# Long-Term Survival of 224 Patients with Myocardial Infarction Treated in a Community Hospital

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In a retrospective, five-year follow-up study of 224 patients treated for acute myocardial infarction in a community hospital, there was an 82 percent in-hospital survival rate and an overall 57 percent five-year survival rate. Corrected for expected mortality, the five-year survival rate was 68 percent. Patients who had had a previous infarction had a lower five-year survival rate, 40 percent. Survival decreased significantly with age, but was not affected by hypertension, diabetes, smoking, sex, or obesity (when corrected for age differences). Women and nonsmokers who had myocardial infarctions could expect to have longer lifespans than men and smokers because they were older at the time of their infarction. At the time of their infarction, women averaged 68 years of age, men 60 years. Nonsmokers averaged 67 years, smokers 55 years.

Ischemic heart disease and its complications are the leading cause of death in this country, 675,000 per year. Each year 1,300,000 people suffer myocardial infarctions.[1] There is a great deal of research related to short-term prognosis, ie, the survival during hospitalization for infarction.[2-11] Few studies have been done of long-term survival since the development of coronary care units.[7,12-14] There is a paucity of data on the long-term survival of patients treated for myocardial infarction in community hospitals. For this reason, a retrospective study of 224 patients treated in the coronary care unit of a community hospital was undertaken.

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## Methods

Patients treated at a community hospital, Emerson Hospital in Concord, Massachusetts, for acute myocardial infarction were studied. All patients were cared for in a coronary care unit. Patient selection was based on the hospital's Diagnosis Index which lists all patients by diagnosis. All patients admitted between September 1970 and October 1972 with either a primary or secondary diagnosis of myocardial infarction were considered for the study, a total of 254 admissions. Of these, 24 patients were eliminated because they did not fulfill the criteria for diagnosis of myocardial infarction and 6 patients were eliminated because of the presence of other life threatening illnesses (including malignant neoplasm, renal failure, and mesenteric artery occlusion). All the remaining 224 admissions were included. Eight patients were admitted for two infarctions during the study period; both admissions were included as separate subjects in the study.

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**Table 1. Cause of Death**

| | Number of Patients (%) |
|---|---|
| Cardiac | 54 (63) |
| Cardiac, probable | 14 (16) |
| Other | 10 (12) |
| Unknown | 8 (9) |
| **Total** | 86 (100) |
| Autopsy | 19 (22) |

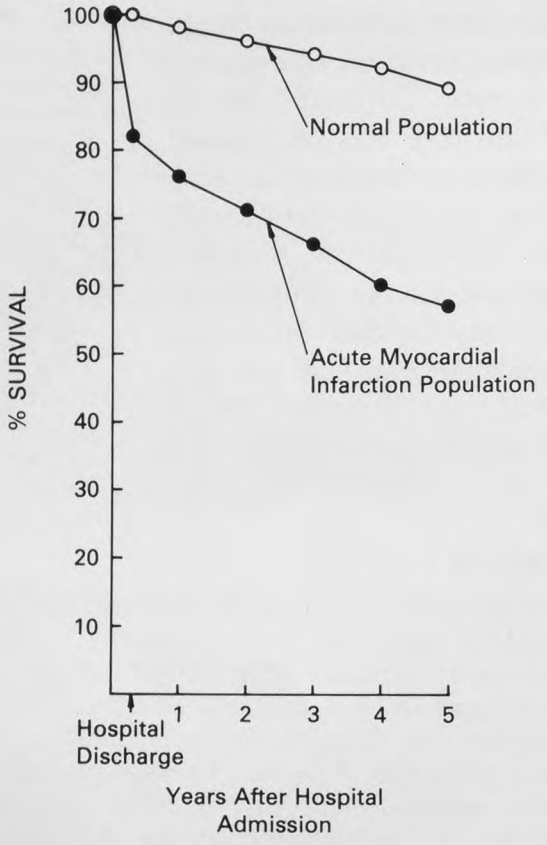


Figure 1. Comparison of the survival curve for acute myocardial infarction with that of the normal population

Each patient's medical record was carefully reviewed, and served as the source for the data on age, past medical history, and extent of pump failure. An attempt was made to follow-up on each patient for five years after the hospital admission. Follow-up data were obtained through hospital records, physicians' office records, death certificates, and voter registration lists for the patients' town of residence. Patients were not contacted directly.

The diagnosis of acute myocardial infarction required either findings at autopsy of myocardial necrosis of an age corresponding to the onset of symptoms or two out of three of the following: (1) a typical clinical story; (2) typical electrocardiographic changes; or (3) SGOT over 40 units (normal range: 8-40 units). During the time of the study creatine phosphokinase (CPK) measurements were not routinely made and isoenzyme studies were not available.

A patient was considered obese if he or she was more than 20 pounds over ideal body weight based on actuarial data of the Metropolitan Life Insurance Company.[15]

The Killip classification of pump failure was used to assign degree of failure during the acute hospitalization:

Class I: no signs of pulmonary or venous congestion

Class II: moderate heart failure with basilar rales, $S_3$, tachypnea, or venous and hepatic congestion

Class III: severe heart failure with pulmonary edema

Class IV: shock with systolic blood pressure less than 90 mmHg.

Survival rates were calculated using the follow-up life table technique.[16] This method incorporates the patients lost to follow-up into the survival rate. P values were calculated by the differences among K proportions method.[17]

## Results

### *Population Characteristics*

There were 224 patients in the study. Of these, 40 died during the acute hospitalization, a total of 86 died during the five-year follow-up, 88 patients survived at least five years, and 50 patients were lost to follow-up. The mean age for the group was 62 years, with a range of 31 to 91 years. There were 162 men (72 percent) and 62 women (28 percent) with mean ages of 60 and 68 years, respectively. Fifty-one (23 percent) of the patients had had a previous myocardial infarction; 72 (32 percent) were hypertensive; 45 (20 percent) were diabetic; 96 (56 percent) smoked; and 66 (37 percent) were obese. It could not be determined from data in the medical record whether 52 patients

**Table 2. Correlation of Age and Survival**

| Age (Years) | Number of Patients (%) | 5-Year Survival Rate (%)* | Mean Age (Years) | Expected 5-Year Survival Rate (%) | Corrected 5-Year Survival Rate (%)** |
|---|---|---|---|---|---|
| <50 | 39 (17) | 78 | 44 | 97 | 81 |
| 50-59 | 60 (27) | 63 | 54 | 93 | 70 |
| 60-69 | 71 (32) | 55 | 64 | 87 | 78 |
| 70+ | 54 (24) | 36 | 77 | 67 | 69 |

*Corrected for patients lost to follow-up. P value for differences in 5-year survival rate <0.05[16]
**P value for differences in 5-year survival rate=0.4
The corrected 5-year survival rate equals 5-year survival plus 100 percent minus expected 5-year survival. For example, for patients <50 years old the corrected 5-year survival=78 percent+100 percent−97 percent=81 percent

were smokers or not, nor whether 46 patients were obese or not. One hundred thirty-two patients (61 percent) did not develop pump failure (Class I); 44 (20 percent) had moderate failure (Class II); 19 (9 percent) developed pulmonary edema (Class III); and 23 (10 percent) developed cardiogenic shock (Class IV).

### *Cause of Death*

Of those who survived hospitalization, 86 died during the five-year follow-up. As seen in Table 1, 63 percent of the patients died of definite cardiac disease: pump failure, asystole, ventricular fibrillation, or myocardial rupture. Sixteen percent of the deaths were due to probable cardiac disease. The autopsy rate was 22 percent.

### *Overall Survival*

During the acute hospitalization, 40 patients (18 percent) died (Figure 1). An additional 13 (6 percent) died during the first year, and a mean of 8 patients (4 percent) died in each of the next four years. The patients lost to follow-up were incorporated into the overall survival by the use of a follow-up life table.[15] The overall survival rate of hospitalization was 82 percent; five-year survival rate was 57 percent. Using the United States National Center for Health Statistics Life Tables and a mean age of 62 years, the expected survival of the study population was calculated. The expected five-year survival rate for this control group was 89 percent.

### *Correlations with Survival*

There were significant differences in five-year survival rates for the four age groups ($P<0.05$), as seen in Table 2. The five-year survival rate for patients under 50 years was 78 percent compared to 36 percent for those over 70 years. Men and women also differed significantly ($0.1>P>0.05$), with five-year survival rates of 60 percent for men as compared to 46 percent for women (Table 3). However, when survival was corrected for age-dependent, expected mortality, the five-year survival rate was not significantly different for the four age groups ($P=0.4$) and was nearly identical for men and women ($P=0.6$).

Patients who had had a previous myocardial infarction had significantly lower survival rates (40 percent) than those who were having their first myocardial infarction (62 percent), as seen in Table 4. This difference remained significant after being corrected for the expected mortality. The five-year survival rate was not significantly affected by hypertension, diabetes, smoking, or obesity. Patients who smoked had a lower mean age than those who did not, 55 vs 67 years.

Determination of the five-year survival rate revealed significant differences among patients with the four different classes of pump failure, ranging from 75 percent for those without failure (Class I) to 14 percent for those in Class IV (Table 5). These differences remained significant when the five-year survival rate was corrected for the expected mortality.

**Table 3. Correlation of Sex and Survival**

| Sex | Number of Patients (%) | 5-Year Survival Rate (%)* | Mean Age (Years) | Expected 5-Year Survival Rate (%) | Corrected 5-Year Survival Rate (%)** |
|---|---|---|---|---|---|
| Male | 162 (72) | 60 | 60 | 90 | 70 |
| Female | 62 (28) | 46 | 68 | 77 | 69 |

*P<0.05[16]
**P=0.4

**Table 4. Correlation of Past Medical History with Survival Rate**

| History | Number of Patients (%) | 5-Year Survival Rate (%) | P Value[16] | Mean Age (Years) | Expected 5-Year Survival Rate (%) | Corrected 5-Year Survival Rate (%) |
|---|---|---|---|---|---|---|
| No previous MI | 172 (77) | 62 | <0.05 | 61 | 90 | 72 |
| Previous MI | 51 (23) | 40 | | 63 | 88 | 52 |
| Unknown | 1 | | | | | |
| Hypertension | 72 (32) | 49 | <0.05 | 63 | 88 | 61 |
| Unknown | 2 | | | | | |
| Diabetes | 45 (20) | 59 | <0.05 | 62 | 89 | 70 |
| Unknown | 0 | | | | | |
| Smoking | 96 (56) | 68 | <0.05 | 55 | 93 | 71 |
| Unknown | 52 | | | | | |
| Obesity | 66 (37) | 58 | <0.05 | 59 | 92 | 66 |
| Unknown | 46 | | | | | |

MI=Myocardial Infarction

## Discussion

Most patients who die of a myocardial infarction do so before they reach the hospital. In one study, only 23 percent of male subjects under the age of 50 years who died of a myocardial infarction lived long enough to be seen by a physician.[18] It should be kept in mind that this study is only concerned with those patients who reach the hospital alive.

In this study, 82 percent of the patients survived hospitalization. McGuire et al found an 81.5 percent survival rate among 341 patients treated in the University of Virginia Hospital coronary care unit.[11] Grayboys found an 81.4 percent survival rate among 759 patients treated in the Peter Bent Brigham Hospital Coronary Care Unit.[19] In 1963, Geismer et al studied all the patients hospitalized for myocardial infarction in Denmark over a two-month period, 1,094 patients.[13] Coronary care units were not yet in existence and all the patients were treated on general medical wards. The in-hospital mortality rate was 41 percent, more than double the mortality since the development of the coronary care unit. Geismer found the five-year survival rate of those patients who survived hospitalization to be 56 percent, which is considerably less than the 71 percent of this study. The overall five-year survival rate for Geismer was also lower than for the patients in this study, 33 percent compared to 57 percent. Substantial progress in the treatment of myocardial infarction would seem to have been made between 1963 and 1970.

It is interesting to note that a large percentage of the patients in this study were hypertensive, di-

**Table 5. Correlation with Pump Failure**

| Class* | Number of Patients (%) | 5-Year Survival Rate (%)** | Mean Age (Years) | Expected 5-Year Survival Rate (%) | Corrected 5-Year Survival Rate (%) |
|---|---|---|---|---|---|
| I—No failure | 132 (61) | 75 | 62 | 89 | 86 |
| II—Moderate failure | 44 (20) | 51 | 62 | 89 | 62 |
| III—Severe failure | 19 (9) | 21 | 67 | 80 | 41 |
| IV—Cardiogenic shock | 23 (10) | 14 | 60 | 90 | 24 |
| Unknown | 6 | | | | |

*See text for elaboration of class criteria
**$P<0.05$[16]

abetic, smokers, and/or obese. As the Framingham Study has shown, there is an association between these factors and the *development* of a myocardial infarction.[20] However, in this study, there was no significant association between these factors and the *mortality* from an infarction. These patients may have been more likely to have a myocardial infarction, but they were no more likely to die from their MI than the normotensives, nonsmokers, non-diabetics, and non-obese. Although the five-year survival rate of smokers and nonsmokers was not statistically different, the nonsmokers have a longer life span because they were 12 years older than smokers at the time of their infarction.

Patients who had had a previous myocardial infarction did show a significantly different five-year survival rate, 40 percent compared to 62 percent for those with no previous myocardial infarctions. Age had a significant association with mortality, but this could be entirely explained by the expected increase in mortality with age.

As has been documented in previous studies,[5,13] there is a striking male predominence among heart attack victims in the present study (72 percent male, 28 percent female). Although the age corrected five-year survival rate was almost identical, women could expect a longer life span because they were older on the average than the men at the time of their infarction (68 vs 60 years).

Many studies have looked at the hospital course of patients with myocardial infarction to determine which factors are the best predictors of survival. Some have developed prognostic indices based upon such factors as the degree of pump failure, age, and the height of rise of SGOT values.[8,9] In this study, the degree of pump failure was examined and found to be predictive of the mortality.

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