Eighteen patients, 15 to 74 years of age, in intractable and life-threatening heart failure underwent emergency open heart surgery. There were 14 long term survivors. One hundred percent mortality was predicted without the application of surgery. The cause of failure was valvular heart disease in 14 and coronary heart disease in four patients. Assisted circulation during the most critical period, namely, the interval between the induction of anesthesia and the institution of total cardiopulmonary bypass, proved life-saving, at least in five patients. On the basis of this study it is postulated that no heart patient is too sick to be operated upon if he is dying from a surgically remediable underlying cardiac condition.

Eighteen patients underwent emergency open cardiac surgery at the Presbyterian-St. Luke’s Hospital in Chicago in the past four years. The major indication for surgery in each instance was intractable and immediately life-threatening heart failure caused by conditions amenable to surgical repair. The majority of these patients were moribund and several of them were semi-comatose before coming to the operating room. Severe metabolic acidosis and azotemia indicated significant degree of metabolic derangement due to poor cardiac performance and inadequate tissue perfusion. Ten of these patients were operated upon either during the night or over the weekend. Cardiogenic shock led to cardiac arrest in seven patients before or during the initial stage of the operation. The records of these patients have been reviewed to examine the feasibility of major surgical intervention in the presence of fulminating heart failure and particularly to delineate a surgical approach most likely to succeed in keeping such patients alive until the institution of total cardiopulmonary bypass and correction of the heart lesion.

**Clinical Data**

Of the 18 patients, all but four suffered from valvular heart disease. These included mitral obstruction in one, mitral insufficiency in three, aortic stenosis in three, and aortic insufficiency in seven patients. The remaining four patients had coronary heart disease and the specific preoperative diagnoses included postmyocardial infarction ventricular septal rupture in one, left ventricular aneurysm in two, and acute left coronary insufficiency in one. Patients who underwent pulmonary embolectomy and emergency closed mitral commissurotomy are not included. Five patients had been operated upon previously. The ages ranged from 15 to 74 years with a mean of 50 years. Nine patients were taken directly to surgery without prior study. The preoperative evaluation in the majority of instances consisted of emergency angiography to confirm the diagnosis. Only four underwent cardiac catheterization which demonstrated lowered cardiac output and peripheral arterial desaturation in every case.

**Methods**

Because of the development of cardiac arrest during the induction of anesthesia in the second and third patients, we have adopted the policy of postponing general anesthesia until preparations have been completed for partial bypass using the common femoral vessels. The patient is placed on the operating table with his trunk elevated and while he receives oxygen, expeditious cannulation of an ulnar artery and the superior vena cava via an ante-cubital vein permits continuous monitoring of the arterial and central venous pressure. After adequate skin preparation, the patient is draped and under local anesthesia usually the right common femoral artery and vein are dissected, intravenous heparin in the amount of 4 mg per kilogram of body weight is administered, and these vessels are cannulated...
and one aortic) died on the operating table, because of failure of the heart to resume cardiac contractions. One patient, 74 years of age, remained unconscious after seemingly successful aortic valve replacement and died on the 31st postoperative day of brain damage. The fourth patient suffered a sudden attack of pulmonary edema eight months following prosthetic mitral valve replacement. Emergency cardiac catheterization revealed severe mitral obstruction. At surgery, which was performed approximately one hour later, a large piece of clot was found to be impacted in the prosthesis almost completely obliterating the valve orifice. The clot was removed and the intact valve was left in place. The patient died of severe bronchopneumonia on the 12th postoperative day.

Fourteen patients left the hospital in good to excellent condition. The following four cases are typical examples of the types of patients operated upon and demonstrate how dramatically surgery added to continued medical management can restore the cardiac hemodynamics to normal.

**Case Reports**

A 65-year-old white man with severe aortic stenosis was admitted to the medical service in mild congestive heart failure (Fig 2A). Forty-eight hours later his condition deteriorated and maximal intensification of medical management failed to produce any improvement (Fig 2B). Because of predictable impending death, surgical consultation was requested during the night. On the way to the operating room the patient suffered three episodes of cardiac arrest requiring external cardiac massage. Because of the intractable nature of his cardiogenic shock and myocardial irritability, partial bypass was instituted under local anesthesia utilizing the technique described. This permitted exposure of the heart through a midline sternotomy incision and completion of total bypass by rapidly inserting the second venous catheter into the right atrium and clamping the main pulmonary artery. An extremely calcific and highly stenotic aortic valve was then resected and replaced with a sutureless Magovern prosthesis. The postoperative course of this patient was remarkable in that he excreted 4 liters of urine during the first 12 hours after surgery. Further sponta-

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**Table 1—Emergency Open Heart Surgery: Hospital Mortality in 18 Patients**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age, Sex</th>
<th>Diagnosis</th>
<th>Operation</th>
<th>Cause of Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25, M</td>
<td>Partially detached mitral prosthesis</td>
<td>Insertion of a new valve</td>
<td>Heart failure</td>
</tr>
<tr>
<td>2</td>
<td>65, F</td>
<td>Partially detached aortic prosthesis</td>
<td>Insertion of a new valve</td>
<td>Heart failure</td>
</tr>
<tr>
<td>3</td>
<td>74, F</td>
<td>Severe aortic stenosis</td>
<td>Aortic valve replacement</td>
<td>Brain infarct.</td>
</tr>
<tr>
<td>4</td>
<td>56, F</td>
<td>Obstruction of mitral valve prosthesis</td>
<td>Removal of clot impacted in valve</td>
<td>Bronchopneumonia</td>
</tr>
</tbody>
</table>

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**Results**

Four patients did not survive the operation (Table 1). Two with periprosthetic leak (one mitral

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neous diuresis and maintenance of excellent cardiac output resulted in the correction of severely impaired serum electrolytes and preoperative azotemia of 64 mg percent. The patient was discharged in good condition on the 18th postoperative day (Fig 2C). He was last seen three years after surgery, remaining asymptomatic, and in spite of his advanced age, working full time.

CASE 2

Severe aortic insufficiency was the cause of failure in seven patients. The basic pathologic process responsible for aortic incompetence in each patient is outlined in Table 2. One of these patients was a 41-year-old man who had been in excellent health until three days prior to admission to another hospital. With a diagnosis of free aortic regurgitation and left heart failure unresponsive to all available medical means, he was transferred to our service for surgical consideration (Fig 3A). The patient, nearly comatose, expectorating frothy and bloody fluid, severely cyanotic with unobtainable blood pressure, was rushed to the operating room and following minimal skin preparation and adequate draping, connections were made between the right common femoral vessels and the pump oxygenator primed with lactated Ringer's solution within ten minutes. Institution of partial perfusion was followed by induction of anesthesia, endotracheal intubation and exposure of the heart via a midline sternotomy incision. The pericardium contained approximately 500 ml of dark blood. This was rapidly evacuated and the second venous catheter was placed into the right atrium. Significant improvement of cardiac contractions occurred as soon as the pericardium was drained. The ascending aorta was ecchymotic and when this was entered, complete circumferential intimal tear was found about an inch superior to the aortic valve. The normal aortic cusps

![Figure 2 (Case 1). Anteroposterior roentgenograms: A: on admission; B: two days later when patient developed massive left heart failure, and, C: six months after surgery showing reduction in heart size and clear lung fields.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21475/)

![Figure 3 (Case 2). Anteroposterior roentgenograms: A: on admission showing cardiomegaly and massive pulmonary edema, and B: on discharge ten days after surgery showing significant decrease in heart size and clear lung fields.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21475/)
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FIGURE 4 (Case 2). The schematic drawings of ascending aortic dissection and its surgical repair.

were prolapsed into the left ventricle, causing total regurgitation. Surgical correction consisted of circumferential suturing of the dissected layers and reanastomosis of the divided ends of the aorta (Fig 4). This resulted in elevation of the prolapsed aortic cusps into their normal position and therefore restored valvular competence. He maintained an uneventful postoperative course and left the hospital in excellent condition ten days after surgery (Fig 3B).

The two year postoperative evaluation has revealed an asymptomatic individual with no evidence of aortic insufficiency.

CASE 3

A 49-year-old man suffered a massive myocardial infarction and one week later, while making a satisfactory recovery, he suddenly went into profound congestive heart failure. Examination at this time revealed a new finding, namely a loud systolic murmur over the entire precordium. Because of the intractable nature of his failure and the development of a murmur suggesting an added hemodynamic complication, possibly amenable to surgical repair, he was transferred to our service at the Presbyterian-St. Luke's Hospital. On admission he appeared dyspneic, cyanotic, tachypneic, hypotensive and totally disoriented. The pulse rate was 140 per minute. His neck veins were distended in the sitting position. The lungs contained crepitant rales to the apices (Fig 5A). A Grade IV systolic murmur was present over the entire precordium. The liver edge was at the level of the umbilicus and peripheral edema extended to the knees. Emergency angiography with the injection of the dye in the left ventricle confirmed the clinical diagnosis of ventricular septal rupture and the patient was taken to the operating room at 2:00 a.m. The initial steps of the operation were identical to those described for the previous two cases. The only technical variation was that the second venous catheter was passed into the superior vena cava instead of the right atrium. This was necessary so that both cavae could be occluded to achieve a dry field in the right side of the heart. Operative findings consisted of two muscular defects in the ventricular septum, the large one measuring 3 cm in diameter. These were exposed through a right ventriculotomy incision and in spite of recent infarction, satisfactory closure could be achieved. The patient made an excellent recovery (Fig 5B).

Unfortunately, the development of a left ventricular aneurysm, a second complication of his original myocardial infarction, went unrecognized by his physician, and he succumbed to this complication three months after the operation.

CASE 4

A 60-year-old man was transferred to us in mild congestive heart failure caused by an exceedingly large left ventricular aneurysm. The patient had suffered two proved episodes of myocardial infarction and a questionable third attack all within three months prior to his admission to our service. His cardiac decompensation had defied all available medical means and, therefore, he was referred for possible surgical intervention in spite of recent infarctions. The aneurysm was unusually large and on examination produced

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FIGURE 5 (Case 3). Anteroposterior roentgenograms: A: on admission showing massive pulmonary congestion and cardiomegaly, and B: nineteen days after surgery when the patient was discharged in perfect cardiac compensation.
readily palpable paradoxic impulse in the left third, fourth, and fifth intercostal spaces. The patient required oxygen in bed and in addition to signs of left heart failure and mild cerebral ischemia, he exhibited moderate electrolyte imbalance and pre-renal azotemia. Decision was made to defer surgery at least temporarily to determine, if possible, whether or not current myocardial injury existed and meanwhile direct maximum effort to the treatment of failure and correction of his metabolic derangement. A sudden development of a nearly fatal cardiogenic shock necessitated emergency excision of the aneurysm during the week end (Fig 6A). Intensive medical care, including the use of isoproterenol and vasopressors, had failed. The important consideration, of course, was the possibility of a new infarct or extension of myocardial injury if, indeed, he had suffered a third episode of heart attack several days earlier. It seemed that the only possibility of survival was to resect the aneurysm which unquestionably made a major contribution to the patient’s downhill course. He was, therefore, taken to the operating room almost unresponsive with systolic blood pressure of 50 to 60 mm of mercury and typical signs of profound left heart failure. Expeditious institution of partial perfusion was carried out under local anesthesia using the right common femoral artery and vein. This allowed maximal flow of 3400 ml per minute. In spite of this, immediately upon induction of anesthesia the heart arrested in ventricular fibrillation. Immediate endotracheal intubation was followed by rapid entry into the mediastinum through a midline sternotomy incision and the second venous catheter was inserted into the right atrium increasing the flow to 5 liters per minute. To avoid left ventricular distention, the aneurysm was incised away from its margin and from then on the operation was carried out in the usual manner. The patient’s postoperative recovery, although slow, has been quite satisfactory (Fig 6B).

**COMMENT AND CONCLUSION**

This study demonstrates the feasibility of major surgical intervention in terminal cardiac patients. It is important, however, to be certain: (1) maximum efforts utilized medically to treat the patient’s heart failure had failed; (2) that the cause of this intractable cardiovascular collapse is amenable to surgical repair. The decision for emergency surgery in every instance should be a consensus reached by the surgeon and a cardiologist who either has been actively treating the patient or has reviewed the treatment rendered elsewhere in case of a transfer. Under these dire circumstances extensive preoperative evaluation such as cardiac catheterization should be avoided. When a clinical diagnosis is certain, operation can be undertaken promptly. In case of need for confirmation of diagnosis, usually an angiogram will be sufficient. This modality of preoperative evaluation proved valuable in three patients. One patient developed marked congestive heart failure one week after mitral valve replacement and in the absence of a systolic murmur, the clinical impression of recurrent mitral insufficiency due to a peri-prosthetic leak was substantiated by an emergency left ventricular injection of the dye. The patient was then transferred from the X-ray Department to the operating room and a large leak around the valve was obliterated successfully. The second patient (Case 3) developed a loud systolic murmur one week after the onset of a massive myocardial infarction. Although the clinical impression was that of ventricular septal rupture, severe mitral insufficiency could not be ruled out with confidence. Since the first lesion is best approached through a sternotomy incision and the second condition via a right...
rest preceded by the coronary arteriography showing almost complete occlusion, she developed two episodes of cardiac arhythmia. While on monitoring system and severe myocardial ischemia on the electrocardiograms. The clinical diagnosis of coronary insufficiency was confirmed by selective coronary arteriography showing almost complete occlusion of the left main coronary artery. Reconstruction of this vessel by venous patch angioplasty during total cardiopulmonary bypass restored an asymptomatic state and rapid recovery from a life-threatening failure. She remains well now one and one-half years after the operation.

The important aspect of the surgical treatment in this group has been the use of assisted circulation during the most critical period, namely, the interval between the induction of anesthesia and the institution of total cardiopulmonary bypass. We have extended the concept of circulatory assist to severely ill or poor risk cardiac patients undergoing elective open heart surgery. A number of surgeons have cannulated peripheral veins for extracorporeal circulation and several others have suggested cannulation of the venous and arterial systems under local anesthesia in preparation for partial circulatory support. Utilization of this concept and other advancements achieved in the field of cardiovascular surgery, together with the ever-increasing ability of the cardiologists to treat the failing heart have brought the following statement to a realization: no heart patient is too sick to be operated upon if he is dying from a surgically remediable underlying cardiac condition.

References


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