Acute ST-elevation myocardial infarction in the elderly (>75 years)

Results from a regional multicenter study

Summary

Objectives This prospective multicenter study assessed the prevalence and feasibility of percutaneous coronary angioplasty (PTCA) in the acute phase of ST-elevation myocardial infarction (STEMI) in 3 nonacademic interventional cardiology centers (Alsace, France).

Methods We studied the clinical characteristics, angiographic data, and PTCA results of all STEMI patients and analyzed the revascularization rates and adverse events during hospitalization. We compared patients at least 75 years of age and younger patients for these data and with the literature.

Results Of the 1672 patients admitted for STEMI, 342 (20.45%) were at least 75 years of age. Half the patients in this high-risk subgroup were women. These patients had more co-morbidities (e.g., hypertension and diabetes mellitus) than younger patients, and more of them had three-vessel disease. Mortality rate was high in this subgroup and always higher than for comparable younger subjects, but it varied according to the initial clinical profile. Their global mortality rate was 20.47%, but it fell to 5.41% when we excluded patients with cardiogenic shock or in Killip stage III, and those who were resuscitated. PTCA is a coronary reperfusion technique especially indicated for elderly patients with STEMI. It is an effective revascularization technique, with a reperfusion rate (exclusively TIMI III flow) reaching 93.88% in the elderly group, only slightly lower than among younger patients (97.18%).

Conclusion PTCA is a technique particularly indicated in the elderly in Alsace because of regional geographic and medical specificities: nearby emergency services are available to virtually the entire population of Alsace, and most interventional cardiology teams apply a strategy of exclusive primary PTCA.

While the incidence of myocardial infarction has remained stable for several years, its prognosis has improved notably. In the French Monica project, for example, the mortality rate fell from 21 to 11% between 1985 and 1990. This better prognosis and reduced mortality rates from better initial management. The establishment of cardiac intensive care units, drug treatments, thrombolytics, and revascularization techniques have improved the management of patients with myocardial infarction. Percutaneous transluminal coronary angioplasty (PTCA), also known as balloon angioplasty, is performed during the acute phase of myocardial infarction in centers with adequate equipment and qualified personnel; frequent comparison with thrombolysis has shown the efficacy of PTCA to be clearly superior. The objective of this prospective multicenter study was to assess the results and feasibility of PTCA treatment for acute myocardial infarction among the elderly, specifically, those aged 75 years or older.

Methods

Study population
All patients admitted to one of the study centers from 1 January 1999 through 31 December 2002 for acute myocardial infarction participated in this study, which took place at 3 non-university hospital centers in...
**ORIGINAL ARTICLE**

**Thrombolysis In Myocardial Infarction (TIMI)**

**Glossary**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR</td>
<td>Cardiopulmonary Resuscitation</td>
</tr>
<tr>
<td>PTCA</td>
<td>Percutaneous transluminal coronary angioplasty</td>
</tr>
<tr>
<td>TIMI</td>
<td>Thrombolysis In Myocardial Infarction</td>
</tr>
</tbody>
</table>

Myocardial infarction was defined according to the standard criteria in the literature, that is, a suggestive clinical picture associated with ECG signs (Pardee wave) or a new left bundle-branch block. We subsequently included patients who met guidelines published after we began our study: those with an acute coronary syndrome with permanent ST-segment elevation of at least 2 mm in more than 2 contiguous chest leads or a new left bundle-branch block.

The study included patients with cardiac arrest who received prehospital cardiopulmonary resuscitation (CPR). All 3 centers managed all patients with myocardial infarction by primary PTCA and systematic stenting, regardless of their clinical state on admission. Treatment was the same regardless of age, presence of cardiogenic shock and massive acute pulmonary edema, or intubation.

**PROCEDURE**

All patients underwent coronary angiography during acute myocardial infarction. The standard procedure used Seldinger's technique to puncture the femoral or radial artery. Revascularization was systematically completed by implantation of a coronary stent, except in small vessels. Starting in 2000, some patients underwent primary stenting without angioplasty predilation (SWAP). Premedication was not standardized but included aspirin, clopidogrel, standard or low-molecular-weight heparin, gastroprotec tors, and nitrate derivatives.

By convention, arterial reperfusion was defined by TIMI (Thrombolysis In Myocardial Infarction) grades, a system established during the first clinical trials of thrombolysis in myocardial infarction. Reperfusion success in our study was defined as a TIMI grade 3 flow. Treatment of myocardial infarction after PTCA included early administration of beta blockers, angiotensin-converting-enzyme inhibitors, statins, aspirin, clopidogrel, and occasionally anti-GpIIb/IIIa for 24-48 hours. Standard heparin therapy continued until sheath removal (4-18 hours), when it was replaced by low-molecular-weight heparin. Some clinics also used beta blockers, intraaortic balloon pumping, or ventilatory assistance.

**TYPE OF DATA COLLECTED**

We collected general patient data, cardiovascular risk factors, data about the initial phase of their myocardial infarction (time until treatment, clinical and ECG data), angiography data (arteries involved, distribution of damage, perfusion grade), specific PTCA procedures, outcome (in-hospital death, relapse within 24 hours, immediate success, techniques used), and mortality by age and by initial clinical presentation. Because we began collecting certain items of information during the study that had not initially been recorded, sample size differs for some items.

**EXHAUSTIVENESS AND DATA ANALYSIS**

We verified the exhaustiveness of our case collection by comparing the cases with those from each hospital's medical informatics department and coronary angiography registry. Information on all cases of myocardial infarction admitted to each of the 3 study centers was collected, entered, and analyzed in Excel and Statview. The analysis used the standard statistical tests – $\chi^2$ for qualitative variables and Anova for quantitative variables. Significance was set at 5%.

**Results**

**PATIENTS’ CHARACTERISTICS**

The study included 1672 patients, divided into 2 groups (Table 1). Half of those aged 75 years or older were women compared with 18.4% of those younger than 75 years (Table 1).

**PATIENT MANAGEMENT**

There was no significant difference in how the 2 groups reached the hospital: both mainly arrived from their homes; 2.2% of those 75 years or older arrived in the cardiac care unit on foot, compared with 0.7% of those younger than 75 (ns).

More than 2/3 of the patients in our sample received care within 6 hours of onset of symptoms (Table 1). Nonetheless, the older patients were treated later than the younger group (68.7% versus 76.8% within the first 6 hours, $p < 0.01$; 29.8% versus 22.6% after 6 hours, $p < 0.01$).

**DATA FROM THE DIAGNOSTIC CORONARY ANGIOGRAPHY**

Table 2 summarizes these data.

**ANGIOPLASTY DATA AND RESULTS**

In the older group, 86% (294/342) of patients had balloon angioplasty, compared with 90.8% of the younger group (1207/1330). We did not perform angioplasty...
### Table 1

**Patient characteristics and time until treatment**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients 75 years or older (n = 342)</th>
<th>Patients younger than 75 years (n = 1330)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>171</td>
<td>1085</td>
<td></td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>171</td>
<td>245</td>
<td></td>
</tr>
<tr>
<td><strong>Sex ratio</strong></td>
<td>1</td>
<td>4.43</td>
<td></td>
</tr>
<tr>
<td><strong>Mean age (years)</strong></td>
<td>80.2</td>
<td>57.3</td>
<td></td>
</tr>
<tr>
<td><strong>Initial clinical presentation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Killip 3</td>
<td>75 (21.9%)</td>
<td>117 (8.8%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>55 (16.1%)</td>
<td>127 (9.5%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Recovery after sudden death and CPR</td>
<td>24 (7.0%)</td>
<td>86 (6.5%)</td>
<td>ns</td>
</tr>
<tr>
<td>*<em>Other</em></td>
<td>17 (5.0%)</td>
<td>32 (2.4%)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>**Cardiovascular risk factors **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>75 (52.4%)</td>
<td>184 (26.1%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>43 (30.1%)</td>
<td>204 (29.0%)</td>
<td>ns</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>6 (4.2%)</td>
<td>39 (5.5%)</td>
<td>ns</td>
</tr>
<tr>
<td>Diabetes, type 1</td>
<td>4 (2.8%)</td>
<td>17 (2.4%)</td>
<td>ns</td>
</tr>
<tr>
<td>Diabetes, type 2</td>
<td>26 (18.2%)</td>
<td>71 (10.1%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Current smoker</td>
<td>10 (5.15%)</td>
<td>187 (26.6%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>18 (9.3%)</td>
<td>82 (11.6%)</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Mean time to treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 3 h</td>
<td>120 (35.1%)</td>
<td>617 (46.4%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>&lt; 6 h</td>
<td>235 (68.7%)</td>
<td>1021 (76.8%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>&gt; 6 h</td>
<td>102 (29.8%)</td>
<td>300 (22.6%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>&gt; 12 h</td>
<td>45 (13.2%)</td>
<td>127 (9.5%)</td>
<td>ns</td>
</tr>
</tbody>
</table>

* Arrhythmias (ventricular tachycardia, atrial fibrillation, complete heart block), right ventricular damage, acute limb ischemia, tamponade
** We do not have information for these items for all members of the sample

### Table 2

**Data from diagnostic coronary angiography**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients aged 75 years or older (n = 342)</th>
<th>Patients younger than 75 years (n = 1330)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arteries involved</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right coronary</td>
<td>121 (35.4%)</td>
<td>518 (38.9%)</td>
<td>ns</td>
</tr>
<tr>
<td>Circumflex-marginal</td>
<td>58 (17.0%)</td>
<td>217 (16.3%)</td>
<td>ns</td>
</tr>
<tr>
<td>IVA (LAD)</td>
<td>133 (38.9%)</td>
<td>496 (37.3%)</td>
<td>ns</td>
</tr>
<tr>
<td>Main coronary</td>
<td>10 (2.9%)</td>
<td>35 (2.6%)</td>
<td>ns</td>
</tr>
<tr>
<td>CAB</td>
<td>7 (2.0%)</td>
<td>17 (1.3%)</td>
<td>ns</td>
</tr>
<tr>
<td>Other</td>
<td>9 (2.6%)</td>
<td>42 (3.2%)</td>
<td>ns</td>
</tr>
<tr>
<td>NR*</td>
<td>4 (2.0%)</td>
<td>5 (0.4%)</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Damage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One vessel</td>
<td>112 (32.7%)</td>
<td>661 (49.7%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Two vessels</td>
<td>94 (27.5%)</td>
<td>362 (27.2%)</td>
<td>ns</td>
</tr>
<tr>
<td>Three vessels</td>
<td>129 (37.7%)</td>
<td>301 (22.6%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>NR*</td>
<td>7 (2.0%)</td>
<td>6 (0.5%)</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Initial TIMI grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>272 (79.5%)</td>
<td>1025 (77.1%)</td>
<td>ns</td>
</tr>
<tr>
<td>I</td>
<td>13 (3.8%)</td>
<td>21 (1.6%)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>II</td>
<td>24 (7.0%)</td>
<td>89 (6.7%)</td>
<td>ns</td>
</tr>
<tr>
<td>3</td>
<td>32 (9.4%)</td>
<td>192 (14.4%)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>NR*</td>
<td>1 (0.3%)</td>
<td>3 (0.2%)</td>
<td>ns</td>
</tr>
</tbody>
</table>

IVA: interventricular anterior (left anterior descending artery); CAB: coronary artery bypass; TIMI: Thrombolysis In Myocardial Infarction
* NR: not reported
when angiography showed initial arterial flow of TIMI grade 3 or very narrow arteries (diameter less than 1.2 mm), very distal damage, or damage to the left main artery justifying an emergency coronary artery bypass. The PTCA success rate and the stenting rate were significantly better among those younger than 75 years (Table 3).

**Complications during hospitalization**

Patients aged 75 years or older died more often in the first 24 hours than those in the younger group (Table 4).

**Variations in the in-hospital mortality rate**

- **As a function of initial clinical status**

  The in-hospital death rate was notably higher among older patients: 20.5% of the most elderly versus 6.8% among those younger than 75 years (p < 0.01), but varied according to initial clinical status (Table 5).

- **As a function of time until treatment**

  We compared the mortality rate of the 2 groups as a function of time from symptom onset until treatment began (within 6 hours or longer) (figure 1). In both groups, excess mortality was proportional to elapsed time until treatment.

**Discussion**

Angioplasty is a coronary reperfusion technique particularly appropriate for managing myocardial infarction among the elderly. It is a rapidly accessible and effective revascularization technique that restores more of the myocardial mass than does thrombolysis. Time until admission for elderly patients with myocardial infarction must be as short as possible, but the elderly wait longer than younger patients before calling for emergency help for coronary symptoms. Information campaigns are important to educate patients and their families about the importance of calling promptly for emergency medical services (911 in the US, 15 in France) in cases of chest pain.

**Limitations of our study**

Our results come from a prospective study at 3 interventional cardiology centers in Alsace that practice the same invasive management of myocardial infarction. Primary angioplasty is widely performed in Alsace and yields excellent results in the short-term. This region meets all the necessary conditions for the development and promotion of PTCA for myocardial infarction. Its cardiovascular mortality is higher than the other regions of France. Because of its dense North-South corridor, more than 95% of the population lives within 25-30 km of a mobile ICU ambulance. These attributes, combined with excellent short-term results and lack of specific contraindications, have contributed to the widespread use of this technique for acute myocardial infarction in Alsace.

**Issues in the management of elderly patients with myocardial infarction**

Advanced age among myocardial infarction patients is associated with high mortality, although no causal mechanism for this has been found. Before the development of reperfusion techniques, the mortality rate among elderly victims of myocardial infarction was 30% at 1 month and exceeded 50% within 1 year. Thrombolysis, the first therapeutic advance in management of coronary disease, increased the number of survivors among myocardial infarction patients. Data about its efficacy and safety in the elderly are contradictory. Several studies show that thrombolysis diminishes the mortality rate, even among elderly patients, but one study suggests it is not beneficial in patients older than 75 years, especially women. Moreover, elderly patients have almost systematically been excluded from clinical studies. Elderly patients are often admitted to the cardiac...
intensive care unit too late – certainly later than younger patients – and this raises questions about the efficacy of the late use of reperfusion techniques. Their atypical clinical presentation may cause this delay: the elderly often have no pain or no ECG signs\textsuperscript{13,14}. They also have a higher risk of intracranial hemorrhages with thrombolytics\textsuperscript{15}.

Primary angioplasty may pose an attractive alternative for these patients. The GUSTO IIb substudy reported that both the 30-day mortality rate and cerebrovascular accident rate in angioplasty-treated patients aged 70-79 years were clearly lower than among patients treated by plasminogen activator\textsuperscript{16}.

Nonetheless, only limited data are available about the effect of age on the success rate, incidence of complications, and outcome\textsuperscript{2,17-19}.

OUR ELDERLY POPULATION

Our patients 75 years and older were a high-risk group that included a high proportion of women (50%), numerous comorbidities (the elderly more often have hypertension and type 2 diabetes) and a significantly greater percentage of patients with three-vessel disease (37.7\% \textit{versus} 22.6\%; \emph{p} < 0.01). Moreover, these high-risk patients waited longer for treatment than younger patients (29.8\% were seen more than 6 hours after symptoms began, compared with 22.6\% among younger subjects; \emph{p} < 0.01).

Angiography showed the same proportion of patients with a TIMI grade 0 flow in both groups. The success of reperfusion, defined by a TIMI grade 3 flow after angioplasty, was significantly lower in patients 75 years or older (93.9\% \textit{versus} 97.2\%; \emph{p} < 0.01). De Geare \textit{et al.}\textsuperscript{17} reported this finding in a study of 3032 patients with myocardial infarction and treated by PTCA: a lower percentage of elderly patients had post-angioplasty TIMI grade 3 (85\% \textit{versus} 92\%; \emph{p} < 0.01). The angioplasty success rate (that is, TIMI grade 3 flow) was high among our elderly patients and better than that reported in most studies\textsuperscript{17,18,20}. Our results are all the more notable in that we included patients at high risk.

\begin{table}
\centering
\begin{tabular}{|l|l|l|l|l|l|}
\hline
\textbf{Variable} & \textbf{Patients aged at least 75 years} & \textbf{Patients younger than 75 years} & \\
\hline
 & \textbf{n} & \textbf{Deaths in \%} & \textbf{n} & \textbf{Deaths in \%} & \textbf{p} \\
\hline
\textbf{All patients} & 342 & 20.5 & 1330 & 6.4 & < 0.01 \\
\textbf{State of shock} & 55 & 72.7 & 127 & 48.8 & < 0.01 \\
\textbf{Not in shock} & 287 & 10.4 & 1203 & 2.4 & < 0.01 \\
\textbf{Killip 3} & 75 & 46.7 & 117 & 33.3 & \text{ns} \\
\textbf{Not in Killip 3} & 267 & 10.1 & 1213 & 4.3 & < 0.01 \\
\textbf{CPR} & 24 & 45.8 & 86 & 33.7 & \text{ns} \\
\textbf{CPR not needed} & 318 & 18.6 & 1244 & 5.0 & < 0.01 \\
\textbf{Not in shock, Killip 3, no CPR} & 222 & 5.4 & 1084 & 1.2 & < 0.01 \\
\hline
\end{tabular}
\caption{Variability of in-hospital death rates according to initial clinical presentation}
\end{table}

\textit{CPR: cardiopulmonary resuscitation after cardiac arrest}
Mortality rate and patient profiles

The in-hospital mortality rate in our study was higher than that reported in the literature\(^1\)\(^\text{-}\)\(^4\),\(^\text{20-21}\): 20.5% in patients 75 years or older and 6.4% in patients younger than 75 years. The high rate can be explained by the particular profile of our patients, who were not selected according to preestablished methodological criteria. Accordingly, our study included patients with the most serious damage (in shock, in Killip class 3, or admitted after cardiac arrest and CPR) and at high risk of mortality. When we exclude patients in shock, in Killip class 3, or admitted after cardiac arrest and CPR, mortality rate is substantially lower: from 20.5% for the entire older group, it drops to 5.4%, and in the younger subjects, from 6.4% to 1.2%. These rates are thus lower than those reported in the literature\(^1\)\(^\text{-}\)\(^4\),\(^\text{20-21}\). In all cases, in-hospital mortality was higher in patients 75 years or older than in younger patients, regardless of initial clinical presentation. De Geare et al.\(^17\) reported a mortality rate after angioplasty 5 times higher in subjects 75 years or older compared with younger subjects (10.2% versus 1.8%; \(p = 0.001\)), after excluding patients in shock. In our study, this ratio was 3.2 (20.5%/6.4%) for all patients and 4.5 (5.4%/1.2%) when we excluded patients in shock, in Killip class 3, or admitted after cardiac arrest and CPR.

PTCA, an interesting technique for myocardial infarction in elderly patients

The proportion of our patients admitted in Killip class 3 was higher among those aged 75 years or older than among younger patients (21.9% versus 8.8%; \(p < 0.01\)). When De Boer et al.\(^22\) compared the results of angioplasty and thrombolysis, angioplasty resulted in a lower in-hospital death rate (2% versus 7%; \(p < 0.01\)) and better left ventricular function (LVF 50% versus 45%; \(p < 0.001\)) than thrombolysis. Angioplasty led to restoration of more myocardial mass than thrombolysis, which helped prevent the risk of heart failure. This technique appears especially appropriate for elderly patients.

PTCA, effective technique for revascularization

The success of reperfusion reduced mortality rates significantly in both groups in our population. De Geare et al.\(^17\) showed that post-procedure TIMI was one of the most important predictive factors of in-hospital death. Reperfusion rates are higher after PTCA, even among the elderly\(^4\),\(^5\),\(^22\),\(^23\). PTCA is an effective technique that permits excellent reperfusion, regardless of patient age.

PTCA, rapidly accessible technique

In our sample, more than 2/3 of patients aged 75 years or older (240/342) received treatment within 6 hours. The mortality rate of patients seen more than 6 hours after onset of symptoms was very significantly higher than of those seen earlier; this result points to the importance of seeking early help in the case of symptoms suggestive of myocardial infarction, especially among the oldest patients. The shorter the time until treatment, the better the clinical outcome of elderly patients. The first component of delay between pain and treatment in myocardial infarction is the delay until admission. The delay between onset of pain and calling for help is a major factor in the management of myocardial infarction\(^25\). Beer et al.\(^26\) showed that involvement of local EMS teams (15 centers, equivalent to US 911 systems) significantly reduced this prehospital delay. For Brown et al.\(^27\), both the failure to call “911” and long prehospital delays are related to 4 principal factors: patients’ lack of knowledge of the symptoms of myocardial infarction, self-medication, contact with a general practitioner, and the high costs of hospitalization and medical care in the United States. Beer et al. found that patients with a history of myocardial infarction were more likely to call 911 directly\(^26\). Knowledge of coronary symptoms is of fundamental importance for patients’ decisions as well as physicians’\(^28\).

What is already known

- The incidence of myocardial infarction has remained stable for several years.
- Treatment by thrombolysis and revascularization have substantially improved prognosis.
- Percutaneous coronary angioplasty (PTCA) at the acute phase of infarction has often been compared with thrombolysis and found to have better efficacy.

What this article adds

- This prospective regional multicenter study examined invasive management by primary PTCA in all patients admitted for acute myocardial infarction, regardless of their clinical state at admission and their age.
- The study compared the patient profiles and results of the technique in patients aged 75 years or older and in younger subjects.
- PTCA is useful in the management of myocardial infarction in elderly subjects.

Infarctus du myocarde du sujet de plus de 75 ans

Données d’un registre multicentrique régional (1672 patients)
Elderly subjects prefer not to call their physician, fearing they will disturb him or her needlessly and consequently sometimes delay calling for help at the onset of pain. Information campaigns to educate patients are underway and should be supported: the call rate for chest pain, especially among the elderly, must be increased. The second component of the delay in treatment is the hospital phase: the time required for reperfusion depends on the route by which the patient reaches the hospital. Initial care by trained emergency ambulance crews speeds up primary angioplasty by 35 minutes compared with other initial care, according to Dutch cardioiology teams. PTCA is an easily accessible technique that permits speedy and total reperfusion.

References


