Original Articles

Percutaneous Coronary Intervention in Chronic Total Occlusion – In Hospital Outcome

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Abstract:

Background*- Although a total coronary occlusion is identified approximately in one third of the diagnostic cardiac catheterizations, still an attempted revascularization of total occlusion accounts for less than 8% of all percutaneous coronary interventions (PCI). Percutaneous Coronary Intervention (PCI) of chronic total occlusion (CTO) is one of the major challenges in interventional cardiology. It is now an well-accepted revascularization procedure.*

Methods: *It was a prospective observational study conducted in National Institute of Cardiovascular Diseases, Dhaka, from July 2004 to June 2005. 50 consecutive patients with chronic total occlusion undergoing PCI were included in the study. Patients were observed during procedure and during the hospital stay.*

Result: *The mean age of the patients was 46.7 ± 9.3 and 48.0% were in the age range of 45-54 years. 24 patients had post MI angina, 20 patients had chronic stable angina and 6 patients had unstable angina. Technical success was in 98% cases and procedural success was in 94% cases. One patient developed vessel perforation and was treated by prolonged balloon inflation. There was no death or STEMI and only 2 patients developed NSTEMI.*

Conclusion: *In our study with the use of available facilities PCI in CTOs was possible with a high success rate. But dealing of more complicated lesion will require more improved technology and hardware. A study with larger number of patients and longer duration of follow up to determine the efficacy of the procedure in improving morbidity and mortality is needed.*

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Introduction

Despite remarkable advances in the procedural and clinical outcomes of percutaneous revascularization, chronically occluded coronary arteries remain a formidable challenge and unresolved dilemma in interventional cardiology. Although a total coronary occlusion is identified approximately in one third of the diagnostic cardiac catheterizations, still an attempted revascularization occlusion accounts for less than 8% of all percutaneous coronary interventions (PCI).[1] In the Emory Angioplasty versus Surgery Trial (EAST), for example, the presence of a chronic total occlusion (CTO) was the most common reason for referral for bypass surgery.[2] Such a disparity between their frequency and treatment not only underscores the technical and procedural frustrations associated with these complex lesions, but also the clinical uncertainties regarding which patients may benefit from CTO revascularization.[3]

Chronic total occlusion is defined as obstruction of a native coronary artery with no luminal continuity and with Thrombolysis In Myocardial Infarction (TIMI) flow grade 0 or 1. The duration of the occlusion had to be more than 30 days [TIMI trial 1988].[4]

Percutaneous Coronary Intervention (PCI) of chronic total occlusion (CTO) is one of the major challenges in interventional cardiology. It is now a well-accepted revascularization procedure.[5]

The key determinants of success include age and length of occlusion, presence of collateral, morphology of stump and operator's skill.[6] Several reports usually based on single center experience have shown that immediate success has improved overtime along with the increased experience and skill of the operator.[7] Multicenter study showed that the primary success is about 80%, in hospital

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death <1%, Q-wave MI <1%, non-Q wave MI-4%, urgent CABG-2%.[8,9]

In addition randomized studies have demonstrated that stent implantation reduces restenosis and re-occlusion rates.[10,11] SICCO (Scandinavian stenting in chronic coronary occlusion) study shows occurrence of restenosis is less in patients who were stented compared to conventional PTCA.[12] Other studies showed that PTCA in CTO reduces left ventricular remodeling & confers long term survival advantage.[13,14,15]

Left ventricular perfusion restores immediately after recanalization of CTO and can be confirmed by disappearance of collateral.[16] Few large series have been published on the long term outcome. A previous report demonstrated that a trend towards improved survival among those with successful PCI of a CTO.[17] Another report demonstrated significantly improved cardiac survival.[18]

In our country there is no study with the success and safety of PCI in chronic total occlusion. We conducted this study to evaluate the efficacy and safety of the PCI in chronic total occlusion in our setting.

Our hypothesis was successful percutaneous coronary intervention can be achieved in a high percentage of chronic total occlusion with a low incidence of complications.Our objective was to investigate the procedural success, in hospital major cardiac events (MACE) in patients who underwent PCI of a CTO.

Methodology

It was a prospective observational study conducted in National Institute of Cardiovascular Diseases, Dhaka, from July 2004 to June 2005. 50 consecutive patients with chronic total occlusion undergoing PCI were included in the study. Chronic total occlusion was defined as obstruction of a native coronary artery with no luminal continuity and with Thrombolysis In Myocardial Infarction (TIMI) flow grade 0 or 1. The duration of the occlusion had to be more than 30 days. Patients with chronic total occlusion of less than 30 days, an acute myocardial infarction within the previous 30 days, heart failure, cardiomyopathy and congenital anomalies were excluded. Initial evaluation by history and physical examination was done. Baseline investigations like blood sugar, serum creatinine, 12 lead ECG, Echocardiography were done. Informed written consent was taken from each patient or from legal guardian of the patient. PTCA with stenting was attempted in all cases. Single cardiologist using a standard protocol performed procedures. Patients were observed during preocedure and during the hospital stay.

Results

Total 50 patients were studied who underwent percutaneous coronary intervention for chronic total occlusion. The mean age of the patients was 46.7 ± 9.3 and 48.0% were in the age range of 45-54 years. 24 patients had post MI angina, 20 patients had chronic stable angina and 6 patients had unstable angina (Table 1). 21 patients had CTO in RCA,

Table-I

Demographic and baseline clinical parameters of the study objects.

Demographic Parameters	n=50 (%)
Age in years (Mean ± SD)	46.73 ± 9.3
Male	48(96.0)
Female	2(4.0)
Hypertension	25(50.0)
Diabetes mellitus	20(40.0)
Smoking	25(50.0)
F/H of IHD	10(20.0)
Dyslipidemia	10(20.0)
Height (cm) (Mean ± SD)	162.73 ± 6.12
Weight (cm) (Mean ± SD)	60.7 ±10.9
Body Mass Index (kg/m^2) (Mean ± SD)	25.1 ± 1.9
Ejection fraction (Mean ± SD)	54.1 ± 6.8
Clinical diagnosis	
Unstable angina	6(12.0)
Post MI angina	24(48.0)
Chronic stable angina	20(40.0)

19 patients had CTO in LAD and 10 patients had CTO in LCX. Most of the CTOs were of 30 to 90 days duration. Most of the vessels were of 2.5 to 3.0 mm size. Lesion length was 13-19.9 mm in 27 patients, 20.0-24.9 mm in 16 patients and 25.0-30.0 mm in 6 patients (Table II). 35 lesions had TIMI 0 flow and 15 patients had TIMI 1 flow. In 26 lesions the stump had an abrupt end, 15 lesions had tapered

end and 9 patients had no definite pattern. 2 lesions had side branch at the stump and 3 patients had bridging collaterals. (Table III).

Table-II

Base line data of the coronary arteries

Base line characteristic	No. of CTO patients	Percentage
Vessel		
LAD	19	(38.0%)
LCX	10	(20.0%)
RCA	21	(42.0%)
Duration (days)		
31-59	27	(54.0%)
60—90	14	(28.0%)
>90	9	(18.0%)
Length (mm)		
13-19.9	27	(54.0%)
20-24.9	16	(32.0%)
25-30	6	(12.0%)
>30	1	(2.0%)
Vessel diameter(mm)		
2.5-3.0	42	(84.0%)
>3.0	7	(14.0%)

Table-III

Baseline characteristics of the CTO lesions

Base line characteristic	No. of CTO patients	Percentage
TIMI flow		
Grade 0	35	(70.0%)
Grade 1	15	(30.0%)
Stump morphology		
Abrupt	26	(52.0%)
Tapered	15	(30.0%)
Not determined	9	(18.0%)
Side branch of stump		
Absent	48	(96.0%)
Present	2	(4.0%)
Bridging collaterals		
Absent	47	(94.0%)
Present	3	(6.0%)

26 patients had single vessel disease, 33 patients had double vessel disease and 1 patient had triple vessel disease (Table IV). But CTO was present only in one vessel in each patient. LAD 84.2% had proximal lesion and 15.8% had middle lesion and no distal lesion. In RCA vessel, 57.1% had proximal lesion and 38.1% had middle lesion and only 4.8% had distal lesion. In LCX 80.0% had proximal and 20.0% had distal lesion.

Table IV

Number of disease vessels of the study patients

No. of vessels	Number	Percentage
Single	26	52.0
Double	23	46.0
Triple	1	2.0
Total	50	100.0

Technical success was in 98% cases and procedural success was in 94% cases. One patient developed vessel perforation, which was sealed by prolong balloon inflation. There was no death; no STEMI and only 2 patients developed NSTEMI (Table V).

Table-V

Technical and procedural Success and in hospital complication of 50 patients.

Parameters	No (%)
Technical success	49(98.0%)
Procedural success	47(94.0%)
Death	0
STEMI	0
NSTEMI	2(4.0%)
Urgent CABG	0
Urgent repeat PCI	0
Cerebrovascular accident	0
Vessel perforation	1(2.0%)
In hospital MACE	2(4.0%)
Bleeding	2(4.0%)
Hypotension	3(6.0%)

Stents were implanted in all the lesions.The mean diameter of the stent were 3.00 mm with standard deviation 0.19 mm and the mean length of stent were 20.22 mm with standard deviation 4.51 mm.

Discussion

CTOs are present in about one quarter of patients with angiographically documented coronary disease yet accounted for only 15% of PCI in the 1997-1998 National Heart, Lung, and Blood Index Dynamic Registry.[19] Chronic total occlusions are one of the last great challenges in PCI. In spite of improvements in guidewires, devices, and operators' techniques in the last 20 years, success rates of PCI for these lesions is still suboptimal.

We conducted this prospective observational study in the department of cardiology NICVD, Dhaka. This was a first study in Bangladesh; patient with chronic total occlusion. In the present study mean age of the patient was 46.73±9.3. Most of the patient was male (96%) and remaining (4%) was female. Similar type of age and sex distribution was reported by Zoran Olivery et al.[20]

Diagnosis of the patient was unstable angina 6(12%), post MI angina 24 (48%) and chronic stable angina was in 20(40%) patients. In the study of Dzavik et al majority of the patients had chronic stable or chronic progressive stable angina.[21] 38% of patient had LAD lesion, 20% patient had LCX and 42% patient had RCA lesion. TIMI flow grade 0 was in 70% patient and grade-I in 30% patient. CTO duration in most of the patient (54%) was 31-59 days. In 28% patient it was 60-90 days and in 18% patient it was >90 days group. In our study procedural success rate was 94%. Shorter duration of CTO in max patients was possibly one of the reasons of high success rate. CTO duration more than 180 days is a factor for poor outcome of PCI.[21] Lesion length 13.0-19.9 mm in 54% patient, 20.0-24.9 mm in 32%, 25-30 mm in 12% and >30 mm in 2% patient. Length of CTO is also a determinant of procedural success.[22]

Vessel diameter was 2.5-3.0 mm in 84% patient and **>3** mm in 14% patient. Stump with abrupt closure was seen in 52% patient, tapered was in 30% and undetermined in 18% patient. Blunt occlusion at the stump negatively influences the PCI success. Tapered stump is a good predictor of success. In tapered stumps there are usually recanalized micro channels of 200 μm size which is not visualized by angiography helps in wire manipulation.[23] Bridging collaterals was present in 6% of patient and side branch at stump was present in 4% cases. These are also poor predictors of successful PCI.

Maximum patient 52% had single vessel disease, 46% patient had double vessel disease and 2% patient had triple vessel disease. Technical success was achieved in 98% cases and procedural success achieved in 94% cases. In hospital MACE (non Q wave MI) occured in 2(4%) cases. One patient had vessel perforation. In hospital complication other than MACE 3(6%) patient had developed hypotension, one patient (2%) had arrhythmia and 2(4%) patient developed prolong bleeding.

Between 1990-1992 in Mid America Heart Institute, Emory University and the Mayo Clinic PCI was attempted in CTOs of 1739 patients. Angiographic success was reported in 66% to 72%, emergency CABG in 1% to 3%, MI in 1% to 4% and in hospital death in 1% to 2%.[24,25,26] In 2001, a 20 year experience with more than 2000 CTOs was reported from the Mid-America Heart Institute, 93%. This report showed improving success rates over time with rates of MACE similar to non- CTOs and a distinct 10 year survival advantage for successful CTO treatment compared with failed CTO treatment.[27] A multicentre registry of 29 Italian centers in 1999-2000 reported contemporary CTO therapy in 419 consecutive patients. Technical success was reported in 77.2% and in- hospital MACE in 5.1% cases.[20]

In our study the success rate was higher than the other studies and metaanalysis. This was because average durations of the CTOs were lesser in our study. The no. of lesions with bridging collaterals and side branch at the site of occlusion were also low in our study.

Limitation of study- Although the result of this study support the hypothesis, but there are some facts to be considered which might affect the result- a) The study was a non-randomized. b) Number of study population was limited, c) Duration of follow-up period was short.

Conclusion

Improved guidewire technology, including the safe-cross system and the stiffer Miracle wire, has resulted in substantially higher rates of CTO recanalization in recent years. Coupled with the advent of DES, these strategies have enhanced the long-term patency with improved symptomatic palliation, reduced need for CABG & of improved longevity. In our study with the use of available facilities PCI in CTOs was possible with a high success rate. But dealing of more complicated lesion will require more improved technology and hardware. A study with larger of number of patients and longer duration of follow up to determine the efficacy of the procedure in improving morbidity and mortality is needed.

Conflict of Interest - None.

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