

## Early Outcome of PTCA in Totally Occluded Coronary Arteries

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**Background:** Since percutaneous transluminal coronary angioplasty (PTCA) was first introduced in 1977 by Gruentzig as a treatment for proximal short-segmental, non-calcified, concentric isolated coronary stenosis, it has been used with increasing frequency in patients of symptomatic coronary artery disease with broader indications, including patients with multi-vessel disease, unstable angina, acute myocardial infarction and totally occluded coronary arteries. Among these, total coronary occlusion constitutes a subdivision with specific features that require separate evaluation. The purpose of this study was to determine the initial results of PTCA for total coronary occlusion.

**Methods:** Thirty-five patients with manifested ischemic heart disease with totally occluded coronary arteries, documented by coronary angiography, underwent recanalization procedure by PTCA between Jan. 1990 and Oct. 1991.

**Results:** Thirty-five patients were comprised of 20 acute myocardial infarction (MI), 7 old MI and 8 unstable angina. Eighteen (50.1%) patients had one major atherosclerosis risk factor and 10 (29.4%) had two or more. PTCA for total coronary artery occlusion was attempted in the left anterior descending artery (LAD) in 16 patients, right coronary artery (RCA) in 11, left circumflex artery (LCx) in 2 and protected left main in one. PTCA was successful in 23 patients (66%): LAD in 11/18 (61%) and RCA 11/14 (79%), showing significantly higher success rate with RCA than LAD ( $p < 0.05$ ). Primary success rate of PTCA in accordance with the duration of the total occlusion estimated on the basis of clinical and angiographic data was 71% (15/21) when less than two weeks, 63% (5/8) when between 2 to 12 weeks, and 50% (3/6) longer than 12 weeks. Mean duration of the total occlusion in successful PTCA was 1.4 months (range; 10 days-5 months) and, 1.7 months (range; 3 weeks-3 years) in failed PTCA. Diameter stenosis of the lesions was significantly decreased from 100% to 19.7% after successful PTCA. There was no death but 2 patients were complicated with coronary artery embolization occluding major distal branches.

**Conclusion:** The study suggested that PTCA of total coronary artery occlusion can be performed safely and effectively in selected cases and might be more successful in the lesion with shorter duration of occlusion.

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**Key Words:** Total coronary artery occlusion, Percutaneous transluminal coronary angioplasty

### INTRODUCTION

Since percutaneous transluminal coronary an-

gioplasty (PTCA) was first introduced in 1977 by Gruentzig as a treatment for proximal short-segmental, non-calcified, concentric isolated coronary stenosis<sup>1)</sup>, it has been used with increasing frequency in patients of symptomatic coronary artery disease with broader indications, including multi-vessel disease, unstable angina, acute myocardial infarction and totally occluded coro-

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nary arteries. Among these, total coronary occlusion constitutes a subdivision with specific features that require separate evaluation. The purpose of this study was to determine the initial results of PTCA for total coronary occlusion.

## MATERIALS AND METHODS

### 1. Patients

Thirty-five patients with manifested ischemic heart disease with totally occluded coronary arteries, documented by coronary angiography, underwent recanalization procedures by PTCA between Jan. 1990 and Oct. 1991. Total occlusion was defined as complete absence of forward flow (TIMI flow 0). But functional total occlusion, defined as trivial antegrade flow with major filling of the distal vessel predominantly by collaterals (TIMI flow 1), was excluded. Duration of occlusion was estimated from clinical data (time of infarction or sudden increase in anginal symptoms) or from the date of previous angiogram that did not show occlusion. Success was defined as an improvement in the stenosis by 50% or more of the luminal diameter without major complication.

### 2. Methods

PTCA was performed from femoral artery approach in each case, using an over-the guide-wire system. If attempts to cross the site of occlusion with a flexible guide wire were unsuccessful, a less flexible, steerable guide wire or magnum wire was used. Coronary angiograms obtained after successful angioplasty were evaluated closely for evidence of distal small vessel cut-off or pruning. Electrocardiogram and cardiac enzyme levels were evaluated for all patients before angioplasty and after procedure. After successful angioplasty, patients were maintained on intravenous heparin infusion for 24 hours. All patients received oral aspirin three days before and indefinitely after PTCA.

The differences in outcome of dilatation were tested by means of chi-square analysis. A p value <0.05 was considered significant.

## RESULTS

Table 1 summarizes the patient characteristics. They were 28 men and 7 women with a mean age of 55±10 years. Twenty patients (57.1%) were acute myocardial infarction, 7 old myocardial

infarction (20%) and 8 unstable angina.

Twenty-eight patients had one or more major atherosclerosis risk factors and 10 patients had two or more major atherosclerosis risk factors (Table 2).

Attempted lesions were the left anterior descending artery in 19 (51.4%), the right coronary artery 14 (40%), left circumflex artery 2 (5.7%), and protected left main one. Twenty two patients (63%) had single-vessel disease and 12 patients had multi-vessel disease and one had left main disease (Table 3).

In 21 patients with a duration of occlusion less than 2 weeks, the success rate was 71% (15 of 21), while in patients with duration of occlusion from 2 to 12 weeks, the success rate was 63% (5 of 8) and the success rate was 50% in 6 patients with duration of occlusion longer than 12 weeks (3 of 6) (Table 4).

The outcome of coronary angioplasty was not significantly influenced by the age and sex of the patients, associated risk factors and the number of involved vessels, but the procedural success rate was higher on the RCA than on the LAD (p<0.05) (Table 5).

The mean percentage of stenosis decreased from 100% to 20.5% in left anterior descending

Table 1. Clinical profile of the Patients Studied

	n	%
Age (yrs)	55.1±10.7 (31-74)	
Sex		
Male	28	80.0
Female	7	20.0
Acute MI	20	57.1
Old MI	7	20.0
Unstable angina	8	22.9

MI: myocardial infarction

Table 2. Associated Risk Factors in the Patients

Risk factors	N (%)
Smoking	24(68.6%)
Hypercholesterolemia (TC ≥ 220 mg/dl)	9(26.5%)
Hypertension	6(17.6%)
Diabetes mellitus	2(5.9%)

One or more major atherosclerosis risk factors: 28(81.3%)

Two or more major atherosclerosis risk factors: 10(29.4%)

**Table 3. Angiographic Findings of 35 Patients and the Site PTCA Tried**

Extent of coronary artery disease	n (%)
One vessel	22 (62.8%)
Two vessel	9(25.7%)
Three vessel	3( 8.6%)
Left main	1( 2.9%)
<b>Site PTCA tried</b>	
LAD	19 (51.4%)
RCA	14(40.0%)
LCx	2( 5.7%)
Left main	1( 2.9%)

LAD: left anterior descending artery  
 RCA: right coronary artery  
 LCx: left circumflex artery

**Table 4. Primary Success Rate Related to the Duration of Occlusion**

Duration (wk)	Primary success (%)
0-2	15/21 (71%)
2-12	5/8 (63%)
>12	3/ 6 (50%)
<b>Total</b>	<b>23/35(66%)</b>

Mean duration of occlusion:  
 1.4 months (1 day-5 months) in successful PTCA  
 1.7 months (3 wks-3 yrs) in failed PTCA

artery, 19.1% in right coronary artery and 17.0% in left circumflex artery (Table 6).

The most common reason of the procedural failure was inability to cross the lesion with the wire in 9 patients and inability to follow the wire across the lesion with balloon catheter in 3 (Table 7).

Distal embolization was observed in 2 patients with successful PTCA. Other complication included spiral intimal dissection in one, acute reocclusion in one and prolonged chest pain in one (Table 8).

## DISCUSSION

Since PTCA of total coronary occlusion was first reported by Savage et al<sup>2)</sup>, many study groups have reported the initial and late results of PTCA of this disease. The reported overall initial success rate ranged from 63% to 72%<sup>3-10)</sup>. Our primary success rate without significant residual stenosis

**Table 5. Patients Characteristics**

	Success (n=23)	Failure (n=12)
Men	18	10
Age (yrs)-mean range	55.3±9.3 (31-72)	55.5±12.7 36-74
<b>Clinical setting</b>		
Acute MI	14	6
Unstable angina	5	3
Old MI	4	3
<b>Risk factors</b>		
+	19	11
-	4	1
<b>PTCA</b>		
1 artery	14	8
>1 artery	9	4
<b>Arteries</b>		
LAD	11	7
RCA	11	3
LCx	1	1
Left main	0	1

No significant differences for the 2 groups  
 LAD=left anterior descending coronary artery; LCx =left circumflex coronary artery; RCA=right coronary artery; PTCA=percutaneous transluminal coronary angioplasty; MI=myocardial infarction

**Table 6. Residual Stenosis in 23 Successfully Recanalized Patients**

Site of PTCA tried	%
LAD	20.5
RCA	19.1
LCx	17.0
<b>Mean</b>	<b>19.7</b>

**Table 7. Procedural Failures**

Unable to cross the lesion with the wire	9
Unable to follow the wire across the lesion with balloon catheter	3

**Table 8. Complications Associated with PTCA**

Distal embolization	2
Intimal dissection	1
Acute reocclusion	1
Prolonged chest pain	1

was 66%. This result is similar to initial success rates previously reported. Many study groups have reported that the main factor that determines the outcome of PTCA for occlusion is duration of occlusion<sup>5,7,9)</sup> i. e. the age of the lesion. Thus, older lesions are less likely to be crossed with the guidewire. In the present study, the success rate was 71% in patients with a duration of occlusion less than 2 weeks, but it was 50% in patients with duration of occlusion longer than 12 weeks. The reports from Stone et al<sup>9)</sup> identified the bridging collateral vessels and the tapered occlusion morphology as independent factors of procedural outcome. Other variables, including the estimated duration of occlusion, lesion length and location and extent of disease, were unrelated to success.

With present technique and sufficient operator experience, 70% to 80% of total occlusion could be successfully recanalized by coronary angioplasty with a lower complication rate<sup>3)</sup>.

Careful case selection, with attention to angiographic variables related to procedural success, may be expected to improve procedural outcome. Holmes et al<sup>4)</sup> suggested that certain precautions should be taken with dilatation of completely occluded arteries. First, perfusion of the myocardium in the distribution of the occluded vessel relies on the remaining coronary vessels. Care must be taken to avoid trauma to the nondilating segments that supply these vessels. Second, it is important to visualize the course of the distal vessel and thus determine the proper route for the dilating catheter. This may be possible by reviewing films before the time of complete occlusion or by visualizing the distal vessel by way of collateral channels.

This study suggested that PTCA of total coronary artery occlusion can be performed safely and effectively in selected cases and might be more successful in the lesion with shorter duration of occlusion. But total coronary occlusion is the main limiting factor of PTCA with guide wire technique. New technique has been developed to achieve the higher success rate for the recanalization of chronically occluded coronary arteries, such as low-speed rotational angioplasty or laser angioplasty<sup>11-12)</sup>. And the long-term clinical and angiographic follow-up in patients having successful recanalization of an occluded coronary vessel should be done to determine the long-term benefit of the procedure.

## REFERENCES

1. Gruentzig A: *Transluminal dilatation of coronary artery stenosis. Lancet* 1:263, 1978
2. Savage R, Hollman J, Gruentzig AR, King S III, Douglas J, Tankersley R: *Can percutaneous transluminal coronary angioplasty be performed in patients with total occlusion? (Abstract) Circulation* 66:II-330, 1982
3. Stone GW, Rutherford BD, McConahay DR, Johnson WL, Giorgi LV, Ligon RW, Hartzler GO: *Procedural outcome of angioplasty for total coronary artery occlusion: An analysis of 971 lesions in 905 patients. J Am Coll Cardiol* 15:849, 1990
4. Holmes DR, Vlietstra RE, Reeder GS, Bresnahan JF, Smith HC, Bove AA, Schaff HV: *Angioplasty in total coronary artery occlusion. J Am Coll Cardiol* 3:845, 1984
5. Kereiakes DJ, Selmon MR, McAuley BT, McAuley DB, Sheehan DJ, Simpson JB: *Angioplasty in total coronary artery occlusion: Experience in 76 consecutive patients. J Am Coll Cardiol* 6:526, 1985
6. Finci L, Meier B, Favre J, Righetti A, Rutishauser: *Long-term results of successful and failed angioplasty for chronic total coronary arterial occlusion. Am J Cardiol* 66:660, 1990
7. Melchior JP, Meier B, Urban P, Finci L, Steffenino G, Noble J, Rutishauser W: *Percutaneous transluminal coronary angioplasty for chronic total coronary artery occlusion. Am J Cardiol* 59:535, 1987
8. DiSciascio G, Vetrovec GW, Cowley MJ, Wolfgang TC, Va R: *Early and late outcome of percutaneous transluminal coronary angioplasty for subacute and chronic total coronary occlusion. Am Heart J* 111:833, 1986
9. Park SJ, Park SW, Kim JJ, Seong IW, Song JK, Lee JK: *Coronary angioplasty in patients with totally occluded coronary arteries. Kor Circ J* 21:686, 1991
10. Safian RD, Snyder LD, Snyder BA, McKay RG, Lorell BH, Aroesty JM, Bradley AB, Monrad ES, Baim DS: *Long-term results and follow-up of coronary angioplasty of totally occluded coronary arteries[Abstract]. Circulation* 72:III-141, 1985
11. Vallbracht C, Liermann D, Drignitz I: *Results of low-speed rotational angioplasty for chronic peripheral occlusion. Am J Cardiol* 62:935, 1988
12. Baim DS, Safian RD: *Coronary angioplasty for total occlusion: Ongoing problems despite improving results. J Am Coll Cardiol* 15:857, 1990