram, was available for each patient on which to base the diagnosis.

The medical record librarian pulled all patient records showing a diagnosis of myocardial infarction. When there was any doubt, the patient's file was examined by the two reviewing physicians. The patient records were arranged in groups of 25, and each physician reviewed the cases independently and recorded the data required. To arrive at an unequivocal diagnosis of myocardial infarction, the reviewing physicians studied the patient's entire chart, including history and physical examination report, progress notes, and laboratory findings (electrocardiogram, white blood cell count, sedimentation rate, and serum transaminase when available). Questionable cases, such as those with only T-wave changes in the electrocardiogram, were rejected.

The reviewing physicians recorded for each patient whether it was the first diagnosis of myocardial infarction or the second, third, and so forth, and whether the patient was a "good" or "poor" risk, that is, whether the patient had a mild or severe attack, on the basis of criteria cited by Russek and Zohman (*3*). For each admission they checked each incident of complication which occurred during that hospital stay. Incidents of complication were defined as acute pulmonary edema, pulmonary embolism, cardiac arrhythmia, cardiac psychosis, intractable pain, shock, congestive heart failure, pericarditis, death, and "any other" (which was to be specified). They also checked whether or not the patient received anticoagulant therapy.

For each patient included in the study the following information was recorded from the admission form: name of patient, dates of each admission and of each discharge, and hour and date of death if death occurred during the hospital stay. Age, sex, ethnic group, marital status, and occupation were also noted.

Table 1. Patients with proved diagnosis of myocardial infarction hospitalized at Manchester (Conn.) Memorial Hospital and immediate mortality [1] under conventional and intensive patient care classified by good or poor risk, sex, age, and the use of anticoagulant therapy

	Both groups			Conventional care			Intensive care		
	Total	Anticoagulants		Total	Anticoagulants		Total	Anticoagulants	
		Not used	Used		Not used	Used		Not used	Used
All patients	175(21)	51(14)	124(7)	74(2)	22(2)	52	101(19)	29(12)	72(7)
Good risk	81(3)	12(2)	69(1)	44	8	36	37(3)	4(2)	33(1)
Males	66(2)	5(1)	61(1)	36	3	33	30(2)	2(1)	28(1)
Under 50	19(1)	3(1)	16	12	2	10	7(1)	1(1)	6
50–64	34	2	32	19	1	18	15	1	14
65 and over	13(1)	0	13(1)	5	0	5	8(1)	0	8(1)
Females	15(1)	7(1)	8	8	5	3	7(1)	2(1)	5
Under 50	1	1	0	1	1	0	0	0	0
50–64	7(1)	2(1)	5	3	1	2	4(1)	1(1)	3
65 and over	7	4	3	4	3	1	3	1	2
Poor risk	94(18)	39(12)	55(6)	30(2)	14(2)	16	64(16)	25(10)	39(6)
Males	61(10)	22(7)	39(3)	19(1)	7(1)	12	42(9)	15(6)	27(3)
Under 50	11(2)	3(1)	8(1)	4	2	2	7(2)	1(1)	6(1)
50–64	22(2)	4(1)	18(1)	7	0	7	15(2)	4(1)	11(1)
65 and over	28(6)	15(5)	13(1)	8(1)	5(1)	3	20(5)	10(4)	10(1)
Females	33(8)	17(5)	16(3)	11(1)	7(1)	4	22(7)	10(4)	12(3)
Under 50	0	0	0	0	0	0	0	0	0
50–64	6	2	4	2	0	2	4	2	2
65 and over	24(8)	15(5)	12(3)	9(1)	7(1)	2	18(7)	8(4)	10(3)

[1] Figures in parentheses are deaths occurring within 48 hours after admission.

Results

The medical record librarian accumulated 469 cases for review, of which only 175 proved acceptable under the established criteria. Table 1 shows the patients meeting the criteria for proved diagnosis of myocardial infarction and the deaths occurring in the initial 48-hour period after admission, distributed by type of hospital care received: (*a*) conventional care (those hospitalized before the intensive care unit was established), and (*b*) intensive care (those hospitalized in the intensive care unit). The patients are also classified by sex, good or poor risk, age, and the use of anticoagulant therapy. Since all patients were white, there was no need to classify by ethnic group.

Of the total of 175 patients, 127 (72.6 percent) were men and 48 (27.4 percent) were women. Of the 127 men, 30 (23.6 percent) were less than 50 years of age and 97 (76.4 percent) were more than 50 years of age. Of the women, all but one were over 50 years old. Of the total of 175 patients, 74 received conventional care during 1955 and 1956 and 101 received intensive care during 1958 and 1959. Of those receiving conventional care, 55 (74.3 percent) were men and 19 (25.7 percent) were women. Of the 101 receiving intensive care, 72 (71.3 percent) were men and 29 (28.7 percent) were women. For each group the ratio of men to women was slightly under 3 : 1. About one-fourth of the men were under 50 years of age. The women were older; about 2 out of 3 were over 65, while only about 1 out of 3 of the men was in this age group.

There was a marked increase in the percentage of deaths during the 48-hour period after admission for patients under intensive care (18.8 percent) over the percentage for patients under conventional care (2.7 percent). This is explained largely by the higher proportion of poor risk patients hospitalized under intensive care. About 63 percent of the intensive care patients were classified as poor risks compared with about 40 percent of the conventional care patients. The increase in poor risk patients un-

Table 2. Mortality rates for myocardial infarction patients [1] hospitalized at Manchester (Conn.)

Risk, sex, and age	Conventional care			Intensive care		
	Anticoagulants		Total	Anticoagulants		Total
	Not used (1)	Used (2)	(3)	Not used (4)	Used (5)	(6)
ALL PATIENTS:						
Deaths	7	10	17	8	3	11
Patients	20	52	72	17	65	82
Death rate	.3500	.1923	.2361	.4705	.0462	.1341
TOTAL, GOOD RISK:						
Deaths	2	5	7	0	1	1
Patients	8	36	44	2	32	34
Death rate	.2500	.1389	.1590	0	.0312	.0294
GOOD RISK, MALES:						
Deaths	1	5	6	0	1	1
Patients	3	33	36	1	27	28
Death rate	.3333	.1515	.1667	0	.0370	.0357
Under 50 years:						
Deaths	0	1	1	0	0	0
Patients	2	10	12	0	6	6
Death rate	0	.1000	.0833	0	0	0
50–64 years:						
Deaths	1	2	3	0	0	0
Patients	1	18	19	1	14	15
Death rate	1.0000	.1111	.1579	0	0	0
65 years and over:						
Deaths	0	2	2	0	1	1
Patients	0	5	5	0	7	7
Death rate	0	.4000	.4000	0	.1428	.1428
GOOD RISK, FEMALES:						
Deaths	1	0	1	0	0	0
Patients	5	3	8	1	5	6
Death rate	.2000	0	.1250	0	0	0
Under 50 years:						
Deaths	0	0	0	0	0	0
Patients	1	0	1	0	0	0
Death rate	0	0	0	0	0	0
50–64 years:						
Deaths	0	0	0	0	0	0
Patients	1	2	3	0	3	3
Death rate	0	0	0	0	0	0
65 years and over:						
Deaths	1	0	1	0	0	0
Patients	3	1	4	1	2	3
Death rate	.3333	0	.2500	0	0	0

[1] Excluding patients who died within 48 hours after admission.

der intensive care undoubtedly reflects a tendency to admit to the intensive care unit critically ill patients for whom treatment would formerly have been initiated at home and who would not have survived to reach the hospital. The investigators chose, therefore, to eliminate the effect of immediate mortality by excluding the 21 patients who died within 48 hours.

The data in table 1 on use of anticoagulant drugs verify that it was the treatment of choice for myocardial infarction at Manchester Memorial Hospital during the two calendar periods under study. About 7 out of every 10 patients in both the conventional care and the intensive care groups received these drugs.

Analysis of the data on complications is limited to deaths and mortality rates because we found that the records on other incidents were uncertain and therefore incomplete. The deaths and mortality rates for the 154 myocardial infarction patients who survived the first 48 hours after admission classified by type of hospital care and use of anticoagulant therapy and by sex, good or poor risk, and age are given

Memorial Hospital under conventional and intensive patient care

Risk, sex, and age	Conventional care			Intensive care		
	Anticoagulants		Total	Anticoagulants		Total
	Not used (1)	Used (2)	(3)	Not used (4)	Used (5)	(6)
TOTAL, POOR RISK:						
Deaths	5	5	10	8	2	10
Patients	12	16	28	15	33	48
Death rate	.4167	.3125	.3571	.5333	.0606	.2083
POOR RISK, MALES:						
Deaths	1	3	4	4	1	5
Patients	6	12	18	9	24	33
Death rate	.1667	.2500	.2222	.4444	.0417	.1515
Under 50 years:						
Deaths	0	0	0	0	0	0
Patients	2	2	4	0	5	5
Death rate	0	0	0	0	0	0
50–64 years:						
Deaths	0	2	2	2	0	2
Patients	0	7	7	3	10	13
Death rate	0	.2857	.2857	.6667	0	.1538
65 years and over:						
Deaths	1	1	2	2	1	3
Patients	4	3	7	6	9	15
Death rate	.2500	.3333	.2857	.3333	.1111	.2000
POOR RISK, FEMALES:						
Deaths	4	2	6	4	1	5
Patients	6	4	10	6	9	15
Death rate	.6667	.5000	.6000	.6667	.1111	.3333
Under 50 years:						
Deaths	0	0	0	0	0	0
Patients	0	0	0	0	0	0
Death rate	0	0	0	0	0	0
50–64 years:						
Deaths	0	1	1	1	0	1
Patients	0	2	2	2	2	4
Death rate	0	.5000	.5000	.5000	0	.2500
65 years and over:						
Deaths	4	1	5	3	1	4
Patients	6	2	8	4	7	11
Death rate	.6667	.5000	.6250	.7500	.1428	.3636

in table 2. Because mortality increases with age, the relation of mortality to the sex of the patient for these data should be noted. Comparison of the mortality rates for men and women, good and poor risk, and use and non-use of anticoagulants indicates that women, poor risks, and patients who did not receive anticoagulant therapy had higher rates than men, good risks, and patients who received anticoagulants. The data have thus been arranged in table 2 to facilitate comparison and to permit computation of the statistical significance of the differences in mortality rates between the two forms of hospital care with the influence of sex, risk, age, and use of anticoagulants held constant. Since the effect of anticoagulant therapy in myocardial infarction is also of interest, the data also permit comparison and computation of a similar test of significance of the differences in mortality rates for patients who received and those who did not receive this therapy, with sex, age, risk, and type of care held constant.

The mortality rates in table 2 are based on unequal numbers of patients in each pair of cells, as are the rates for the total number of patients in each group. To achieve the effect of an equal proportion of cases in the intensive and conventional care groups, the weighted

average difference and the weighted variance of the average difference were computed by the following formulas:

$$\bar{d}=\frac{\Sigma dw}{\Sigma w}, \qquad SE_{\bar{d}}=\frac{\sqrt{\Sigma w^2 SE^2_d}}{\Sigma w}$$

where

$$d=\frac{r_1}{n_1}-\frac{r_2}{n_2}$$

$$w=\frac{n_1 n_2}{n_1+n_2}$$

r_1 and r_2=deaths

n_1 and n_2=patients

The weighted average difference in mortality rates is 15 percent (0.1549±0.0652) greater for the patients hospitalized under conventional care at Manchester Memorial Hospital, with a weighted standard error of 6.5 percent. The $\bar{d}/SE_{\bar{d}}$ is 2.3758. The weighted average difference is significant at the 2 percent level (P=0.0176). Hospitalization in the intensive care unit is thus associated with a reduction in mortality for myocardial infarction patients of 15 percent.

Immediately the questions arise: Is the reduction in mortality the result of having eliminated the worst risks by excluding patients who died during the first 48 hours? If it is a "true" reduction, is it due to superior nursing care rather than to the effect of the pattern of organization of hospital care? It may be that an intensive care unit is only one method of achieving improved care of patients. Whether other arrangements can achieve the same results remains to be tested. Nevertheless, at the Manchester Memorial Hospital the intensive care unit did have a statistically significant effect on the mortality rate of myocardial infarction patients.

Reports of the relative benefits and hazards of using anticoagulant drugs indicate that some cardiologists (*4–6*) question the use of these drugs for mild attacks and good risk cases of myocardial infarction. The data obtained in this study permit analysis of the effect of anticoagulant therapy on the mortality rates of patients with unequivocal diagnoses of myocardial infarction, with age, sex, risk, and type of hospital care controlled.

The weighted average difference in mortality rates is 28 percent (0.2807±0.1119) greater for patients not receiving anticoagulant therapy with a weighted standard error of 11 percent. The $\bar{d}/SE_{\bar{d}}$ is 2.5085, which is significant at approximately the 1 percent level (P=0.0122). Anticoagulant therapy thus reduced the mortality rate among myocardial infarction patients at Manchester Memorial Hospital by 28 percent. Mainly contributing to this difference are good risk patients hospitalized under conventional care and poor risk patients hospitalized in the intensive care unit, as a comparison of the average weighted differences and their standard errors indicates:

	Conventional care	*Intensive care*
Good risk	23.0± 7.6	No difference
Poor risk	2.5±25.7	46.3±19.5

This finding suggests that intensive care combined with anticoagulant therapy may be more effective than either treatment alone.

Summary and Conclusions

A study at Manchester (Conn.) Memorial Hospital attempted to measure the effects of an intensive care unit and of anticoagulant therapy on mortality rates of patients with myocardial infarcts (exclusive of those dying within 48 hours after hospital admission).

A total of 175 patients with an unequivocal diagnosis of myocardial infarction were investigated. Of the 74 patients hospitalized under conventional care before the intensive care unit was established, 72 survived longer than 48 hours after admission. Of 101 patients admitted to the intensive care unit, 82 survived for at least this period. In the conventional care group 52 patients received anticoagulant drugs. In the intensive care group 65 received such therapy.

When the effects of sex, age, "good" or "poor" risk, and use of anticoagulant therapy were held constant and the data weighted to achieve relatively equal proportions of patients in each group, 15 percent fewer deaths were found to have occurred in the intensive care group than in the conventional care group, a difference significant at the 2 percent level. This finding suggests that further studies of the effect of in-

tensive care in this or other hospitals on a series of specific diagnoses would be valuable.

The data also showed that use of anticoagulants reduced the mortality rate by 28 percent when the effects of sex, age, risk, and type of hospital care were controlled. The evidence supports the value of anticoagulant therapy and suggests that this treatment combined with intensive care may be more effective than either treatment alone.

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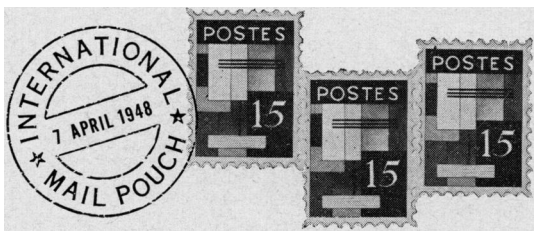

Transfer of Virus Laboratory

The University of the West Indies has assumed administration of the Trinidad Regional Virus Laboratory in Port-of-Spain. The laboratory, a unit of the Rockefeller Foundation virus research program, will expand its investigations to include most of the viruses of public health importance to the Caribbean region. The 9-year-old laboratory will also broaden its training of young scientists in techniques of virus research.

The Rockefeller Foundation has given $275,000 to the university for operation of the laboratory during the next 3 years. The government of Trinidad and Tobago, other West Indies governments, and the Department of Technical Cooperation of the United Kingdom will continue financial support of the research work.—*Excerpted from Rockefeller Foundation Grants* 13: 9–10, fourth quarter 1962.

Mental Health Center

A center to classify and collect information about mental health problems in Latin America has been opened at the headquarters of the Pan American Sanitary Bureau, Regional Office of the World Health Organization, in Washington, D.C. The center will compile directories of psychiatrists, psychiatric hospitals, and psychiatric services and clinics in Latin America, determine what resources and facilities are available in the area for the solution of mental ills, provide information to mental health investigators and institutions, and promote research in mental health.

The new organization will sponsor a regional mental health seminar in October 1963 in Mar del Plata, Argentina, for participants from Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela.

Dr. Jorge M. Velazco-Alzaga of Mexico the Bureau's mental health adviser for the hemisphere, is director of the center, and a sociologist, Dr. Margaret Urist of Osborne, Kans., is co-director. The center is being financed mainly by a $127,000 grant from the National Institute of Mental Health, Public Health Service, until 1966 when the Pan American Sanitary Bureau will assume full budgetary responsibility.

New Journal

The Central Public Health Engineering Research Institute of Nagpur, India, has begun publication of a quarterly journal, *Environmental Health.* The new periodical is the only one in southeast Asia devoted entirely to various aspects of water supply, sewage, waste water treatment, air pollution, and industrial hygiene. The annual subscription including postage by surface mail is $5. Further information can be obtained from R. S. Mehta, director, Central Public Health Engineering Institute, Nagpur.