

THE EVALUATION OF CHRONIC TOTAL OCCLUSION ANGIOPLASTY RESULTS, IN PATIENTS SUFFERING FROM CORONARY ARTERY DISEASE

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Contribution

All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objective: Considering the prevalence and increasing rate of coronary artery disease patients diagnosed with CTO, the promising reports of angioplasty results in these patients and lack of information on these results in the country, this research has been carried out on the referrals of Modarres hospital in the year 2008 to determine the efficacy of CTO angioplasty.

Methodology: The research has been carried out using case series design. CTO angioplasty was done by the ante-grade method from the femoral approach. If the guidewire enters the true lumen and after predilatation, ante-grade flow is established, it is proclaimed successful, on the other hand if the guide wire fails to pass through CTO, or ante-grade flow is not established, it is considered the endpoint to angioplasty and proclaimed unsuccessful. The role of age and gender, bridging collaterals, existence of bending in the site of obstruction, duration of obstruction for more than one year, long lesions, existence of side branch in the site of obstruction, in the outcome of CTO angioplasty, was statistically assessed using Fisher exact test.

Results: The research was conducted on 32 patients, aged 49 ± 10 , 81% of whom were male. The success rate was 65.6% and presence of bending, bridging collaterals and the long obstruction were significant in failure ($P < 0.02$).

Conclusion: Based on our findings, the success of CTO angioplasty is acceptable when certain factors are present.

Key Words: CTO angioplasty, Bridging collaterals calcification, Duration, Long lesions

INTRODUCTION

The results of chronic-total occlusion angioplasty is a matter of concerns among interventional cardiologists, with a reported failure rate of up to 40%.^{1,2}

In cases where angioplasty was unsuccessful, based on the involvement of other vessels, medical therapy or open cardiac surgery (CABG) is performed. In fact, CTO is the most prevalent cause of CABG referral.^{3,4}

Reports show that successful CTO canalization can reduce the need for subsequent CABG and increase the patient's survival.^{5,6}

The failure rate of CTO angioplasty in reports varies from 15% to 40%.^{1,2}

Many factors have been reported effective in this failure; such as existence of calcification, bending in the site of the obstruction, bridging collaterals, long lesions, duration of obstruction and the presence of side branch at the site of obstruction.⁷

Thus far, the results of angioplasty have not been reported in. The introduction of guidewire and other equipment specific to CTO has increased the success rate.⁸ This research was carried out on patients suffering from CTO lesions referred to Moddares hospital during 2007 and 2008, with the objective of evaluating the success of angioplasty and the factors involved.

METHODOLOGY

The research was done using a case series design. All patients studied were diagnosed with CTO.

The diagnosis of CTO was based on TIMI ante-grade (0) flow and, the duration of obstruction for three months or more or the presence of bridging collaterals.^{7,8,9} The duration of obstruction is calculated from the last angioplasty showing CTO (in patients who had undergone angiography) or from the onset of symptoms suggesting ischemic heart disease in those without previous angiography.

Patients with CTO lesions who had clinical signs or ischemic heart disease based on non-invasive tests, underwent angioplasty.¹⁰

Angioplasty is performed using the femoral approach and by ante-grade method. Guiding extra back up was used for LAD angioplasty, as well as left Amplatz for LCX and right Judkins or right Amplatz for RCA.¹¹

Different guidewires were used depending on the type of lesion and the operator's decision to use the hydrophilic or stiff types, which have been explained below by the gradual step up method.

In cases where CTO included micro channels or the use of stiff wire was unsuccessful, hydrophilic wires were used. If

the guidewire entered the true lumen and ante-grade flow was re-established after predilatation, it would be proclaimed successful¹².

The process would be considered a failure, when ever fluoroscopy lasted more than 60 minutes, dye volume consisted of more than 600cc in patients with normal kidney function, large false lumen occurred especially when associated with staining adventitia, damages to collateral vessels prevented normal distal flow, fatigue in patients or physicians became severe and the guidewires failed to pass through.⁷

Successful & unsuccessful cases were registered, noting the cause.

The roles of sex, age, affected vessel, presence of bridging collaterals, calcification, bending site, duration of obstruction lasting more than one year, length of obstruction, presence of side branch in the site of obstruction were investigated. All these factors were determined by questioning the patients, clinical investigations and angiography results.

Data from information forms were classified and the failure rate of angioplasty in the patients and the actual rate in the population (confidence interval=c.i) were estimated with a probability of 95%. The roles of age, gender and other related factors were evaluated using Fisher exact test., and if an association existed, the odd's ratio was calculated.

RESULTS

This research was performed on 32 appropriate candidates; 6 female (18.8%), and 26 (81.2%) male, aged 49 ± 10 years, ranging from at least 35 up to 69 years of age. Among the population, seven subjects (21.8%) had three vessels affected, 46.9% had two and 31.3% had one.

Among 14 patients the RCA, LAD and LXC/OM were affected in 47.3%, 40.6%, and 15.6% respectively.

Results demonstrated that 21 cases (65.6%) had successful therapy and 11 cases (34.4%) had unsuccessful therapy. Cases without of therapeutic success consisted of one case of large false lumen, 2 cases of shearing off of collaterals, 2 cases of dye more than 600cc, and 6 cases (18.7%) in which fluoroscopic time lasted more than an hour.

The failure rate in these patients was estimated 95% with a range 30-50%. C.I95= (30-50). Sign test showed the success rate is statistically significant ($P < 0.05$).

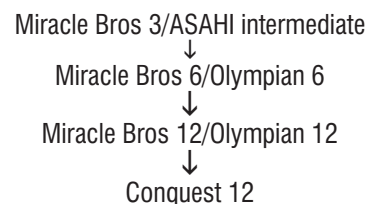


Table 1: Distribution of related factors in patients undergoing CTO angioplasty according to therapeutic outcome

Test result Factors related	Successful N=21	Unsuccessful N=11	Test result
SEX:			
Male	18(85.7)	8(72.7)	P<0.6
Female	3(14.3)	3(27.3)	
Vessel:			
RCA	9(42.9)	5(45.4)	P<0.4
LAD	9(42.9)	4(36.4)	
LCX/OM	3(14.2)	2(8.2)	
Bridging collaterals			
Yes	21(100)	6(54.5)	P<0.003
No	0(-)	5(45.5)	
Calcification			
Yes	21(100)	10(90.9)	P<0.7
No	0(-)	1(9.1)	
Bending			
Yes	21(100)	7(63.7)	P<0.01
No	0(-)	4(36.3)	
Duration of occlusion:			
Less than 6 months	20	8	P<0.7
More than 6 months	1(4.8)	3(27.3)	
Long occlusion			
Yes	20	6(54.5)	P<0.02
No	1(4.8)	5(45.5)	
Side branch			
Yes	19	8	P<0.4
No	2	3	

Distribution of the related factors in patients is shown in Table 1, which demonstrates the rates of success and failure among female patients were 27.3% and 14.3% respectively (P<0.7).

A greater number of bendings in the site on obstruction, bridging collaterals and longed obstructions length were observed in patients experiencing unsuccessful angioplasty in comparison with the group with therapeutic success. However even though the vessel affected, calcification, obstructions lasting more than a year, and presence of side branch at the obstruction site were seen more commonly

among those without therapeutic success, the findings were not statistically significant. (P<0.4)

Procedural side effects consisted of large false lumen formation in one (3%) patient, and collateral flow cessation in two (6%) patients, one of whom experienced chest pain and enzymatic rise (CPKMB > 2 times) after the procedure. Stroke or death did not occur during the procedure or hospitalization. Contrast nephropathy or a decrease of haemoglobin more than 3 g/dL did not occur in any of the patients.

DISCUSSION

The research demonstrated a success rate of 65.6% for CTO angioplasty.

In a study conducted by Kilian, et al,¹³ in September 2005, published in the interventional cardiology journal, the success and safety of performing CTO angioplasty were evaluated. In this research, PCI was performed on 100 patients suffering from CTO and the results were compared with the control group. The success rate due to CTO angioplasty was reported 79%. In comparison with the 98% success rate in the control group, there was a significant difference; however, the procedural rate was less in the CTO group. This study implies that CTO angioplasty is a safe procedure, yielding an acceptable success rate, which is consistent with our findings.

Based on guidelines published in the journal, *Circulation* 2006, The American Heart Association (AHA) claimed that the success rate of CTO angioplasty was 65% percent on average, which is less than that of other lesions (91-92%).¹⁴ This finding is similar to our results.

Over the past 10 years, some centers have reported higher success rates than others, which may be due the manufacturing and selecting suitable CTO guidewires, increasing skill of those centers, as well as an increase in the number of their cases.

In a study carried out by Saito. et al, published in the journal, *catheterization & cardiovascular intervention*, 2003, the use of tapered tip guidewires, such as conquest, cross it, increased the success rate from 67% to 81%.⁸ The success rate in our study was similar to that of the control group in Saito's study, probably due to the unavailability of cross it guidewires and the limiting the use of confianza wires to only 19% of cases.

In another study, presented by HAN Ya-Ling, and published in the Chinese medical journal, 2006, the relationship between the lesions' characteristics and the procedural success rate was assessed. This study was performed on 1236 patients. Although the total success was 88.9%; however, the duration of obstruction, long lesions (15mm>), presence of collateral bridging, absence of a distinct stump, tortuosity, or moderate to severe calcification and CTO located distal or ostial, were related to failure.¹⁵

Due to the number of samples, the operators in this center were more experienced than us; this justifies the higher rate of success in their procedures; furthermore, some of the mentioned factors were the cause of failure in our study.

In some studies performed and published by other centers, the above factors have not been obstacles when carrying out a successful procedure. In a study presented by Kinoshita, and published by the interventional cardiology, 397 patients suffering from CTO were divided into two separate groups,

based on the presence or absence of collateral bridging. These patients underwent angioplasty and the success rates were 75% for those with collateral bridging and 83% for those without, which ultimately had no significant difference.¹⁶ However, in a study carried out by Stohe. et al, and Maiello. et al, published in the *American heart journal*, successrate of CTO angioplasty with collateral bridging, was only reported in 18% and 29% of cases, which shows significantly better success among the group without collateral bridging.^{17,18} On the other hand, this may have been caused by the fewer number of patients.

In a study performed by Holmes published in the *American Coll cardiology*, obstructions lasting for more than six months were presumed failures¹⁹; in another study presented by Bell. et al, and published in *Circulation*, the duration of obstruction did not turn out to be influential in the success rate.²⁰

Apparently, by improving the operators' skills and increasing the number of cases, the only factors associated with CTO angioplasty failure are severe calcification and tortuosity or severe bending in the site of obstruction.⁷

Since one of the patients in our study suffered from severe calcification, our study could not give a definite conclusion in this regard. However bending was presumed influential in the failure of our study.

Having fewer samples (32 samples), lack of access to various types of guidewires and IVUS, and working in a training center, with intervention performed by fellows can account for some failures. However, we did not have an exit evaluation and the study was carried out using case series design, which was considered an important and valuable aspect of this study.

The success rate appears to be acceptable, considering the limitations of this study, although 34.5% of failure rate is a concern. Other methods such as retrograde are used in angiography; since, atleast 100 cases of CTO performed by ante-grade method are required prior to this method²¹, therefore using ante-grade method maybe useful. Secondly, patients who did not undergo CTO angioplasty must be referred to CABG that has its specifically known side effects.

CONCLUSION

The important and valuable conclusion of this study is that the presence of bridging collaterals, bending in the obstruction site and length of obstruction are possibly influential in failure.

RECOMMENDATIONS

It is recommended that our colleagues investigate all causes of failure in future studies. The lack of experience of interventionalists ,new to performing CTO angioplasty may

be a relevant factor in failure.

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