

# Percutaneous Transluminal Coronary Angioplasty for Angina Pectoris After a Non-Q-Wave Acute Myocardial Infarction

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Despite initially favorable prognosis in patients with non-Q-wave acute myocardial infarction (AMI), long-term mortality in this subset of patients appears to be similar to or even greater than that in patients with Q-wave AMI. The relatively poor late prognosis is primarily due to a high incidence of unstable angina and recurrent AMI. Between January 1982 and January 1987, 114 patients with suitable coronary narrowing underwent percutaneous transluminal coronary angioplasty (PTCA) for angina pectoris (present either at rest or during mild exertion, and despite optimal pharmacologic therapy), a median of 31 (range 2 to 362) days after a non-Q-wave AMI. Success was achieved in dilating the obstructed artery in 98 patients (113 of the 129 dilated arteries). Emergency bypass surgery was performed in 7 patients. Mean clinical follow-up of 20 (range 3 to 59)

months was obtained in all patients and revealed no deaths. Of the 98 patients with successful PTCAs, 6 (6%) developed a nonfatal recurrent AMI and 62 (63%) were asymptomatic. However, recurrent angina affected 31 patients (32%) and was treated by repeat PTCA (n = 18), coronary bypass surgery (n = 5) or pharmacologic therapy (n = 8). At follow-up, 74% of the patients (73 of 98) were asymptomatic after a successful PTCA and, if necessary, a repeat PTCA, without incidence of recurrent AMI, coronary bypass surgery or death. The high initial success rate, low incidence of subsequent death and late recurrent AMI and sustained symptomatic benefit suggest that PTCA is an effective initial treatment strategy in these selected patients.

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The clinical course of patients with non-Q-wave acute myocardial infarction (AMI) has been a subject of interest. Natural history studies have suggested that, compared with Q-wave AMI, non-Q-wave AMI is associated with less necrosis, better left ventricular function and lower in-hospital mortality. Despite this more favorable initial prognosis, long-term survival for patients with non-Q-wave AMI appears to be similar to or even less than that in patients with Q-wave AMI.<sup>1-13</sup> The relatively high mortality rate of patients with non-Q-wave AMI seems to be related to unstable angina or subsequent recurrent AMI in the same area<sup>1-10</sup> and may be preventable if recurrent AMI can be averted with revascularization.

The present study describes the short- and long-term results of consecutive patients treated with per-

cutaneous transluminal coronary angioplasty (PTCA) for severe angina after a non-Q-wave AMI.

## Methods

**Patients:** The study population consisted of 114 patients with a non-Q-wave AMI who underwent PTCA between January 1982 and January 1987. All had symptoms of angina, either at rest or during mild exertion, despite optimal pharmacologic therapy. They represented 8% of our total PTCA population during the study period. Non-Q-wave AMI was defined in this study as prolonged chest pain compatible with AMI, associated with electrocardiographic ST-segment and T-wave abnormalities without progression to pathologic Q waves, but with abnormal elevation of the creatinine kinase level (at least twice of the normal value) before any intervention. Postinfarction angina was considered unstable if it occurred at rest lasting for at least 15 minutes and was associated with electrocardiographic manifestations of myocardial ischemia without evidence of further myocardial necrosis.

Patients were selected for PTCA if the ischemia-related lesion was suitable for dilatation. The selection was based only on symptoms and coronary anatomy, and was not influenced by left ventricular function.

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**TABLE I Clinical and Angiographic Data**

Pts (n)	114
Male/female	88/26
Age (median, yr)	57 (range 31-74)
Previous CABG/PTCA	2/9
Anterior/inferior non-Q-AMI	73/41
Peak CK enzyme level (median, U/liter)	357 (range 206-972)
Stable/unstable angina pectoris	61/53
Therapy before procedure:	
Triple therapy (NTG, iv)*	97 (35)
Double therapy	17
Median time from AMI to PTCA (days)	31 (range 2-362)
Single/double/triple vessel disease	75/33/6
Total occlusion	22
Single-vessel dilatation	100
Multivessel dilatation	14
Initial global ejection fraction (%)	58 ± 8 (range 32-71)

AMI = acute myocardial infarction; CABG = coronary artery bypass graft; CK = creatinine phosphokinase (normal <100 U/liter); PTCA = percutaneous transluminal coronary angioplasty.

\* Optimal pharmacologic therapy consisted of β blocker, calcium antagonist and nitrates, including 35 patients who needed intravenous nitroglycerin (NTG, iv).

PTCA was considered successful when a reduction of the severity of the obstruction to <50% luminal diameter narrowing was achieved with abolition of acute ischemic symptoms and without progression to AMI, emergency surgery or death. PTCA was performed a median of 31 (range 2 to 362) days after non-Q-wave AMI; 53% of the procedures were performed within 30 days of AMI. Clinical and angiographic data are summarized in Table I. After the procedure, patients were monitored for 24 hours in the medium care unit. They were treated with nifedipine 60 mg daily and acetylsalicylic acid 500 mg daily over a period of 6 months.

All patients were followed at the outpatient clinic. Survival status, recurrent AMI, angina pectoris, cardi-

**TABLE II Angiographic Results**

PTCA Artery	No.	Primary Success
Left anterior descending	78	70 (90%)
Right	31	27 (87%)
Left circumflex	20	16 (80%)
Total	129	113 (88%)

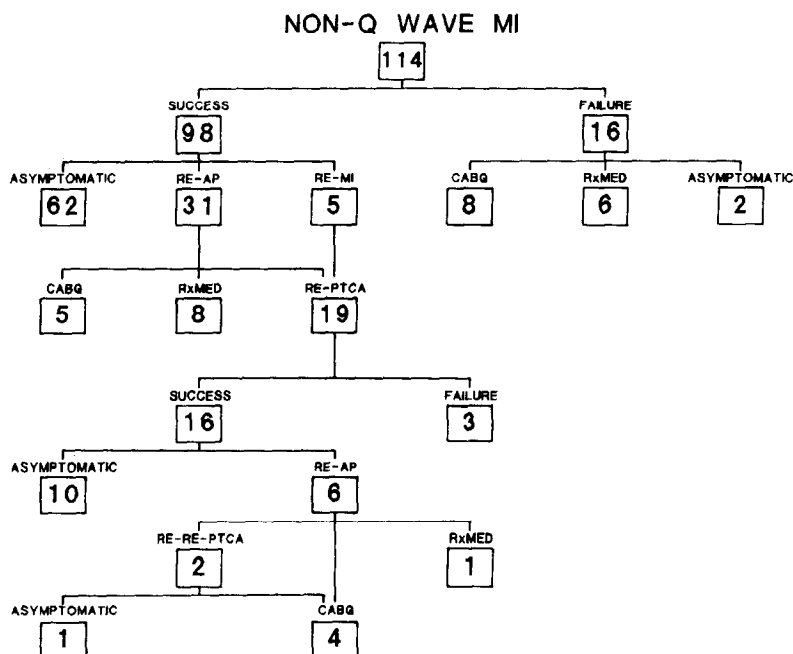
ac failure, bypass surgery and PTCA were recorded. The majority underwent symptom-limited exercise on the bicycle ergometer with stepwise increments of 20 watts every minute. The orthogonal leads XYZ of the Frank lead system were recorded. An ischemic response was defined as at least a 0.1 mV ST-segment depression, occurring 0.08 seconds after the J point. The maximum workload achieved was expressed as a percentage of the normal workload predicted for age, sex and height.

**Results**

From the 114 patients who underwent PTCA for angina after a non-Q-wave AMI, 129 lesions were dilated. Single-vessel dilatation was performed in 100 patients, including 16 multilesion dilatations in the same artery. Double artery dilatation was performed in 13 patients and triple artery dilatation in 1 (Table II). Success was achieved in dilating the obstructed artery in 98 patients (113 lesions).

Figure 1 shows the clinical outcome of all patients. In 16 patients, the attempted PTCA was unsuccessful: in 9 because the artery was occluded, in 5 because the stenosis could not be crossed with either the guidewire or balloon catheter and in 2 because of abrupt closure or major dissection. Peri-interventional AMI, defined by either cardiac enzyme elevation or new Q waves,

**FIGURE 1. Short- and long-term (mean, 20 months) clinical follow-up in 114 patients undergoing coronary angioplasty (PTCA) for severe angina (AP) after a non-Q-wave myocardial infarction (MI). CABG = coronary artery bypass grafting; Rx Med = controlled by pharmacologic treatment.**



**TABLE III Mean Clinical Follow-Up of 20 (Range 3 to 59) Months**

	Initial Success (n = 98)	Failure (n = 16)
Death	0	0
Emergency CABG	0	7
AMI related to PTCA	0	5
Late recurrent AMI	6	0
Repeat PTCA	13	0
Repeat PTCA + CABG	6	0
Late CABG	5	1
Pharmacologic therapy	8	6
Event-free	62	2

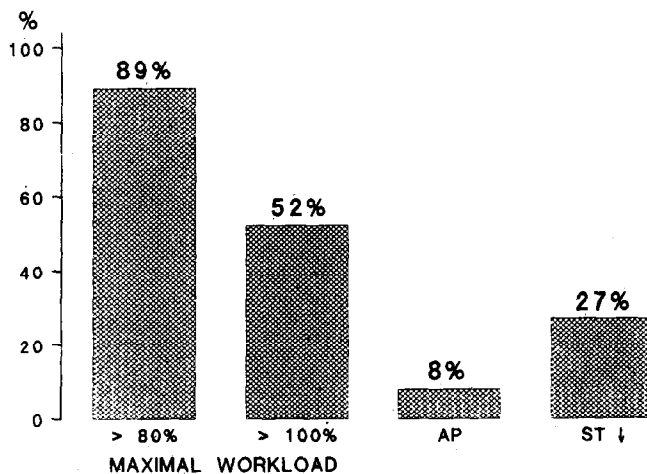
Abbreviations as in Table I.

was documented in 5 patients, of whom 3 underwent emergency bypass surgery.

Of the 98 successfully treated patients, 62 were asymptomatic and 5 developed a nonfatal recurrent AMI (1 of them underwent an urgent PTCA). Thirty-one patients developed recurrent angina and of these, 5 underwent an elective bypass surgery 168 (range 7 to 534) days after the initial procedure, 8 were controlled by pharmacologic therapy, and 18 underwent a repeat PTCA 120 (range 1 to 300) days after the initial procedure. Success was achieved in redilating the artery in 16 patients.

Results of electrocardiographic exercise testing were available in 71% (70 of 98) of the patients, 8 (range 1 to 49) months after initially successful PTCA (Figure 2). The mean maximum workload achieved, predicted for age, sex and height, was 98% (range 54 to 131%).

Clinical follow-up was obtained in all patients, at a mean interval of 20 (range 3 to 59) months, and is



**FIGURE 2.** Results of electrocardiographic exercise testing (n = 70), 8 (range 1 to 49) months after initially successful PTCA. A maximum workload of >80% and >100% predicted for age, sex and height was achieved in 89% and 52% of the patients, respectively. The majority of the patients (92%) were symptom-free during the test; an ischemic ST-segment depression was documented in 27%.

**TABLE IV Time Delay from Non-Q-Wave AMI to PTCA**

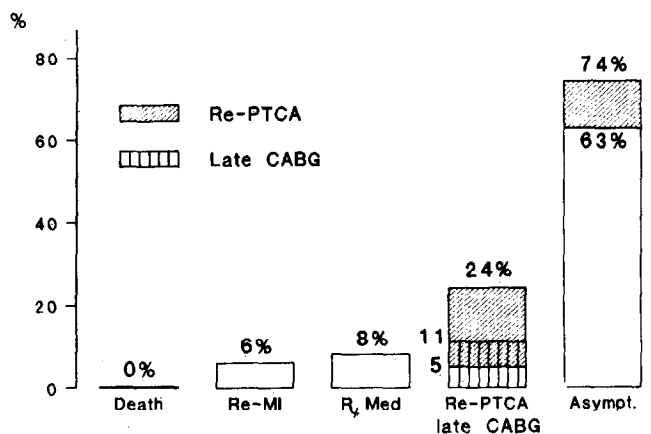
	Patients Treated <30 days	Patients Treated >30 days
Number of patients	60	54
Anterior AMI	67%	60%
Unstable angina	72%	18%
Initial success rate	85%	85%
Emergency CABG	7%	5%
AMI related to PTCA	5%	4%
Late recurrent AMI	5%	5%
Repeat PTCA/late CABG	23%	22%

Abbreviations as in Table I.

summarized in Table III. If coronary artery bypass surgery, recurrent AMI, death or recurrent angina requiring pharmacologic therapy were to be considered events, 74% of the patients would be considered event-free at 20 months after successful PTCA, whereas if any cardiac recurrence, including repeat PTCA, were to be considered events, only 63% of patients would be event-free at 20 months (Figure 3).

**Discussion**

The reported incidence of non-Q-wave AMI varies between 20 and 36% of all AMIs.<sup>1,3,5,12</sup> Although non-Q-wave AMI and Q-wave AMI (as classified by electrocardiographic results) cannot always be anatomically differentiated,<sup>4,14</sup> it seems likely that they differ clinically, physiologically and prognostically, as discussed by Spodick.<sup>15</sup> Despite the initially limited area of myocardial necrosis and favorable short-term prognosis for patients with non-Q-wave AMI, several studies show substantial late morbidity and mortality rates in these patients.<sup>1-13</sup> Despite marked improvement in



**FIGURE 3.** If coronary artery bypass surgery (CABG), recurrent myocardial infarction (re-MI), death or recurrent angina requiring pharmacologic therapy (Rx Med) were to be considered events, 74% of the patients would be considered event-free (Asympt.) at 20 months after initially successful angioplasty, whereas if any cardiac recurrence, including repeat coronary angioplasty (Re-PTCA) were to be considered an event, only 63% of patients would be event-free.

pharmacologic therapy, the reported incidence of recurrent AMIs remains high at 6 to 86% and is associated with a poor prognosis.<sup>1,4-6,10,16,17</sup> Maisel et al<sup>5</sup> reported a high mortality, both early and late, for patients with subsequent extension following a non-Q-wave AMI. In-hospital mortality rate in this subset of patients was 43%, while in those with Q-wave AMI was 15%. The 1-year cumulative survival rates for patients with Q- versus non-Q-wave AMI without extension were similar: 82% and 84%. For those with extension, however, 1-year survival rates were 66% and 35%, respectively. This finding was supported by others.<sup>1,3,10,18,19</sup>

Several investigators suggest that coronary bypass surgery or PTCA is feasible and safe for patients with angina after non-Q-wave AMI.<sup>20-23</sup> Our present results indicate not only that PTCA can be performed safely and effectively in this subset of patients, but also that the incidences of late recurrent AMI (6%) and cardiac death (0%) are lower than expected. However, recurrent angina occurred in 32% of our patients after successful PTCA, a percentage similar to that reported for stable angina.<sup>24</sup> All patients were satisfactorily treated by repeat PTCA, coronary bypass surgery or pharmacologic therapy. These findings are comparable with the general results of the total PTCA population during the same period, perhaps because PTCA was performed in half of the patients >1 month after non-Q-wave AMI, thus hindering any significant distinction between them and an average PTCA population. However, the time delay from non-Q-wave AMI to PTCA did not affect the outcome, despite the fact that unstable angina was more frequent among the patients treated within 30 days than those treated >30 days, as shown in Table IV.

Among the 22 patients with a totally occluded artery at the time of PTCA, attempted recanalization was successful in only 13 (success rate of 59%), and of these, repeat PTCA or coronary bypass surgery or both was necessary in 6. Of the 9 unsuccessful cases, 3 underwent emergency bypass surgery, 5 had residual angina controlled by pharmacologic therapy and 1 was asymptomatic. When these patients with a totally occluded artery were excluded, the primary success rate became 92%. These findings suggest that when the artery is occluded, the benefits of PTCA after a non-Q-wave AMI are limited, even when recanalization is initially successful.

Limitations of this study include the fact that it was uncontrolled and involved only patients with non-Q-wave AMI with recurrent anginal symptoms and anatomy suitable for PTCA. In fact, most patients had a single-vessel disease with relatively small to moderate enzymatic infarct size and might be expected to have a favorable outcome. However, these patients constituted a high-risk subgroup because of the presence of ongoing angina, which implied that the cardiac event was not yet complete and suggested that more aggressive invasive management could have improved clinical status and the condition of the myocardium.

The high initial success rate and the low incidence of subsequent death and late recurrent AMI, as well as

the sustained beneficial effect, suggest that PTCA is an effective initial treatment strategy in patients with angina after a non-Q-wave AMI.

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