PTCA in evolution: Why is it so popular?

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■ The last 10 years have seen a dramatic increase in the number of percutaneous transluminal coronary angioplasty (PTCA) procedures performed in the United States. The increase can be attributed to experience and improved technology, which have made PTCA a viable and effective procedure for an increasing number of coronary disease patients—including those with traditional high-risk factors such as advanced age and multivessel disease. Data from 9,000 PTCA procedures performed at the Mid-America Heart Institute of St. Luke's Hospital in Kansas City, Missouri, show high success rates with few complications and low mortality.

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IN 1979, about 2,000 coronary angioplasty procedures were performed in the United States. That number has increased annually such that in 1988, 235,000 angioplasty procedures were performed. That year, the angioplasty volume exceeded coronary artery bypass graft (CABG) volume, with 53% of revascularization procedures being accomplished using coronary angioplasty (*Figure 1A* and *B*).[1] It is estimated that 280,000 procedures were performed in 1989. Why has angioplasty become such a popular procedure? Why is it being performed in increasing volume? Despite all the criticisms of PTCA's inadequacies and limitations, there are some good reasons why it has caught on.

Ten years ago, rigid investigational indications for PTCA meant that only about 5% of patients with coronary disease were candidates for the procedure. Today, because of experience and improved technology, at least 50% of these patients are suitable candidates. PTCA is now performed in patients with higher risk features, including advanced age, prior bypass surgery, poor left ventricular function, multivessel disease, and acute myocardial infarction.[2]

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EXPERIENCE WITH 9,000 CASES

At the Mid-America Heart Institute of St. Luke's Hospital in Kansas City, Missouri, my colleagues and I have performed more than 10,000 PTCA procedures. The data presented here are from 9,000 consecutive cases that have been analyzed. Our experience and results are not unique, but are common to all major centers—including The Cleveland Clinic Foundation. These data support the thesis that angioplasty remains a viable procedure with an important role in the care of patients with coronary artery disease.

From June 1980 to May 1989, we performed 9,000 PTCA procedures (*Figure 2*), during which we attempted to dilate 20,406 stenoses. The patients, 78% of whom were male, ranged in age from 15 to 92 years (mean 59.9), with a 15-year-old girl being perhaps the youngest patient in the country to have coronary angioplasty.

Among our 9,000 patients were these traditional high-risk subsets: 1,748 (19%) patients were more than

A,B

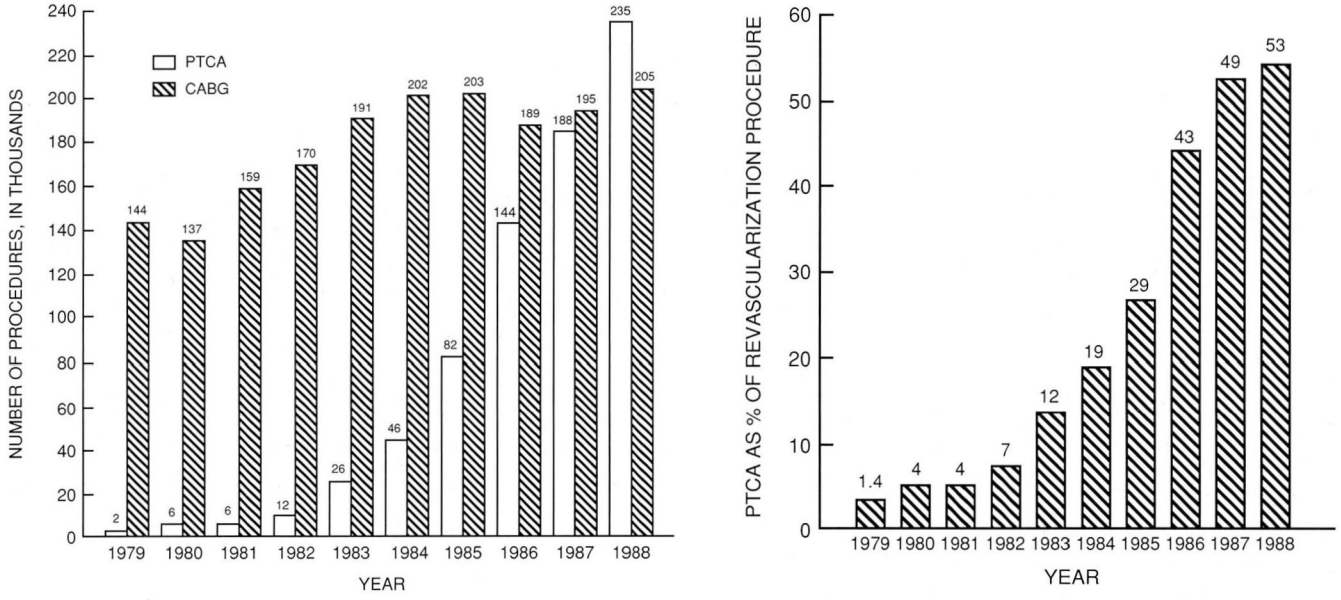

FIGURE 1A. Number, in thousands, of PTCA and CABG procedures performed from 1979 through 1988, in the US.[1] FIGURE 1B. Percentage of revascularization procedures performed by PTCA during the same period.[1]

70 years old; 1,321 (15%) had poor left ventricular function defined as an ejection fraction of less than 40%; 1,908 (21%) had undergone previous coronary bypass surgery; 851 (9.4%) were acute infarct intervention patients; and 5,277 (59%) required multiple lesion dilatation. Overall, 21% of our PTCA patients have undergone prior bypass surgery, but on a year-to-year basis, the number has increased and is currently about 35%. The majority of our multilesion angioplasty patients have multivessel disease.

Today, it does not matter which coronary segment is being dilated; primary success is the same. This success rate in experienced hands, including at our institution, is 94% overall (*Table 1*). Complications of the 9,000 procedures, excluding acute infarct interventions, were as follows: 1.4% of the patients experienced Q-wave infarction, 1.7% required urgent bypass surgery; and 0.9% died.

HIGH-RISK POPULATION IS INCREASING

Closer examination of the features of our series show that complex cases represent an increasing percentage of our PTCA procedures. High-risk patients now account for approximately 60% of PTCAs performed in our practice, with high risk defined as ejection fraction less than 40%, age over 70, left-main coronary artery disease, left main equivalent disease, triple-vessel disease, or acute infarct intervention.

Approximately 17% of our patients over the last 4 years have had poor left ventricular function with ejection fractions of less than 40%. Although much work is still needed to characterize PTCA in these patients relative to the results of bypass surgery, there is no doubt in my mind that angioplasty gives good results in patients with poor left ventricular function and carries less risk than the operative approach. The problem becomes the long-term result, which may prove better with bypass surgery and will require a randomized trial for clarification. Patients of advanced age represent an increasing proportion of our angioplasty cases. In 1988 alone, 25% of our patients were more than 70 years of age.

Patients with multivessel disease are another high-risk subset that has increased dramatically. Over the last 5 years, approximately 38% of our PTCA patients have had triple-vessel disease, compared with only 5% in 1980.

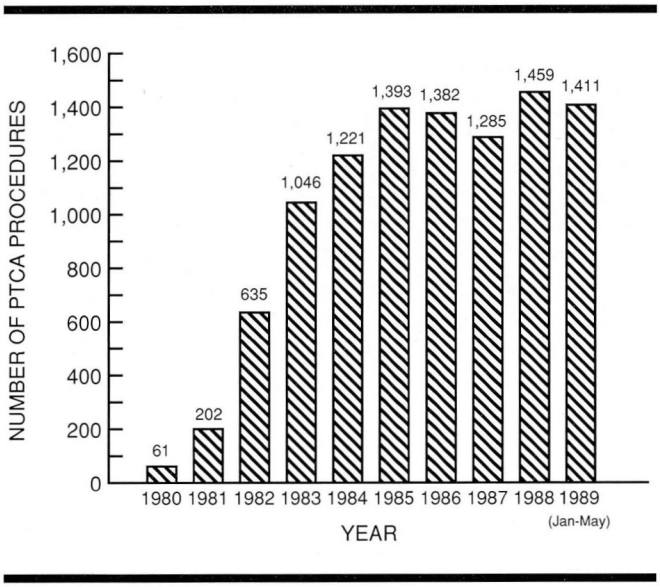

FIGURE 2. Number of PTCA procedures performed by Cardiovascular Consultants, Inc., at the Mid-America Heart Institute of St. Luke's Hospital, 1980 through May 1989.

TABLE 1
SUCCESS OF 9,000 PTCA PROCEDURES

Stenosis location	Stenoses attempted	Number successful	% success
Left anterior descending artery	7,979	7,551	95
Right coronary artery	5,899	5,548	94
Circumflex artery	5,386	5,086	94
Left main artery	165	153	93
Graft	977	926	95
TOTAL	20,406	19,264	94 overall

TABLE 2
SURVIVAL OF FIRST 700 MULTIVESSEL PATIENTS

Follow-up (years)	% survival
1	97
2	95
3	93
4	91
5	89

Annual mortality rate = 2.3%

One high-risk subset that may be unique to our practice and that has not changed is acute infarct intervention. Approximately 10% of our patients from about 1981 to the present time compose this subset.

COMPLICATION RATES DECLINING

While the number of high-risk PTCA patients has increased over the last 10 years, the complication rates have declined. At our institution, the need for emergency bypass surgery was 9.8% in 1980. Last year, that figure was just 0.8%. The incidence of transmural or Q-wave infarction has also declined over the years. In 1987, it was just 0.6%. Although the transmural infarction incidence increased to 1.7% in 1988, the figures overall have been very low. The total mortality rate, including infarct intervention patients, was 0.8% in 1987 and 1.1% in 1988. When infarct intervention patients were excluded, the mortality rate dropped to 0.6% in 1987 and 0.8% in 1988. In total, approximately 3% of patients undergoing PTCA experienced a major complication in the last 4 years.

MULTIVESSEL PTCA

Looking more closely at our multivessel PTCA patients, we analyzed the results of 3,160 two- and three-vessel procedures performed from June 1980 to November 1988 (from a total of approximately 8,800 PTCAs). Seventy-nine percent of these patients were male. Ages ranged from 22 to 92 years, with a mean of 60.3. Patients with double-vessel disease composed 74.6% of the study population. Of the 3,160 patients, 683 (21.6%) were over age 70, 406 (12.8%) had poor left ventricular function, and 725 (22.9%) had undergone prior bypass surgery. Excluded were patients with left main coronary artery disease and acute myocardial infarction.

Of 11,249 dilatations attempted among the 3,160 multivessel patients, 10,759 were successful, resulting in a primary success rate of 95.6%. Complication rates proved similar to those obtained for our global PTCA population and included a 1.5% rate of infarction, 1% emergency bypass rate, and 0.9% mortality rate. Overall, 2.9% of these multivessel patients experienced major complications.

Five-year multivessel survival

We have followed the first 700 of these multivessel patients for more than 5 years. Our survival figures (*Table 2*) are comparable to data published in the Coronary Artery Surgery Study registry for survival following double- and triple-vessel disease bypass surgery.[3] In addition, at 5 years, 84% of patients were asymptomatic (65% class I angina) or minimally symptomatic (19%

class II angina). However, 33% of our patients did require repeat PTCA in that period and 7% had PTCA for new coronary disease. But perhaps what is most important is that only 15.7% of these patients crossed over to bypass surgery in that 5-year period.

COST OF PTCA V BYPASS SURGERY

PTCA has cost benefits in addition to clinical ones. A recent study from Emory University compared the cost of multivessel bypass surgery with multivessel angioplasty at that institution.[4] The average cost of an angioplasty procedure at Emory was $2,761, compared with $4,368 for bypass surgery. The study also showed that the mean hospital stay for angioplasty was 5 days, compared to 13 days for bypass surgery. This translated into hospital room and miscellaneous charges of $3,424 for angioplasty and $11,005 for bypass surgery. The physician fees for PTCA and bypass at Emory were $2,953 and $7,398 respectively. The final cost: $9,138 for PTCA *v* $22,771 for bypass surgery. The researchers noted, however, that at 1 year the figure for angioplasty increased to about $11,000 because of the need for repeat procedures. Even so, the cost difference was substantial.

Our group recently presented a similar study of matched patients undergoing either PTCA or bypass surgery for multivessel disease.[5] In our study, the initial angioplasty costs were 56% less than for multivessel bypass surgery. Similar to the Emory study, the cost difference for angioplasty dropped to 47% less than bypass because of repeat procedures in 24% of the PTCA patients. But again, the cost savings were significant. Furthermore, mortality was less with angioplasty, although the difference in mortality between the two procedures was neutralized at 1 year. Finally, our bypass patients had slightly less angina at 1 year, but life-satisfaction and activity were described as similar by both sets of patients.

SUMMARY

Angioplasty is not a perfect procedure. In addition to a restenosis rate of 30%, PTCA has a number of limitations that have led to a host of new devices and procedures, including perfusion balloon catheters, hemodynamic support, atherectomy devices, stents, and lasers. But none of these approaches has even begun to rival the efficacy of balloon angioplasty.

Obviously, surgical controversies exist. But I believe the best attitude we can have is one of cooperation, with the ultimate goal of doing what is best for the patient.

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