



## Acute Myocardial Infarction: Patient Selection for Reperfusion with Coronary Angioplasty

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**Key words:** acute myocardial infarction, coronary angioplasty, primary percutaneous transluminal coronary angioplasty, reperfusion

### Abstract

**Background:** Despite the clinical advantages of mechanical reperfusion in the treatment of acute myocardial infarction, widespread use of percutaneous transluminal coronary angioplasty has been limited by a lack of human and institutional resources.

**Objective:** To evaluate the feasibility of a PTCA-based reperfusion strategy for AMI patients selected according to high risk clinical criteria.

**Methods:** The study group included 110 patients selected for mechanical reperfusion out of 1,080 AMI patients according to the following criteria: hemodynamic disturbance (40%), large anterior wall MI (54%), contraindication to thrombolysis (15%), previous MI (13%), re-infarction (4.5%), non-diagnostic electrocardiogram (0.9%), and unsuccessful thrombolysis (30%).

**Results:** Cardiogenic shock was present in 23% of the cases and cardiac arrest with prolonged resuscitation in 8%. The cohort 30 day mortality rate was 15%. The 30 day mortality rate for patients without cardiogenic shock was 6.3%.

**Conclusions:** Selection of high risk patients who would benefit most from mechanical reperfusion appears feasible, resulting in low mortality rates when compared with those in the literature. Widespread implementation of well-defined selection criteria should promote better utilization of the limited resources available for primary PTCA.

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Mechanical reperfusion based on coronary angioplasty in cases of acute myocardial infarction has documented clinical advantages over medical therapy alone. Previous studies have demonstrated that primary or rescue percutaneous transluminal coronary angioplasty may be associated with better left ventricular function, decreased recurrent coronary event rates, and lower mortality when compared to thrombolysis [1,2]. However, widespread implementation of this strategy has been limited by several factors. Generalization of the benefit of primary PTCA to the entire AMI population is questionable. Further, registry analyses [3,4] have found less favorable results than the aforementioned studies. However, perhaps most significant is the lack of institutional and human resources required for the performance of this procedure, limiting its applicability to a small number of hospitals.

As a result of these conditions, a strategy to select patients at high risk who would benefit most from immediate revascularization through coronary angioplasty appears to be an effective and useful tool. Based on this premise, we analyzed the feasibility of a clinically oriented selection strategy for mechanical reperfusion in the AMI population. It is our hope that this will provide a more structured approach and allow efficient implementation of this strategy in high risk patients.

### Methods

This was a retrospective study of 110 patients (10%) who had been selected for mechanical reperfusion out of 1,080 patients admitted with a diagnosis of ST elevation AMI (thrombolysis 432 patients, 40%) between 1995 and 1997 based on the following clinical criteria:

- Extensive anterior wall MI as defined by ST elevation more than 1.5 mm in at least four precordial leads in the initial electrocardiogram.
- Hemodynamic compromise defined by the presence of systolic blood pressure less than 100 mmHg and/or pulmonary rales in the initial examination in the emergency room.
- Contraindication to thrombolysis, including ischemic stroke during the previous 6 months, recent bleeding, non-cardiac surgery during the previous month, and prolonged cardiopulmonary resuscitation. Age was not considered a contraindication for thrombolysis.
- Re-infarction, as defined by recurrent ST elevation and chest pain in a medically treated AMI patient.
- Non-diagnostic ECG due to intraventricular conduction defect.
- Previous myocardial infarction based on clinical history or admission ECG.
- Failed thrombolysis defined by persistent ST elevation (more than 50% in comparison to the initial ST elevation level), 90 minutes after thrombolysis.

Patients were selected for mechanical reperfusion at the discretion of the treating physician. Thrombolysis-eligible patients with high risk criteria who rejected heart catheterization or were not available for urgent heart catheterization due to logistic reasons underwent thrombolytic therapy.

PTCA = percutaneous transluminal coronary angioplasty  
AMI = acute myocardial infarction

Demographic, clinical, angiographic and procedural characteristics were obtained by chart and film review. One month major clinical event rate, including post-infarction ischemia, recurrent myocardial infarction, additional revascularization measures and mortality, was analyzed.

### Definitions

- *Acute myocardial infarction*: The presence of chest pain lasting 30 minutes to 12 hours and associated with ST elevation in at least two contiguous ECG leads or a new left bundle branch block.
- *Procedural success*: Residual stenosis less than 50%, with TIMI III flow.
- *Post-procedure myocardial infarction*: Two of the three following criteria: chest pain more than 30 minutes; ST elevation in at least two contiguous ECG leads; creatine phosphokinase elevation twice the upper limit of normal.
- *Recurrent ischemia*: Recurrent chest pain associated with ECG changes compatible with ischemia.

## Results

### Clinical and angiographic characteristics

Table 1 gives the baseline clinical characteristics. It should be noted that anterior wall MI was observed in 68 patients (62%). Killip class III–IV was seen in 42 patients (38%) and previous MI in 14 patients (13%). Cardiac arrest due to ventricular arrhythmias was present in 9 patients (8%) before admission. The angiographic characteristics are shown in Table 2. Of note is the presence of multivessel disease in 70 patients (64%) and angiographic TIMI flow 0–II in 91 patients (83%).

### Clinical selection criteria for mechanical reperfusion

Table 3 shows the selection criteria for coronary angioplasty. The most frequent reasons were extensive anterior wall MI (59 patients, 54%), and hemodynamic compromise (42 patients, 38%). Absence of clinical or ECG findings of reperfusion after thrombolysis was the criterion for 33 patients (30%).

### Procedural characteristics

Primary PTCA was performed in 77 patients (70%) and rescue PTCA in 33 patients (30%) during the study period. The mean time from the onset of pain to the opening of the artery was  $228 \pm 270$  minutes. The mean time from admission to hospital to the opening of the artery was  $108 \pm 65$  minutes. Stenting was performed in 47 patients (43%) and IIb/IIIa antagonists were used in 13 patients (12%). Intraaortic balloon pump was used in 26 patients (24%), mechanical ventilation in 15 patients (14%), and temporary pacemaker in 10 patients (9%).

Angiographic success was achieved in 96 patients (87%). Acute closure was seen in two patients (2%) and no-reflow in seven (6%).

### One month clinical events

Table 4 shows major coronary and clinical events at 1 month follow-up. It is relevant that re-infarction was seen in five patients (5%) and post-infarction ischemia in four (4%). Repeat-PTCA was performed

**Table 1. Baseline clinical characteristics**

No. of patients	110	
Age (yrs)	60.9 ± 11.4	
Men	89	81%
Smoking	31	28%
Hypertension	32	29%
Diabetes mellitus	22	20%
Dyslipidemia	23	21%
Anterior MI	68	62%
Killip III	21	19%
Killip IV	21	19%
Previous MI	14	13%
After cardiac arrest	9	8%

**Table 2. Baseline angiographic characteristics**

No. of patients	110	
Single vessel disease	40	36%
Double vessel disease	32	29%
Triple vessel disease	38	35%
Culprit artery		
LAD	61	55%
RCA	35	32%
LCX	9	8%
Lesion type		
A	4	4%
B1	6	5%
B2	15	14%
C	88	80%
TIMI flow 0–II	91	83%

**Table 3. Selection criteria for angioplasty**

No. of patients	110	
Extensive anterior MI	59	54%
Hemodynamic compromise	42	38%
Contraindication to thrombolysis	17	15%
Re-infarction	5	5%
Previous MI	14	13%
Non-diagnostic ECG	1	1%
Non-reperfusion after thrombolysis	33	30%

**Table 4. One month major clinical events**

No. of patients	110
Re-infarction	5 (5%)
Recurrent ischemia	4 (4%)
Recatheterization	11 (10%)
Acute or subacute thrombosis	4 (4%)
Redo PTCA	3 (3%)
Coronary artery bypass graft	8 pts (7%)
Death	17 (15%)

in three patients (3%) and coronary bypass in eight (7%) due to recurrence of symptoms or to multivessel disease. One month mortality rate was 15% (n=17). The mortality rate was 6% in patients with absent or mild heart failure, and 57% in patients with cardiogenic shock.

## Discussion

Mechanical reperfusion with coronary angioplasty represents a relatively recent and important advancement in the treatment of AMI and results in better outcomes. According to retrospective studies and randomized trials, primary or rescue PTCA is associated with higher rates of TIMI III flow, improved left ventricular function, and decreased incidence of re-infarction, acute ventricular septal defect, acute mitral regurgitation and stroke, as well as reduced short and long-term mortality and earlier hospital discharge when compared to thrombolysis [1,2,5–8].

The most important limitation to the widespread utilization of this treatment strategy, however, is the absence of technological and human resources in the majority of hospitals. Additionally, the optimistic results mentioned above have not always been reproducible in real-life settings outside of experienced referral centers. In a comparative study of 1,050 patients treated with primary angioplasty and 2,095 patients treated with thrombolysis in a community hospital setting, Every et al. [4] reported no difference in hospital mortality (5.6 vs. 5.5%,  $P = 0.92$ ). Likewise, in another comparative analysis based on the Alabama Registry of Myocardial Infarction Investigators, no short or long-term differences in acute coronary events or mortality were seen between the two treatment strategies [10]. The discordant results are felt to be primarily due to differences in the various centers' expertise in providing this highly operator-dependent technique [11], as well as to variable patient selection criteria among centers.

In view of resource limitations, operator variability and controversial results, clearly defined selection criteria to enable speedy identification and transfer of high risk patients who would most benefit from mechanical reperfusion with coronary angioplasty seem to be a needed tool in decision making between this option and thrombolysis.

In our study, the feasibility of using clinical criteria to select patients for mechanical reperfusion was evaluated. Subgroups of patients characterized as high risk who potentially would derive the most benefit from primary or rescue PTCA according to previous analyses were selected. High risk categories were chosen according to the following rationale:

- *Anterior wall MI* is usually associated with larger necrotic mass and worse outcome than infarcts in other localizations. An increased benefit of primary PTCA in this situation was reported by Stone et al. [12], who found a hospital mortality of 4.1% compared to 11.9% with thrombolysis ( $P = 0.01$ ). Additionally, no mortality benefit was seen in non-anterior MI patients (3.2% vs. 3.8%,  $P = 0.08$ ).
- *Hemodynamic compromise during AMI* is associated with increased mortality that is correlated with Killip class. Furthermore, major benefit is observed with early revascularization in the most severe cases [13–15]. In our study, 38% of the population was classified as Killip class III or IV, which has been previously associated with a mortality of 38 and 81%, respectively. Twenty-three of our patients presented in cardiogenic shock and their mortality rate was 57%, which is slightly better than the statistics mentioned previously, but nonetheless consistent with a grim prognosis [13–15]. Importantly, this subgroup of high mortality

rate could account for the high 30 day mortality rate of 15% seen in our cohort.

- *Relative contraindications to thrombolysis* have been associated with a 4.3-fold higher mortality (8.6% vs. 2.0%,  $P = 0.002$ ) compared with lytic-eligible patients. Furthermore, the hospital mortality in this population was seen to be significantly reduced by coronary angioplasty (2.9%) vs. t-PA (13.2%) [16]. In our study, contraindication to thrombolysis was the reason for primary PTCA in 15% of cases, including nine patients after cardiac arrest and prolonged cardiopulmonary resuscitation. A mortality of 35% was seen in this subgroup, primarily due to the poor outcome seen in five post-cardiac arrest patients [17].
- *Non-diagnostic ECG due to left bundle branch block* was the reason for primary angioplasty in only one patient in our cohort. This selection criterion is based on the diagnostic uncertainty frequently associated with this group of patients, the lower or delayed use of thrombolytics, and the concurrent high mortality that accompany this conduction abnormality [13,18].
- *Previous infarction and re-infarction after thrombolysis* are usually associated with additive necrotic mass, decreased left ventricular function, hemodynamic compromise and a higher mortality [19]. These criteria were present in 19 (17%) of our patients.
- *Unsuccessful thrombolysis* as determined by clinical and ECG criteria represented a substantial number of our patient population (33 patients, 30%) and was associated with a mortality of 9%. Previous reports confirm the increased risk associated with non-reperfusion. Despite non-uniform results, randomized trials support the use of rescue PTCA to achieve adequate reperfusion and reveal associated improvement in left ventricular function and clinical benefit in this subgroup [7,20,21].

In our study, a 30 day mortality rate of 6% was observed after the exclusion of patients with cardiogenic shock, a figure similar to previously mentioned registries, and suggestive of the feasibility of selecting patients for mechanical reperfusion based on simple clinical criteria and its association with good clinical outcome in an otherwise high risk group of patients.

### Limitations of the study

The conclusions of this study are limited by its retrospective and non-randomized design and the small study population. The advantage of the invasive approach over thrombolysis therapy cannot be concluded without a control group. Accurate information about door to balloon time, left ventricular function before and after the procedure, and quantitative analysis of angiographic characteristics is absent.

Stents were used only when they were required due to suboptimal results obtained with balloon angioplasty. Recent trials have reported improved outcome with stenting [22]. A more generalized use of stents might have resulted in even better outcomes in our study population. In addition, IIb/IIIa antagonists were used in only 12% of our patients. Recently published data have clearly associated the use of this class of drugs with a better prognosis after primary angioplasty in AMI patients. Therefore,

greater use of IIb/IIIa antagonists may have led to further improvement in outcome.

## Conclusions

Selection of patients for mechanical reperfusion based on simple clinical criteria is feasible and associated with low mortality in an otherwise high risk group of AMI patients. Well-defined selection criteria to identify patients who would probably derive the greatest benefit from mechanical reperfusion should result in more efficacious utilization of the limited resources available for primary or rescue PTCA. Randomized trials are suggested to evaluate the clinical and cost/benefit issues of this strategy.

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*I've been rich and I've been poor. Believe me, honey, rich is better*

*Sophie Tucker (1884-1966), Russian-born U.S. singer with a career spanning more than 60 years; she appeared in vaudeville, burlesque, nightclubs and music halls and became known as "the last of the red-hot mamas. Her best-known songs are "Some of These Days" and "My Yiddisher Mama."*