Original Article

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PERCUTANEOUS CORONARY INTERVENTION FOR CHRONIC TOTAL OCCLUSION: EXPERIENCE AT ARMED FORCES INSTITUTE OF CARDIOLOGY

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ABSTRACT

Objective: To evaluate the procedural outcome of patients having Chronic Total Occlusion (CTO) undergoing Percutaneous Coronary Intervention (PCI) at our clinical setup.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: This study was conducted at AFIC/ NIHD Rawalpindi from Feb 2012 to Dec 2013.

Material and Methods: A total of 50 patients who underwent PCI for CTO were included in our study. Patients with CTO lesion ≥3 months were included in our study. All the patients were selected by non-probability sampling technique. Patient's demographic data and data regarding procedural outcome was recorded. Finally data was analyzed using descriptive statistics.

Results: Out of 50 patients 43 were male while 7 were female with male to female ratio of 1:6.14. Age range of the patient was 38-82 years with mean age of 64.72±8.52. The mean estimated duration of occlusion was 15±10 months. Major contributing risk factors were diabetes, hypertension, hyperlipidemia, smoking, positive family history, prior myocardial infarction and chronic hemodialysis. In 23 (46%) LAD was involved, in 7 (14%) LCx while in 20 (40%) patient RCA was involved. Procedural success was achieved in 49 (98%) patients while in 1(2%) patient it was unsuccessful. The failure of procedure is due to inability of wire to cross the CTO lesion. Thus overall procedural success was achieved in 98% patients.

Conclusion: The recanalization of CTO lesion was successfully done in 98% cases using PCI. However 2% cases were unsuccessful due to failure of guide wire to cross the lesion.

Keywords: Chronic Total Occlusion (CTO), Percutaneous Coronary Intervention (PCI), Procedural success.

INTRODUCTION

Coronary CTO are frequently encountered by cardiologist on diagnostic angiography worldwide. About 30-50% of the patients having major coronary artery disease arriving at catherization lab have CTO of atleast on vessel[1]. CTOs are complex lesion with low procedural success rates and even after successful PCI, chances of restenosis are 1.5 to 4 times greater than non-occluded coronary artery lesion[2,3]. Procedural success rate has improved over time but it is still low mainly due to inability to cross the lesion with guide wire[4,5]. Recent advancement in technology has improved the recanalization of occluded arteries.

A recent consensus define chronic total occlusion (CTO) as a completely occluded coronary artery with no antegrade flow (thrombolysis in myocardial infarction [TIMI] 0 flow) for at least three months[6]. Histopathology of CTO reveales a proximal cap of occlusion which is often calcified or fibrotic and provides sufficient resistance wire advancement during the procedure. Distal to proximal cap and along the length of occlusion there is loose fibrous tissues or thrombus often organized[7,8]. Residual channels and micro channels may develops during CTO consolidation process[9].

CTO is the last stage of coronary artery atherosclerosis and accounts for one third of the diseases confirmed by angiography[10]. The patients with CTO presents with characteristic angina or angina like features including dyspnea and fatigue that can be minimized through accommodation and denial. Stable angina is present in in most of the patients. Dyspnea is the most common angina equivalent among the patients with CTO[11]. CTO can result in myocardial ischemia, myocardiolysis, reduction of the number of myocardial cells, ventricular remodeling which lead to decreased myocardium contractility, reduction of quality of life and poor prognosis[12].

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The choice of therapy for patients with CTO depends on local policies and an outcome of revascularization depends on operator experience. Revascularization for CTO lesion is more difficult and influenced by baseline clinical features, lesion level, and intervention equipment and manipulation techniques[13]. While no prospective studies comparing medical vs surgical vs PCI intervention for treating CTO have been conducted, multiple retrospective trials have proved the superiority of PCI over other therapeutic interventions. Medications alone doesn't improve the clinical symptoms, however it has little effect on long term heart functions and patients survival as well. PCI is therapeutic procedure not only used for recanalization of occluded vessels but also increases reperfusions, contractile functions, inhibits left ventricular remodeling ad decrease adverse cardiac events[14-16]. However there is no published data comparing the survival rates among patients having CTO.

In a meta-analysis of 13 observational studies mortality over a weighted mean follow-up of six years was 14.3% among 5,056 patients with successful CTO recanalization compared with 17.5 % among 2,232 patients with failed CTO recanalization[17]. Until recently the success rate of PCI was low, however with the development of interventional technologies and physician manipulation the success rate of CTO lesion on PCI has increased significantly 18. The use of drug eluting stents has significantly reduced the chances of restenosis and re-occlusion 19. Besides all new advents PCI for CTO is still challenging and QOL index of the patients after PCI still require lot of debate. Keeping this perspective in mind we conducted a study that analyzes the clinical output of patients with CTO undergoing PCI.

MATERIAL AND METHODS

This was a retrospective study conducted at catherization lab, Armed Forces Institute of Cardiology from Feb 2012 to Dec 2013 over a period of approximately two years. A total of 50 patients who underwent PCI for CTO were included in our study. Patients who presented with acute myocardial infarction (MI) or cardiogenic shock; undergoing only bare-metal stent (BMS) implantation or balloon angioplasty without DES implantation; CTO lesions with DES restenosis, graft vessel occlusion, or culprit lesion of acute coronary syndrome within 4 weeks; severe hepatic dysfunction (≥3 times normal reference values); life expectancy <3 years; or contraindication to antiplatelet agents were excluded from the study.

We defined CTO as the lesions with TIMI 0 antegrade flow and the duration of occlusion of equal to or greater than 3 months and duration of occlusion as interval from last diagnostic angiogram with total occlusion in patients with the previous angiograms or from the first onset of clinical symptoms suggesting IHD in patients without previous angiogram to the timing of the coronary intervention. PCI success was defined as successful recanalization of CTO lesion with resultant TIMI 3 without any adverse event. PCI indications were completely or partially reversible distal ischemia. CTO lesions with complete necrosis of distal myocardium were generally not indicated for PCI. Thirty minutes from the insertion of arterial sheath to the successful crossing of CTO lesion is essential to reduce the dose of radiation and amount of contrast dye. In order to avoid CABG procedure time can be increased above 30 mins if the probability of successful cannulation into the CTO lesion was expected not be low. If total duration of procedure exceeds 90 min or if the total amount of injected dye exceeds 300 ml, the procedure was not continued anymore.

The CTO lesion was first crossed with run through guide wire, but if we couldn't cross the lesion then pilot 50 guide wires was used. CTO lesion was pre-dilated with balloon and then stented with coronary stents. Post dilatation was done which give excellent result with no residual stenosis. All the procedure was performed according to the standard practice by the operator using radial or femoral approach. Choice of the device was made on the basis of operator's judgment.

Follow up visits were planned. Relevant data including demographic data and procedural results were recorded. All the data

was analyzed by using descriptive statistics approach.

RESULTS

A total of 50 patients who underwent PCI for CTO were included in study out of which 43 were male and 7 were female. Age range of patients was 38-82 years with mean age of 64.72 ± 8.52. The mean estimated duration of occlusion was 15 ± 10 months.

Major contributing risk factors were diabetes in 28(56%) patients, hypertension in 44(88%), hyperlipidemia in 26(52%), smoking in 23(46%), positive family history in 18(36%), prior myocardial infarction in 31(62%) and chronic hemodialysis in 1(2%) patient. In 23 (46%) patients lesion was present in left anterior descending artery (LAD), in 7 (14%) patients lesion was present in left circumflex artery (LCx) while in 20 (40%) patient CTO lesion was present in right coronary artery (RCA). In 39 (78%) patients radial route was used for coronary intervention while in 11 (22%) patients femoral route was used. Procedural success was achieved in 49 (98%) patients while in 1(2%) patient it was unsuccessful in which lesion was associated in LAD. The failure of procedure is due to inability of wire to cross the CTO lesion. Thus overall procedural success was achieved in 98% patients. Stents were implanted in all successful cases.

Table-1: Clinical characteristics of patients with CTO (n=50).

Characteristics	n (%) n=50
Male	43 (86%)
Female	7 (14%)
Age (mean ±SD) years	38-82 (64.72±8.52)
Duration of occlusion	15±10
(months) Diabetes	28 (56%)
Hyperlipidemia	26 (52%)
Hypertension	44 (88%)
Smoking	23 (46%)
Family history	18 (36%)
Prior myocardial infarction	31 (62%)
Chronic hemodialysis	1 (2%)

Table-1: Lesion characteristics and inteventional approach.

Characteristics	n (%) n=50
Culprit arteries	
LAD	23 (46%)
LCx	7 (14%)
RCA	20 (40%)
Interventional approach	
Radial	39 (78%)
Femoral	11 (22%)

DISCUSSION

Coronary total artery occlusion occurs when coronary arteries become narrowed or occluded as a result of atherosclerosis and subsequent calcification and fibrosis. Histological examination and their three-dimensional reconstruction study in 10 patients with chronic total occlusion > 1 year revealed four types of occlusion classified according to the presence of a tapering or abrupt types of occlusion, and to the presence or absence of a loose fibrous tissue mass penetrating continuously from the proximal to the distal site of the occlusion[20]. Although duration of occlusion is difficult to determine on clinical grounds a total occlusion must be present for atleast 3 months to be consider a true CTO. Another term that is frequent and interchangeably used with CTO is TCO (total coronary occlusion) which is defined as lesion with TIMI 0 or TIMI1 flow and an estimated duration of <3 months. However there are important distinctions between CTO and TCO e.g, success rate for PCI of CTOs are lowered compared with TCOs and long term vessel patency after successful PCI is shorter in CTOs as compared to TCOs.

Coronary CTO have been named the Final Frontier in interventional cardiology[21].The treatment options depend upon the severity of symptoms and judgment of the physician. Despite the notable advances of novel technologies and procedural techniques including the use of Drug Eluting Stents PCI for CTO is still remains a challenge in interventional cardiology. Novel equipment such as microcatheters, specialized guide wires, and specialized devices such as the Crossbos CTO Crossing Catheter and Stingray CTO Re-Entry System device have become available in recent years. Furthermore specialized

techniques such as several techniques for a retrograde approach to interrogate CTO lesion have been develop over the last few years[22]. All these advancement has led to increase success rate of CTO PCI and recent data over the last few years about procedural complication is reassuring[23].

In present study we actually studied the procedural outcome in CTO patients undergoing PCI. About 50 patients having chronic total occlusion were retrospective analyzed for clinical output after PCI. A 98% procedural success was achieved in our study. Similarly first large registry, from the Mid America Heart Institute of Kansas City, was reported by Suero et al in 2001[5]. In a consecutive series of 2,007 patients undergoing intended PCI of a nonacute coronary occlusion at a single center over a 20-year period from 1980 to 1999, procedural success was achieved in 72.3% of cases[4]. However stents were employed in only 7% cases but in our study stents were employed in almost all cases. Aziz et al[24] also conducted similarly study at cardiothoracic centre from 2000 to 2004 in Livepool. Technical success was achieved in 69.4% cases and stents were used in 97.7% of all successfully treated cases. Similarly Milan-New York registry was presented in 2008 also assessed 1362 patients with CTO of duration greater than 3 months who were treated with PCI from 2000 to 2007. It also stated a procedural success of 66.8%. Valenti et al[25] in 2008 also reported a procedural success rate of 71% in his retrospective study.

The most commonly involved vessel in CTO lesion is LAD which is consistent with the literature available. The choice for interventional approach depends upon the physician judgment and patient feasibility. The failure rate in our study was 2% however Aziz et al and Valenti et al stated a failure rate of 31% and 29% respectively. Failure in our study is due to inability of guide wire to cross the lesion.

Stents were imploded in almost all successful cases to prevent restenosis and reocclusion.

The progress in the treatment of CTOs is much likely linked with the success to cross the lesion. Although much of work has been done in this field and new technology is available to cope with this difficulty, still there is much progress to make to deal with failure cases in the future. One could envision the future therapeutics of CTO involving intravascular microscopy.

The study is limited by the fact that it is only retrospective analysis of outcome of PCI and there is no comparison of the patients with group treated with medical therapy or CABG alone.

CONCLUSION

This study demonstrates that CTO PCI is currently performed with high and improving success. New technologies must focus on safe approach on recanalization in failure cases. Additional studies are required to evaluate the comparative prognostic role of PCI recanalization when compared optimal medical therapy and surgery.

Conflict of Interest

This study has no conflict of interest to declare by any author.

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