Myocardial Infarction and Coronary Care Units
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Treatment of Myocardial Infarction in a Coronary Care Unit: A Two-Year Experience With 250 Patients
by T. Killip, III, J. T. Kimball (1)

ABSTRACT
The results of treatment of 250 patients with established acute myocardial infarction in a coronary care unit in a university hospital are described. The criteria for diagnosis have been carefully defined. In 62 percent of patients admitted with a tentative diagnosis of acute infarction, the initial impression was confirmed. Fifteen percent of patients admitted to the unit were classified as having possible infarction; in this group, the mortality rate was 3 percent. A classification of functional severity based on clinical evidence of heart failure or shock is presented.

Morbidity and mortality in acute myocardial infarction are related to the functional severity of the illness. Although arrhythmia is common, the overriding importance of five life-threatening arrhythmias is emphasized. Mortality of patients in the coronary care unit was not improved in comparison to those treated under regular care until strong central direction of therapeutic programs, immediate treatment of arrhythmia in cardiac arrest, and delegation of some medical authority to trained nurses was accomplished. The change in concept of the purposes and practices of special coronary care from resuscitation to prevention of arrhythmia is emphasized.

The mortality in myocardial infarction complicated by shock remains high. In the absence of shock, aggressive medical treatment in the coronary care unit reduced mortality from 26 to 7 percent. The implications of these data in the management of patients admitted to a hospital with a diagnosis of acute myocardial infarction are discussed.

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Review
In 1967, Killip and Kimball (1) published an article that helped confirm the role of the coronary care unit (CCU) as an important tool in the management of patients with acute myocardial infarction (AMI). They asserted that the major benefit of such a specialized unit is the timely recognition and immediate treatment of life-threatening arrhythmias. Most importantly, this landmark study established a method for early risk stratification, or classification, of patients admitted to CCUs with AMI, eventually desig-
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rized units began in 1962. The first CCU in the U.S. was

started by Day in Kansas, and another, not long afterward,

by Meltzer in Philadelphia.

In their landmark article, Killip and Kimball (1) described

their experience with 250 patients with AMI treated in a

specialized CCU. Patients with definite MI, as defined by

electrocardiogram findings and laboratory enzyme results of

SGOT, SGPT and LDH, were treated either on a regular

ward or in a specialized CCU. Each group was subdivided

according to the presence or absence of cardiogenic shock. The

first analysis of mortality and morbidity data was set forth

after eight months of CCU operation. One hundred pa-

tients with definite MI treated in the CCU were compared

with 100 patients treated in a regular ward. In the initial

comparison, the mortality of the two groups was compara-

ble. However, after certain decisive policy changes in the

CCU, significant benefit was obtained. Nurses were author-

ized to apply precordial shock if a physician was not

available within 60 s, and a clear protocol for treatment of

CCU patients was given to the in-house physician by the

senior physician. After these modifications, a significant

improvement in mortality was observed in the next 150

CCU patients who were not in cardiogenic shock. Most

notably, the mortality rate decreased from 26% for patients

treated in a regular ward to 7% for those treated in the

CCU. In addition, patients who suffered a cardiac arrest

were more likely to survive if the event occurred in the

CCU. These findings confirmed the importance of the

prompt recognition and treatment of significant arrhyth-

mias in patients with AMI.

Although the numbers were not large, for those patients

in cardiogenic shock, no benefit from intensive cardiac care

in terms of morbidity or mortality was detected. The

mortality for these patients was quite high—69% in the

patients managed on the regular floor and 85% for those

treated in the CCU. The treatment of such patients remains

a considerable therapeutic challenge today. Although there

is now evidence that the 30-day survival rate is increased in

patients with AMI complicated by cardiogenic shock who

undergo revascularization, the overall mortality remains

high. It seems likely that until further treatment options

become available for these patients, prevention of such

complications as cardiac rupture and intractable congestive

heart failure will be of fundamental concern in the manage-

ment of high-risk patients with MI.

Although Killip and Kimball (1) reported improved

mortality and morbidity in patients with AMI treated in the

CCU, the effectiveness of these units continued to be
debated over the following decades. Killip and Kimball were

not alone in reporting benefit in mortality. Others who

directly compared patients treated in the intensive care unit

with those treated in regular wards and found a benefit in

terms of mortality included Meltzer (7) and Brown and

MacMillan (8). In addition, since 1967, when the CCU

became widely instituted in the U.S., the mortality of

patients with AMI has decreased steadily in those older

than 35 and those younger than 65 years of age. This

finding, however, cannot be attributed to intensive care

alone, as many advances have occurred simultaneously,

including the primary and secondary prevention of athero-

crotic disease and the medical and interventional man-

agement of acute coronary syndromes. In the late 1970s,

Hill and associates (9) compared AMI patients treated at

home with those treated in the hospital. They found no

significant difference in mortality for the two groups. A

notable qualification of this study is that a significant

subgroup of patients was excluded from the trial. These

patients had a higher mortality than either of the other

groups. This finding suggests that the MI was not severe

enough in the included groups to detect a benefit from the

management in an acute CCU. In addition, this trial, as well

as other similar studies, was conducted over 20 years ago,

before vigorous techniques for controlled trials had been

established. It now seems clear that the prevention of

arrhythmic death in those patients who are at high risk is

best carried out in the CCU.

I do think, however, that there is another useful aspect of

the article by Killip and Kimball (1)—namely, the heart

failure (or severity) index they developed. This clinical index

seems to have stood the test of time. It was an attempt to

develop a bedside classification of the integrity of left

ventricular function. Obviously it is not precise, but in large

population studies it seems to work: there is a direct
relationship between the classification and mortality. A number of studies appear to have validated this index with respect to mortality. There is clearly something useful in the classification or index that Thomas Killip and John Kimball developed.

It is possible that some of the less crude and more accurate invasive approaches used in the CCU, such as the routine use of the flow-directed Swan-Ganz catheter for evaluation of ventricular function, may actually increase mortality in some cases. The use of the Swan-Ganz catheter in patients in intensive care units has been widely debated. Several retrospective studies have addressed the benefit of the Swan-Ganz catheter and have detected adverse outcomes in some patients. No prospective clinical trials have been undertaken to date. Some investigators have called for a moratorium on the use of the Swan-Ganz catheter until such a study is completed (10). It is possible, however, that because data are often made available from the pulmonary artery catheter, which is useful in specific clinical scenarios, such a moratorium would not be wise (11). Generally, use of the Swan-Ganz catheter should be limited to a small number of absolute indications in which a specific question is answered or by which drug therapy is guided. The most obvious indication for cases of AMI would be in the management of patients in cardiogenic shock who will be treated with positive inotropic intravenous agents and diuretics. The length of time the catheter is left in place is also important. A shorter duration would be less likely to lead to such complications as bacteremia and right-sided endocarditis.

This landmark article by Killip and Kimball (1) was important in establishing the benefit of intensive care for patients with AMI. Those patients at high risk for sudden death are the most likely to benefit from such specialized care. Another useful aspect of the article was the severity index they developed. Today it is my belief that under specific circumstances the use of an invasive monitoring device such as the Swan-Ganz catheter is important in the management of certain cardiac patients. However, a prospective randomized controlled trial may be useful in confirming this benefit.

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REFERENCES