

Pre-Hospital Management of Acute Myocardial Infarction

CHARLES L. BAIRD, JR.

*Division of Cardiovascular Disease,
Medical College of Virginia,
Richmond 23219*

Atherosclerosis of the coronary arteries is recognized today as a major health problem in the United States, since 600,000 deaths are attributed to it annually (Vital Statistics, 1966). The medical profession and the general public are well aware of the important studies of its pathogenesis and prevention. However, the profession has been so preoccupied with these phases of investigation that the mechanism of death and possible modes of correction have remained obscured until recently.

In 1956 Claude Beck of the Western Reserve University suggested that ventricular fibrillation may be the mechanism of death in many instances of arteriosclerotic heart disease (Beck, Weckesser and Barry, 1956). He popularized the phrase "hearts too good to die" to promote the concept that death in coronary disease was frequently electrical and not always associated with a terminal pathologic process. In 1960 Dr. Adelson reported a study of 500 consecutive sudden deaths attributed to coronary disease, discovering that only one-third of these patients had a recent thrombus or myocardial infarction, while two-thirds of the group had no "new" anatomic disease (Adelson and Hoffman, 1961). This provided further support to the concept that the lethal mechanism in arteriosclerotic heart disease, more appropriately termed ischemic heart disease, was unrelated to the degree of myocardial damage and most likely was an electrical phenomenon. Electrocardiographic monitoring of patients with acute myocardial infarction in coronary intensive care units has subsequently documented that ventricular fibrillation was frequently the mode of death in these patients. The 30 percent decrease in hospital mortality rate of patients with acute myocardial infarction has been attributed to the coronary intensive care unit system with its technique of instant defibrillation (Day, 1956). However, improved supportive medical therapy and the use of

antiarrhythmic drugs may have also decreased the incidence of serious arrhythmias such as ventricular fibrillation. The fate of these patients resuscitated after ventricular fibrillation is excellent, as illustrated by a recent report of a one year mortality rate of only 12 percent in 53 such patients (Lawrie, 1969). Such rewarding results in coronary intensive care units have encouraged physicians to consider wider applications of these effective cardiopulmonary resuscitative techniques.

Pre-Hospital Phase of Myocardial Infarction

The major concern in the management of acute myocardial infarction is the care of patients outside of the hospital, since 55 percent to 75 percent of patients dying with acute myocardial infarction never reach the hospital. In 1966 Frank Pantridge of Belfast, Northern Ireland alerted the medical profession to this problem by the establishment of the mobile coronary care unit, to provide safe transportation as well as prevent death from cardiac arrest (Pantridge and Geddes, 1967). Dr. Pantridge's mobile coronary unit consists of an ambulance with routine monitoring and resuscitative equipment, such as a battery operated defibrillator and pacemaker catheters. The house physician and nursing personnel of the Royal Victoria Hospital coronary care unit are immediately available to accompany this ambulance when summoned by telephone from one of the Belfast physicians. This unit admitted 794 patients with acute myocardial infarction during a 39 month period and encountered 126 cardiac arrests (Pantridge and Adgey, 1969). There were no survivors in 71 patients who did not receive cardiac resuscitation prior to the arrival of the mobile coronary care unit. Cardiac resuscitation was administered to the remaining 55 patients prior to the arrival of the unit; ventricular fibrillation was observed in 48 and asystole in seven

ACUTE MYOCARDIAL INFARCTION

of the patients. Thirty-nine of the 48 patients with ventricular fibrillation were successfully defibrillated but none of the patients with asystole were resuscitated. The majority of the patients who failed to respond to defibrillation were observed to have had inadequate ventilation or sternal compression prior to the arrival of the mobile coronary care unit.

The successful resuscitation by Dr. Pantridge's mobile coronary care unit's team of 30 percent of patients collapsing outside of the hospital with cardiac arrest is significant, particularly since two-thirds of this group were long term survivors. It is doubtful whether any of the patients could have effectively been resuscitated by the available rescue squads and ambulance services that provide emergency health care in the metropolitan areas of the United States. Wilder et al (1964) reported 17 patients in whom appropriate resuscitative measures were applied during transport to the hospital. In all of these patients ventricular fibrillation was abolished in the emergency room but none of the patients survived to leave the hospital. This study reflects the widespread disappointment with the present day techniques in the management of cardiac arrest outside of the hospital. However, the concept of the mobile coronary care unit system remains as a controversial issue (Steel, Cooper and Fox, 1969). Dr. Pantridge's goal of early monitoring of patients with suspected myocardial infarction was achieved by the admission of 75 percent of patients within four hours after the onset of symptoms (Pantridge and Adgey, 1969). This represents a significant improvement over a previous report of an admission rate of only 16 percent in four hours (McDonald, 1967).

It is surprising that only 11 of the 794 patients were arrested during the period of transportation by Dr. Pantridge's mobile coronary care unit. This low incidence must be attributed to the fact that 40 to 50 percent of the mortality occurred during the first hour in patients who died of acute myocardial infarction (Bainton and Peterson, 1963). It is possible that the early administration of antiarrhythmic drugs, such as lidocaine (Xylocaine® hydrochloride) and atropine, may have decreased the incidence of cardiac arrest during transport. It would appear from Dr. Pantridge's data, however, that the major problem is cardiac arrest that occurs shortly after symptoms, a problem that can only be partially solved by the institution of the mobile coronary care unit system. This does not preclude recommending a program to provide effective emergency health services with specially trained, certified para-medical personnel for electrocardiographic monitoring and correction of fatal arrhythmias due to myocardial infarction as well as other disorders such as respiratory failure, complete heart block and electrocution.

Future Management of Myocardial Infarction

Unfortunately, the medical profession is oriented to hospital based "crisis care" to such an extent that certain aspects of community health problems are left unattended. However, the epidemic of coronary deaths that is now occurring outside of the hospital in the United States has stimulated physicians to realize that any appreciable reduction in the mortality rate must come from their advice and support in the emergency health service field. At the present time it appears justifiable to recommend a community program of sophisticated emergency health care, although hopefully in the future preventive care will render such a proposal obsolete.

The least expensive and possibly most effective program would be educating the public concerning the early signs and symptoms of acute myocardial infarction. This could be initiated by physicians as well as volunteer and government supported agencies. Particular attention would be paid to the detection of high risk individuals who have hypertension, diabetes mellitus, hyperlipemia or other conditions that predispose to ischemic heart disease and its complications. The community education program would encourage immediate self referral of patients to a monitoring area (Fig 1) upon the onset of symptoms. It would be quite advantageous to have electrocardiographic monitoring and basic resuscitative equipment at industrial nursing stations, department store dispensaries, and other strategically located extra hospital sites where nurses and/or para-medical personnel provide first aid care. The patient under observation in these units would be managed similarly as if hospitalized in an intensive care unit. Complete electrocardiograms and constant electrocardiographic monitoring would take place until arrival of the ambulance, which would continue electrical surveillance during transport to the hospital. The proposed system of extra hospital monitoring would be enhanced by the effective use of an emergency communication program. The transmission of electrocardiograms via radio telemetry and/or telephone would allow the hospital physician on call for the coronary unit to prescribe antiarrhythmics and other drugs for patients under the supervision of the nurses and para-medical personnel. It is possible that the early administration of atropine for bradyarrhythmias, and/or parenteral lidocaine (Xylocaine® hydrochloride) therapy may prevent subsequent cardiac arrest. If such an assumption proves valid, self-administration of these drugs may be indicated, particularly after transmission of the electrocardiographic data to designated coronary care units.

The proposed public educational system would have such a significant impact on hospital emergency room care that reorganization of these services would be

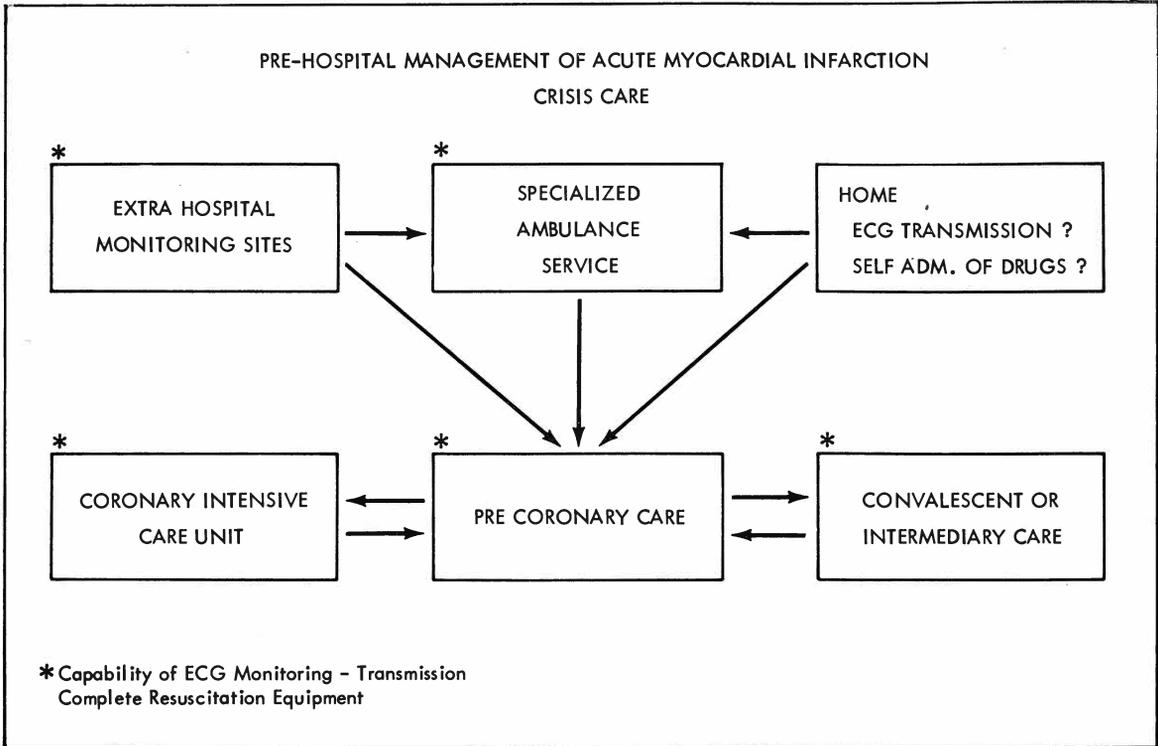


Fig. 1

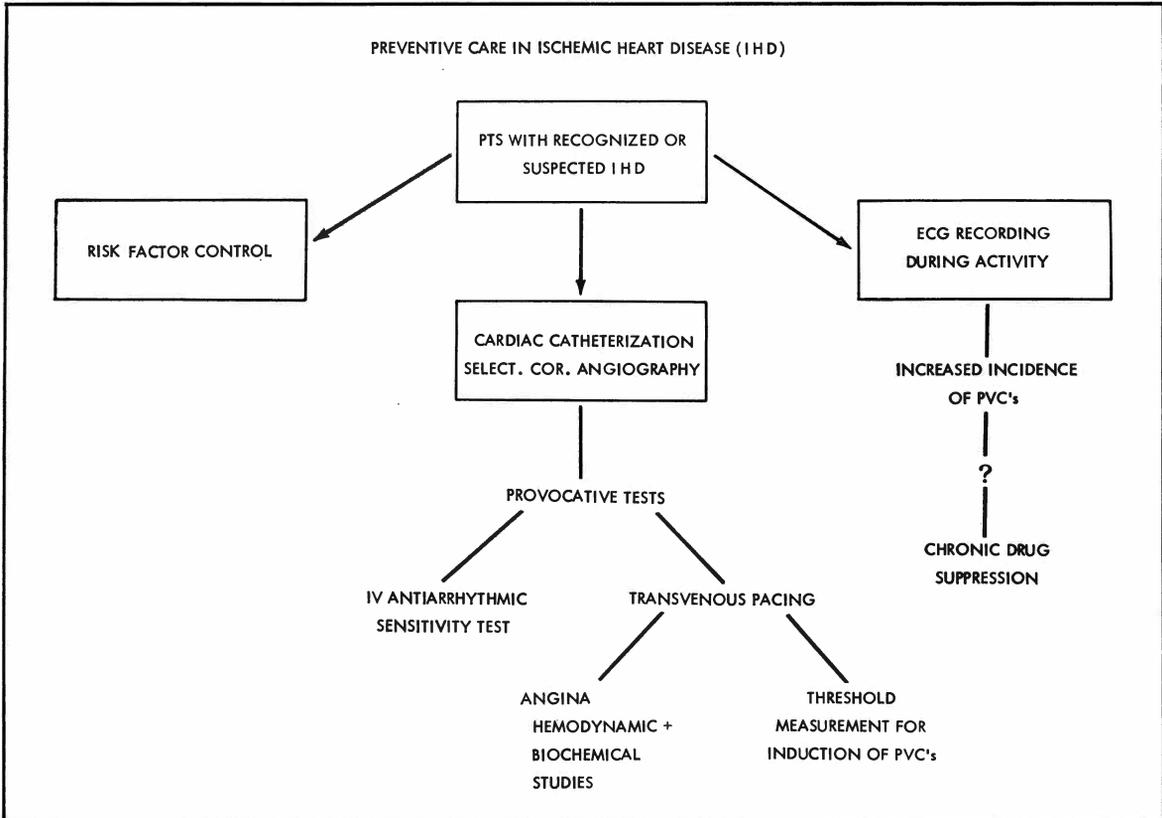


Fig. 2

ACUTE MYOCARDIAL INFARCTION

necessary. A pre-coronary care area, consisting of simple electrocardiographic monitoring with a supervisory staff of nursing personnel, could be developed to screen these patients for possible hospital admission (Sidel, Acton and Lown, 1969). Patients who have clear evidence of ischemic heart disease or serious arrhythmias naturally would be admitted directly to the coronary intensive care unit. Patients with suspected myocardial infarction who present themselves for observation but clearly have other conditions that simulate ischemic heart disease (such as hyperventilation syndrome, gastrointestinal disorders or neuromuscular chest pain) would be reassured and released. A third category of patients in which the diagnosis remains obscure and hospitalization is recommended, would evolve from this large scale screening program. It would appear that the convalescent coronary care unit, originally proposed for continued monitoring of patients with recent myocardial infarctions, would be logically suited for this group. If it becomes established that the patient has "acute" ischemic heart disease or significant arrhythmias, transfer to the coronary intensive care unit, where a greater level of sophisticated care exists, would take place. These suggestions of three different monitoring areas are consistent with today's trend toward graded care in hospital administration.

The reorganization of the emergency health services, the public education program, and graded hospital care would have limited effectiveness because of the remaining problem of sudden death. Therefore, it would be necessary to include in the preventive care programs for ischemic heart disease (Fig 2), methods for selection of patients subject to this and other complications. It is conceivable that patients would be admitted to an ambulatory cardiovascular center where various diagnostic and provocative tests would take place. Cardiac catheterization including selective coronary arteriography, atrial pacing, biochemical determinations, and possibly electrophysiologic threshold pacing would be the nature of such studies. Electrocardiographic rhythm monitoring during stress and daily activities of patients in this proposed unit might provide the means for the identification of patients with a high incidence of ventricular arrhythmias. The reports of Chiang et al (1968), and Hinkle, Carver and Stevens (1969), of a greater risk of sudden death in patients with an increased number of premature ventricular contractions, raises the possibility that chronic drug suppressant therapy, such as quinidine sulfate, may reverse such a trend. A large scale study, perhaps on an international basis, is urgently needed to provide an answer to this very important question. Although the mobile coronary care unit system has not been the final answer in the management of cardiac arrest outside of the hospital, it has succeeded in stimulating the medical profession

as well as other interested members of the community to investigate this problem in its various aspects.

References

- Adelson L, Hoffman W:** Sudden death disease. *JAMA* 176: 129, 1961
- Bainton CR, Peterson DR:** Deaths from disease in persons 50 years of age and younger: a community-wide study. *New Eng J Med* 269: 1085, 1963
- Beck CS, Weckesser EC, Barry FM:** Fibrillation and successful defibrillation. *JAMA* 161: 43, 1951
- Chiang BN, Perlman LV, Ostrander LD:** The clinical and logical significance of premature systoles in patients with disease and sudden death in Tecumseh, Michigan. *Am J Med* 38, 1968
- Day HW:** Effectiveness of an intensive care area. *Amer J Cardiol* 15: 51, 1965
- Hinkle LE Jr, Carver ST, Stevens M:** The clinical significance of asymptomatic disturbances of cardiac rhythm in middle-aged men. *Amer J Med* 38: 1969
- Lawrie DM:** Long-term survival after ventricular fibrillation complicating acute myocardial infarction. *Amer J Cardiol* 1085, 1969
- McDonald EL:** Coronary care units. The Proceedings of the Symposium on Acute Myocardial Infarction. Proceedings of a symposium sponsored by the University of London. Julian DG, Oliver MF (eds) London: Livingstone, 1967
- Pantridge JF, Adgey AA:** Pre-hospital management of myocardial infarction. *Amer J Cardiol* 24: 666, 1969
- Pantridge JF, Geddes JS:** A mobile interhospital system for the management of myocardial infarction. *Amer J Cardiol* 1967
- Sidel VW, Acton J, Lown B:** Models for pre-hospital coronary care. *Amer J Cardiol* 1967
- Steel K, Cooper JK, Fox SM:** Mobile coronary care units. *Circulation* 39: 279, 1969
- Vital Statistics of the United States.** U. S. Department of Health, Education and Welfare, 2, Part 1, 1966
- Wilder RJ, Jude JR, Kouwenhoven WB:** Out-of-hospital coronary resuscitation by trained ambulance personnel. *JAMA* 190: 531, 1964