



Percutaneous transluminal coronary angioplasty in the young adult

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■ A total of 33 patients age 35 years or younger underwent percutaneous transluminal coronary angioplasty (PTCA) at The Cleveland Clinic Foundation between January 1981 and October 1987. Arteriography showed one-, two-, and three-vessel disease in 16, 12, and 5 patients, respectively. Twenty-four patients (73%) had functional Class 3 or 4 angina and 17 (52%) had unstable angina. PTCA was performed in one vessel each in 22 patients and in multiple vessels in 11 patients. Of 47 vessels, 44 (94%) were successfully dilated. There were no deaths, emergency bypass procedures, or myocardial infarctions during hospitalization. At a mean follow-up of 30 months, there were two late deaths, nine repeat PTCA procedures, one coronary bypass, and one nonfatal myocardial infarction. Due to the progressive nature of coronary artery disease in the young adult, PTCA appears to be a good therapeutic modality for selected patients in this age group.

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CLINICAL coronary artery disease is rare in young patients.¹⁻³ Published series of young patients with coronary artery disease have reported a high incidence of coronary risk factors and predominantly single-vessel disease.³⁻⁵

Follow-up studies have shown that a large percentage of these patients require coronary bypass grafting (CABG), which can be accomplished with low morbidity and mortality; however, follow-up usually shows frequent recurrence of symptoms and need for reoperation.^{6,7}

We describe our experience with a group of patients

age 35 years or younger who were treated with PTCA.

MATERIALS AND METHODS

With the aid of a computerized PTCA registry, we identified all Cleveland Clinic patients age 35 years or younger among 5,000 patients undergoing PTCA from January 1981 to October 1987. The study group consisted of 33 patients. Clinical and angiographic data were obtained from hospital records. Follow-up was by telephone interviews with all surviving patients and with the personal physician for the other two. All survivors were contacted between March and May 1988. The mean follow-up was 30 ± 18 months. Death, myocardial infarction, repeat PTCA, and CABG during follow-up were all noted.

Major coronary arteries were defined as the left anterior descending, the left circumflex, and a balanced or dominant right coronary artery. Multivessel disease was

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TABLE 1
INCIDENCE OF CORONARY RISK FACTORS

Factor	Incidence
Cigarette smoking	28/33 (85%)
Cholesterol ≥ 220 mg/dL	21/26 (81%)
Family history of CAD	24/33 (73%)
Family history of CAD before age 50	11/33 (33%)
Hypertension	10/33 (30%)
Diabetes	5/33 (15%)

CAD = coronary artery disease

defined as a stenosis of $\geq 50\%$ of two major coronary arteries; all patients had at least one major coronary artery with $\geq 70\%$ narrowing.

PTCA was performed using standard techniques. Multivessel PTCA was defined as dilation of two or more vessels (right coronary, left anterior descending, and circumflex arteries). Primary success was defined as a stenosis reduction of $>20\%$ with a residual stenosis of $<50\%$ of all lesions attempted, and absence of major complications. Post-PTCA myocardial infarction was defined as presence of a new Q-wave and/or an increase in creatinine kinase level to ≥ 1.5 times the baseline level within 24 hours after PTCA.

These coronary risk factors were coded: cigarette smoking, hypercholesterolemia, family history of coronary artery disease, hypertension, and diabetes. Smokers were defined as patients who admitted to smoking any amount regularly within the past year. Lipid values were obtained at the time of initial evaluation after a 14-hour fast. Family history of coronary artery disease included parents or siblings. Hypertension was defined as a history of hypertension associated with therapy. Patients were classified as having diabetes if they had a history of management with diet, oral agents, or insulin. Anginal class was assigned according to the Canadian Cardiovascular Society classification.

RESULTS

Of 5,000 patients undergoing PTCA between January 1981 and October 1987 at The Cleveland Clinic Foundation, 33 (28 men, 5 women) were 35 years old or younger. The mean age was 32 ± 2 years (range 27–35 years). Table 1 shows the incidence of risk factors in the study group. Cigarette smoking was the most prevalent (85%), followed by hypercholesterolemia and family history of coronary artery disease. Serum cholesterol levels were available in 26 patients. The mean cholesterol level was 274 ± 71 mg/dL (range 167–

TABLE 2
NUMBER OF VESSELS AND LESIONS DILATED

	No. Patients
Number of vessels	
1	24
2	7
3	2
Number of lesions	
1	19
2	9
3–6	5

440 mg/dL). Only one patient had a serum cholesterol level less than 200 mg/dL, and five had cholesterol levels of less than 220 mg/dL.

Angiographic findings revealed single-vessel disease in 16 (48%) patients, double-vessel disease in 12 (36%), and triple-vessel disease in five (15%). Ventricular function was normal in 19 (58%) patients and abnormal in 14 (42%).

Only two patients were asymptomatic and had PTCA based strictly on angiographic findings. Most patients were symptomatic despite medical treatment; 24 (73%) had angina Class 3 or 4 and 17 (52%) had unstable angina. There were also 13 (39%) patients with a history of myocardial infarction.

Table 2 details the number of vessels and number of lesions dilated. If we consider only the three major epicardial coronary arteries, 24 of the 33 patients had a single-vessel dilation and nine had dilation of more than one coronary artery. There were a total of 44 vessels (mean, 1.3 vessels per patient) dilated. Because six patients had single-vessel, multilesion dilation, the total number of lesions dilated was 57 (mean, 1.7 lesions per patient). The vessel most frequently dilated was the right coronary artery (20 patients, Table 3).

PTCA was unsuccessful in three vessels, in one patient due to dissection of a totally occluded right coronary artery and in two due to inability to cross a circumflex branch. These three vessels were secondary targets, so that all three patients had other vessels successfully dilated and experienced no complications.

The primary success rate per patient was 90% (30 of 33), per vessel 94% (44 of 47), and per lesion 95% (54 of 57). All patients had at least one vessel successfully dilated. During the hospital stay, there were no deaths, and no patient had a myocardial infarction or required emergency coronary bypass surgery.

Table 4 details events and survival during follow-up. At a mean follow-up of 30 ± 18 months, there were two late deaths—a cumulative survival rate of 94%. The first

TABLE 3
CORONARY ARTERIES DILATED

Artery	No. Patients
RCA	12
LAD	5
CX	4
DG	1
RCA + CX	4
RCA + LAD	2
LAD + DG	2
LAD + CX	1
RCA + DG + CX	1
RCA + LAD + DG + CX	1

RCA = right coronary artery; LAD = left anterior descending artery; CX = circumflex artery; DG = diagonal artery.

was a 27-year-old patient on chronic peritoneal dialysis who had triple-vessel disease and moderate left ventricular dysfunction. The patient underwent initially successful dilation of the diagonal and circumflex arteries and unsuccessful dilation of a chronic totally occluded right coronary artery. Seven months later, he presented with a non-Q-wave myocardial infarction and underwent successful redilation of the diagonal branch. He died suddenly two and one half months after the second procedure. The second late death was a 33-year-old patient on chronic hemodialysis who had two-vessel disease with normal left ventricular function. The dominant right coronary artery was successfully dilated. He died suddenly five and one half months after PTCA. Autopsy revealed thrombosis of the right coronary artery.

During follow-up only one patient suffered a nonfatal myocardial infarction. Nine patients had PTCA, seven of a restenosed lesion, at a mean interval of 11 months (range 4–23 months) after the initial PTCA, and two had PTCA of a new lesion five and 38 months after the original PTCA.

One patient had elective bypass surgery 19 months after PTCA because of progression of disease in a different vessel. Seventeen patients had coronary angiography at a mean of 13 months following PTCA. Of the eight patients with restenosis, seven underwent successful redilation and one was treated medically. At a mean follow-up of 30 months, 22 patients (67%) had had no cardiac events (death, myocardial infarction, CABG, or PTCA).

Of the 31 survivors, 23 were asymptomatic, and 27 considered themselves improved compared to pre-PTCA. Of 20 patients who had exercise tests during follow-up (15 with thallium imaging), only one demon-

TABLE 4
CUMULATIVE SURVIVAL AND EVENT-FREE SURVIVAL AT A MEAN FOLLOW-UP OF 30 ± 18 MONTHS

	No.	%
Overall survival	31	94
Survival without MI, CABG, PTCA	22	67
Survival without MI or CABG	30	91

MI = myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty; CABG = coronary artery bypass grafting.

strated myocardial ischemia. At follow-up, 24 were working full-time, five were unemployed, and two considered themselves disabled.

DISCUSSION

Clinical coronary artery disease is rare in the young adult. Cullhed and Waern¹ identified 30 patients age 35 or younger among almost 20,000 hospitalizations due to acute myocardial infarction, an incidence of 0.15%. Weinberger et al,² reviewing 4700 admissions for acute myocardial infarction, reported 30 patients (0.6%) under the age of 30. Underwood et al,³ reviewing almost 36,000 patients with angiographically demonstrated significant coronary artery disease, found 101 patients ages 30 years or younger (0.3%). These results are consistent with the incidence in our series of 0.6% patients age 35 or younger undergoing PTCA.

As in previous reports of young patients with coronary artery disease, this group showed a very high incidence of coronary risk factors, specifically cigarette smoking, family history of coronary artery disease, and hypercholesterolemia.

Angiographically, these patients had predominantly single-vessel disease (48%), similar to the series of Davia et al⁴ (60%) and Underwood et al³ (57%). In surgical series, approximately one third of patients are reported to have single-vessel disease.

Coronary artery disease in the young adult represents a special management problem. There is a concern that early-onset coronary artery disease may forecast rapidly progressive atherosclerosis. Underwood et al³ reported a 20% five-year mortality in men, with 48% having coronary bypass surgery within six months of cardiac catheterization.

Although coronary artery bypass surgery in the young adult has a low perioperative mortality, its long-term results are less than satisfactory. In the series of Cohen et al,⁶ 41 patients under age 36 had coronary bypass

surgery, and 63% had a cardiac event, including eight cardiac deaths and five reoperations, during an average follow-up of five years. In the series of Lytle et al,⁷ out of 107 patients age 35 or younger, there was only one operative death and five perioperative myocardial infarctions. Late follow-up demonstrated an event-free survival of only 77% at five years and 53% at 10 years. Events included 15 late deaths, 23 nonfatal myocardial infarctions, and 13 reoperations. In 10 of the 13 reoperations, the indication was a combination of progression of the disease in the native circulation and graft occlusion. At a mean postoperative interval of 47 months, only 56% of saphenous vein grafts were patent, compared to 93% of left internal mammary artery grafts. Progression of disease in the native circulation was present in 32% of patients studied at less than 24 months postoperatively and in 68% of patients restudied at 24 or more months after surgery.

Although long-term surgical results could be enhanced by more extensive use of the internal mammary artery graft, the progressive nature of coronary artery

disease in this age group will always be associated with an increased rate of late events. If we consider that any treatment approach in this age group will be palliative or temporary, PTCA becomes an attractive therapeutic modality. If we restrict indications for PTCA to single-vessel disease, 37.4% of patients in the series of Lytle et al⁷ had single-vessel disease and 45% received a single graft.

Our study shows that single- and multivessel PTCA can be performed with a high primary success rate. At 30 months mean follow-up, 74% of patients were asymptomatic, the overall survival rate was 94%, and event-free survival was 67% if repeat PTCA is included as an event and 91% if it is not included.

In summary, because of the progressive nature of coronary artery disease in the young adult, PTCA appears to be an attractive therapeutic modality.

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