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Diagnostic Significance of Multi-Slice CT in Patients with Coronary Total Occlusion Lesions Prior To Percutaneous Coronary Interventions

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Abstract: *Accurate assessment of coronary total occlusion (CTO) lesion is necessary to build-up a strategy of successful revascularization. Evaluation of multi-slice computed tomography- coronary angiography (MSCT-CA) significance in patients with CTO lesion. Forty patients with a native coronary CTO were included in the present study. Twenty patients (group I) undergo evaluation of the CTO segment with MSCT-CA with assessment of occlusion length, amount of calcification, proximal and distal cap, vessel course, with calculation of (KCCT, CT RECTOR and JCTO scores). Group(II) include 20 patients with CTO segment assessment through invasive coronary angiography (ICA) and calculation of (JCTO, PROGRESS scores).The two groups were compared as regard procedure successes rate, time for wire crossing, amount of contrast, procedure related complication, and impact of calculated scores on prediction of procedure success. Succeeded revascularization in 16(80%) of group I and 15 (75%) patient in group II (without significant difference). No statistically significant difference between the succeeded and failed patients in both groups regarding which artery is affected, site of CTO. We reported that the longer duration of occlusion, the more incidence of failure. Group (I) had a shorter time required for the guide wire to cross the CTO segment than that for group (II) with a significant statistic difference. The current study results showed that MSCT-CA is more sensitive than ICA in quantification of CTO segment calcifications. CTO segment calcifications were not detected by ICA in 14 patients, while 5 of them (35.7%) were detectable by the MSCT-CA. Group (I) had a statistically significant difference as regard the contrast volume used in revascularization. In this study J-CTO SCORE could predict procedure difficulty level; J-CTO score of 0 and 1 had an overall 100% success rate in both groups. While J-CTO score of 2 had a 75 % success rate in angiography based group and 100% in MSCT-CA based group. J-CTO score of 3 or more had a 60% success rate in group I and 69% in group II. These data might reflect more powerful prediction of procedure outcome when MSCT-CA was used to calculate J-CTO score. No statistically significant difference was detected as regard complications related to the procedure between the two studied groups. Although MSCT-CA is an effective tool, its use implies exposure to radiation and contrast material. We might state that it should not be routinely applied in all patients with CTO. Its use should be limited to particularly complex cases (very long or tortuous occlusions, with severe calcification) or previous revascularization failures.*

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I. Introduction

Coronary total occlusion (CTO) has been recognized in about 15% of patients undergoing invasive coronary angiography (ICA). CTO represent about 10% of lesions treated by percutaneous coronary intervention. (1)

Successful recanalization of CTO lesions, in patients with viable myocardium helps not only to reduce angina symptoms, avoid bypass surgery and decrease incidence of myocardial infarction, but also improves long-term survival. (2,3)

Procedural success rate for CTO PCI has been reported to be around 70%. (4) The success rate of PCI for CTO in some international cardiovascular interventional centers has been increased up to 80%-90% due to remarkable advancements in the instruments and the techniques of PCI for CTO lesions. (5)

The recanalization of CTO lesion is still one of the major challenges for the most interventional cardiologists in current clinical practice. Accurate assessment of CTO lesion is essential to design the strategy of revascularization. The effect of recent noninvasive imaging techniques, including Coronary Computed

Tomography Angiography (CCTA), magnetic resonance imaging and single-photon emission computed tomography (SPECT), on the assessment of coronary artery disease have been proved and well documented in many studies. (6 ,7)

Before PCI revascularization, a detailed comprehensives assessment of CTO arteries has become very important. CCTA has seems to be a useful tool for the identification of calcification. Inverse negative correlation was identified between serious calcifications and CTO recanalization success rate. (8, 9)

Proper selection of patients, who probably benefit from revascularization, depends on accurate cardiac imaging. Cardiac imaging has important prospective roles in pre- PCI procedure preparation, post- PCI procedure evaluation of re-vascularized segments and long-term outcomes. (10)

Arterial perforation, dissection and cardiac tamponade, considered as high risk complications that might results due to manipulation of wires and devices through a CTO during PCI procedure without proper technique to visually, characterize and recognize vessel wall boundaries. (11)

Prolonged procedural times for CTOs increases the possibility of contrast nephropathy and radiation skin injury. So importing the MSCT-CA data-sets to the catheterization laboratory directly with a probability of automatic alignment according to the angulation of the C-arm helps the operator to validate the direction of the guidewire advancement in relation to the course of the occluded vessel segment and to recognize angulations of the C-arm that avoid foreshortening of the treated vessel segment. (11-12)

This study aimed to investigate the diagnostic value of MSCT-CA and it is impact on the results of PCI in patients with CTO.

II. Subjects and Methods

Subjects: Forty patients with native coronary artery CTO ; between January 2016 and October 2017; were recruited from catheterization labs and CT labs in Cardiology Department, Tanta University Hospitals and Specialized Heart Center at Kobri AlKobba Military Hospital, Egypt. Written consent forms (approved by the Committee of Human Rights in Research at Tanta University) were obtained from all studied subjects.

Patients were classified into two groups. Group (I) included 20 patients age range 42-71years (mean 56.95$\pm$9.13) underwent evaluation of their totally occluded coronary segment with MSCT CA, with detailed assessment of occluded vessel by calculating occlusion length, amount of calcification, proximal and distal cap, and course of the vessel with calculation of (KCCT, CT RECTOR and JCTO scores) before a trial of percutaneous intervention on this vessel. Group (II) included 20 patients; age range 50-75years (mean 61.5$\pm$7.31). Assessments of the occluded segment in group (II) were done by CA and calculation of (progress score and JCTO score).

The two groups were compared as regard procedure successes rate, time for wire crossing, amount of contrast used, procedure related complication, and impact of calculated scores on prediction of procedure success. Revascularization succeed and failed cases in group (I) were compared to highlight impact of MSCT CA calculated parameters on revasculization such as lesion length, calcification, side branch, tourosity.

All procedures were performed by expert interventional cardiologists at these hospitals. Patient demographic data were confirmed by hospitals chart review. CTO defined as obstruction of a native coronary artery with Thrombolysis In Myocardial Infarction (TIMI) flow grade zero, having an estimated occlusion duration >3 months. (9) Written informed consent was obtained from all patients. Patients with recent myocardial infarction (MI) were excluded, as well as those with small vessel sized <2.0 mm or those with LV ejection fraction < 50%. Also patients with marked renal impairment eGFR less than 30 ml\min, intolerance to dual antiplatelet therapy, presence of any significant co-morbid conditions that severely limit patient life span and those with severe left main disease and a high Syntax scorer requiring CABG were excluded.

Clinical Characteristics: Clinical history and risk factors were evaluated by research team. History of ischemic symptoms or Q wave electrocardiography consistent with MI, or left ventricular wall motion abnormality consistent with the territory of CTO vessel was evaluated. Resting 12 leads ECG; to show any rhythm disturbances or ischemic changes; and echocardiographic assessment of left ventricular function has been examined for every patient.

MSCT-CA protocol and image reconstruction in group I: Oral beta blockers was supplemented; one hour before examination; to patients with heart rate more than 70 beats/min. Sublingual nitroglycerin was administrated prior to the scan (0.3 mg dose). All images were acquired during an inspiratory breath hold, while an electrocardiogram (ECG) was used simultaneously for retrospective analysis of the data. MSCT CA studies were done using a dual source CT machine (Somatom Definition Flash, Siemens Healthcare, Forchheim, Germany) using 2 X-ray tubes and 2 detectors arranged at an angular offset of 95°. Each detector enables data acquisition with 64 detector rows of 0.6 mm width (Z-axis coverage: 38.4 mm). Together with a Z-flying focal spot, this allows simultaneous acquisition of data in 2 x 128 slices. With a gantry rotation time of the system of 0.28 seconds, half-scan reconstruction provides a temporal resolution of 75 ms in the center of the field of view.

Data sets for quantification of coronary artery calcium were rendered using half-scan reconstruction algorithm with 3.0 mm slice thickness, 1.5 mm increment and a medium sharp reconstruction kernel (Siemens B35f). The Agatston score was used for coronary artery calcium quantification using a standard threshold of 120 HU for calcium detection.

Vessel opacification was achieved through automated injection by a power injector (Medrad Stellant) of 60–80 ml iopromide (370 mg I/ml Ultravist, Bayer Schering Pharma AG, Germany) at a flow rate of 5-6 ml/s plus a 40–60 ml saline flush. Imaging was done using 120 kV tube voltages and tube current was set according to body mass index (BMI). All CT imaging data were acquired in deep inspiration.

MSCT-CA data sets were acquired using either prospectively ECG-triggered acquisitions for patients with heart rates 60-70 bpm or using retrospective ECG-gated acquisitions with tube current modulation for patients with higher heart rates and post CABG patients. Data sets were reconstructed at a slice thickness of 0.75 mm. ECG was digitized and continuously monitored during the scanning period.

Acquired datasets were reconstructed by 3D volume-rendered (VR), thin-slab MIP and MPR images. In case of retrospective ECG – gated studies, reconstruction phases were done at the end diastole (best diastolic) and systolic phases were utilized when needed. Reconstructed CTA data were used to evaluate the morphology of the CTO lesion, and the (J-CTO, KCCT, CT RETRACTOR scores) were calculated.

Analysis of MSCT-CA: All MSCT-CA were interpreted by experienced operatorusing a dedicated workstation (iNtuition, Terarecon). Vessel centerline was reconstructed from ostium to distal end. Anatomic characteristics of vessel were assessed by curved multiplanar reconstruction rotated by 360° and thin-slab maximum intensity projection with free 3-dimensional (3D) rotation. CTO segment was defined by complete absence of luminal enhancement. The whole CTO plaque was assessed by cross-sectional views with 1-mm interval to assess the maximal luminal and vessel area of CTO, remodeling index, and semiquantitative extent of calcification. [12,13] CTO length was measured along vessel axis to avoid shortening caused by angulation. Both proximal and distal margin of CTO were categorized as blunted or tapered stump. Side branch was defined by branches having diameter of ≥1.0 mm adjacent to CTO. Bending was defined by >45° within CTO segment. Proximal angulation was defined by >90° bend between the centerlines of proximal vessel segment and CTO entry site. Calcification was assessed in a cross-sectional view with highest calcification burden using optimally widen image contrast to minimize blurring artifact. Significant peripheral calcification was defined by encircling ≥180° and cross-sectional area (CSA) ≥50%. Central calcification was defined by calcification encircling 360° and occluding the whole vessel lumen (CSA=100%). The number of non-CTO lesion with diameter stenosis ≥50% was investigated to assess the burden of coronary artery disease. Severe stenosis (diameter stenosis ≥70%) proximal to CTO which may interfere in the PCI procedure was separately assessed. The presence of collateral vessel was determined by complete visualization of vascular connection between donor and recipient coronary arteries from all curved multiplanar reformatted images rotated by 1° each. [13,14]

Analysis of ICA Procedure

ICA was analyzed by experienced interventional cardiologists using dedicated workstation (GE Centricity Cardiology CA-1000) The morphology of entry and exit site, visible calcification, bending >45°, occlusion length, proximal reference vessel diameter, and side branch adjacent to entry or exit site was assessed .[13,15] Functional occlusion was defined by the absence of a discernible lumen accompanied by faint and late anterograde TIMI 1 flow antegrade flow and major filling of the distal vessel predominantly from collateral flow.

Angiographic success of PCI was defined by achieving diameter stenosis <50% and restoration of TIMI grade 3 flow. The length of occlusion was measured during either antegrade or retrograde (with simultaneous bilateral injections) filling of the distal vessel. Collateral flow andother variables such as calcification, bending, bridging collaterals, and stump morphology were reported using standard definitions. [16]

PCI procedures: Guidewires were used in a stepwise progression, starting with a soft or a hydrophilic guidewire and progressing to stiffer guidewires. The retrograde approach was attempted if the anterograde approach was unsuccessful and collaterals appeared to be appropriate.

Multicenter CTO Registry of Japan (J-CTO),the Korean Multicenter CTO CT Registry Score (KCCT score), and CT-RECTOR scores were calculated. In brief, J-CTO score assigns 1 point to each of proximal blunt stump, visible calcification, bending >45°, occlusion length ≥20 mm, and reattempt. [5,8]

KCCT assigns 1 point to each blunt proximal entry, proximal side branch, occlusion length more than 15 mm, bending, reattempt, more than 12 month duration, moderate calcification, and 2 points for severe calcification.

CT-RECTOR assigns 1 point to multiple occlusion, proximal blunt stump, severe calcification, bending ≥45°, reattempt, and CTO duration ≥12 months or unknown. Summation of point calculates respective scores. (17)

III. Statistical analysis

The data of the present study were collected, reviewed, systematized, tabulated and statistically analyzed using statistical package for social sciences (SPSS) version 23.0 for windows. Data are presented as the Mean ± standard deviation (SD), frequency, and percentage. Categorical variables were compared using the chi-square ($\chi 2$) and Fisher's exact tests (if required). Continuous variables were compared by the Student t test (two-tailed) for parametric data. Mann-Whitney U test was used for comparison of nonparametric data. The level of significance was accepted if the P value < 0.05.

IV. Results

This study was conducted on forty patients (mean age 42 ± 75 years, 83% male) who were confirmed to have at least one totally occluded native coronary artery. Mean heart rate was 60±3beats/min, duration of breath hold was 15s. Study population was divided into two groups, group (I) includedtwenty CTO lesions were assessed by MSCT-CA and ICA, diagnosed as 9 CTOs in the LAD, 7 in the RCA and 4 in the LCX. The length of the occluded segment was determined by MSCT examination in all cases of group (I). Meanwhile, group (II) include 20 CTOs lesions were examined by CA including, 11 CTOs in the LAD, 6 in the RCA and 3 in the LCX. A history of PCI and MI was found in 22% and 38%, in group I and group II respectively.

Successful revascularization procedures were performed in 16/20 (80%) CTO lesions according to the information from MSCT-CA examination (group I) and in 15/20 (75%) of group II, with no significant statistically difference (table 1). In the two studied groups, failure of revascularization was more associated with older age. There was no significant difference regarding gender or known cardiovascular risk factors (table 3).
Antegrade approach was more frequently attempted (82%), while combined antegrade and retrograde approaches was attempted in (18%).The length of the occluded segment was determined by MSCT-CA in group I and by ICA in group II. The length of the CTOs showed no significant difference between two methods (24±5.9 mm vs. 25±7.5 mm, P>0.05). Occlusion length more than 22 mm carries an increased incidence of failure (tables 2, 5 and 6).

Regarding procedural characteristics, the GW-failure group showed higher prevalence of reattempted PCI, retrograde injection, and retrograde wiring, as well as a higher number of overall introduced wires than the GW-success group. Reattempted PCI, retrograde injection, retrograde wiring and long occlusion time (> 9 months) were more prevalent in GW failure. While, which artery is affected by CTO or the site of CTO had no significant difference in GW success except for LAD which showed more failure rate (table 4).
Cases treated guided by data from***MSCT-CA***had a shorter time required for the PCI guide wire to cross the CTO segment and less amount of contrast mediaused than those using ICA alone with a statically significant difference (258.5±96.8 cc for *group I* compared to 324.5±87.5 cc for *group II*). This difference might be due to 3D reconstruction for MSCT-CA image which allow for better vessels tracking (table 5 -7, figure 1).

There was a statistically significant difference between the studied groups regarding increased incidence of failure in the presence of side branches (table 8). Tendency towards increased incidence of failure was also associated with the presence of blunt proximal stump (table 9).

MSCT-CA is more sensitive than ICA in quantification of proximal cap calcification, detection of side branches at the CTO segment (table 8, 9). CTO segment calcificationswere not detected by ICA in 14 patients from group I,**5**of them calcification were detectable by the MSCT-CA. The calcified lesion, CTO segments side branches and blunt proximal stump had a statistically significant higher rate of failure and more incidence of procedure related complication. MSCT-CA showed higher sensitivity in the rate of detection of calcification lesion compared with ICA (69.6% vs. 43.4%, P>0.05). Also, the length of occluded segment could be successfully measured by MSCT-CA (10.1±5.5 mm), but not by ICA. It is noted that MSCT-CA could detect the detailed location (proximal, middle and distal segment) of calcification in occluded vessels, and enabled imaging of the occluded segment territory by using 3D reconstruction (figure 1).

In this study J-CTO SCORE could predict procedure difficulty level; J-CTO score of 0 and 1 had an overall near 100% success rate in both groups. While J-CTO score of 2 had a 75 % success rate in angiography based group and 100% in MSCT-CA based group. J-CTO score of 3 or more had a 60% success rate in group I and 69% in group II. The results of the current study were matched with those of KCCT score, CT RECTOR score and those of J-CTO score (table 10, 11, 12).

Table (1): Percentage of successed and failed revascularization between both groups

	Group I (20)	Group II (20)	P value
	Number of frequency (%)		
Successful (31)	16 (80%)	15 (75%)	0.677
Failed (9)	4 (20%)	5 (25%)	

Table (2): Antegrade and reterograde approach for both groups

	Group I (20)	Group II (20)	P value
	Number of frequency		
Antegrade (33)	17	16	0.677
Retrograde (7)	3	4	

Table (3): Prevalence of hypertension, diabetes and smoking among successful and failed revascularization patients in both study groups.

Conventional Risk factor	Result of PCI in Group I		P value
	Successful (16)	Failed (4)	
DM (11)	7	4	0.043*
HTN (12)	10	2	0.64
Smoking (13)	12	1	0.061
Conventional Risk factor	Result of PCI in Group II		P value
	Successful (15)	Failed (5)	
DM (12)	9	3	1.0
HTN (17)	12	5	0.278
Smoking (9)	6	3	0.436

Table (4): Impact of which vessel treated on success rate of revascularization

Vessel Treated	Group I (20)	Group II (20)	P value
LAD	9	11	0.656
RCA	7	6	
LCX	4	3	

Vessel Treated	Group I			Group II		
	S (16)	F (4)	P value	S (15)	F (5)	P value
LAD	7	2	0.509	9	2	0.739
RCA	5	2		4	2	
LCX	4	0		2	1	

Table (5): Mean time (by minutes) for PCI guide wire to cross CTO segment.

	Time of Wiring		P value
	Group I (20)	Group II (20)	
Mean (min)	22.68	34.33	0.007*
SD	9.59	12.76	
Min	13	15	
Max	45	60	

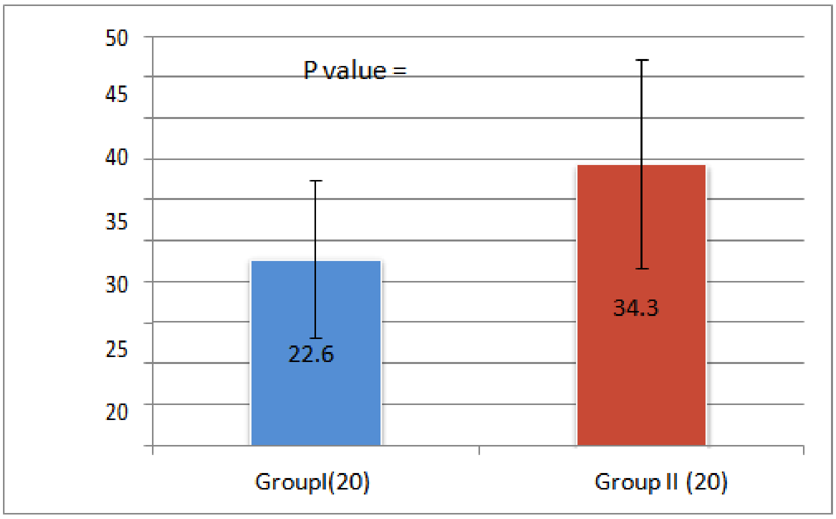

Fig. (1): Mean time (by minutes) for PCI guide wire to cross CTO segment.

Table (6): Amount of contrast material (by CC) used for revascularization in studied groups.

	Amount of Contrast		**P value**
	Not guided (20)	Guided by CT (20)	
Mean	367.5	272.5	0.005*
SD	87.77	112.94	
Min	200	150	
Max	500	500	

Table (7): Impact of occlusion length on success rate of revascularization

Occlusion length	Group I			Group II			P value
Mean (mm)	24.35			25.05			0.746
SD	5.93			7.53			
Min	17			14			
Max	36			36			
Occlusion length	Group I			Group II			
	S (16)	F (4)	P value	S (15)	F (5)	P value	
Mean	22.12	33.25	<0.001*	26.06	22	0.309	
SD	3.91	3.77		7.93	5.83		
Min	17	28		14	14		
Max	30	36		36	30		

Table (8): Impact of side branch detection on success rate of revascularization

Side branch	Group I (20)			Group II (20)			P value
Present (26)	11			15			0.185
Not present	9			5			
Side branch	Group I			GROUP II			
	S(16)	F (4)	P value	S (15)	F (5)	P value	
Present (26)	7	4	0.043	11	4	0.766	
Not present	9	0		4	1		

S= succeeded and F = failed revascularization.

Table (9): Impact of proximal stump morphology on success rate of revascularization

Proximal stump	Group I			Group II			P value
Tapered (16)	11			5			0.053
Blunted (24)	9			15			
Proximal stump	Group I			GROUP II			
	S (16)	F (4)	P value	S (15)	F (5)	P value	
Tapered (16)	10	1	0.178	5	0	0.136	
Blunted (24)	6	3		10	5		

Table (10): Impact of J CTO SCORE on both groups

JCTO SCORE	Group I			Group II			P value
0 (3)	1			2			0.547
1 (4)	3			1			
2 (10)	6			4			
≥3 (23)	10			13			
JCTO SCORE	Group I			GROUP II			
	S (16)	F(4)	P value	S (15)	F (5)	P value	
0 (3)	1	0	0.172	2	0	0.746	
1 (4)	3	0		1	0		
2 (10)	6	0		3	1		
≥3(23)	6	4		9	4		

Fig (2): J-CTO score among successful and failed revascularization of group I.

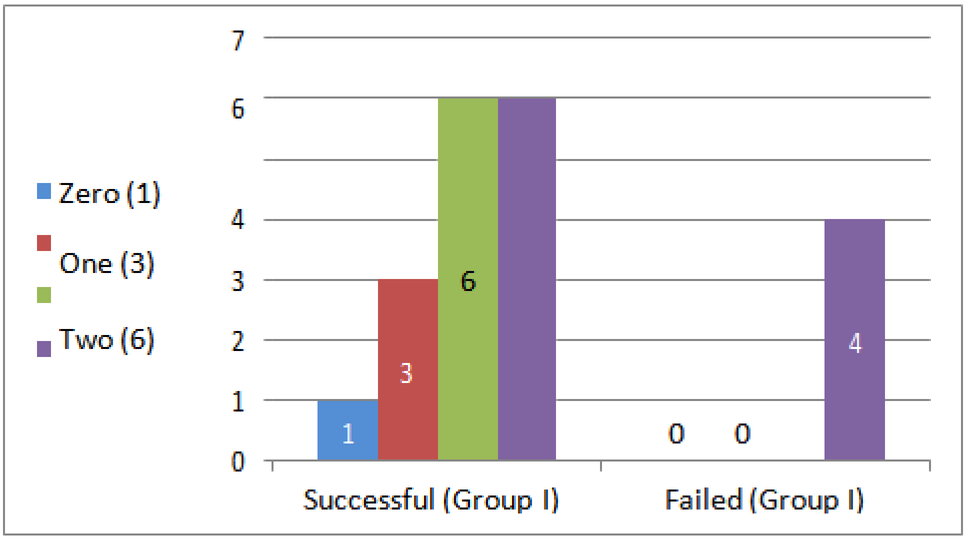

Fig (3): J-CTO score among successful and failed revisualization of group II.

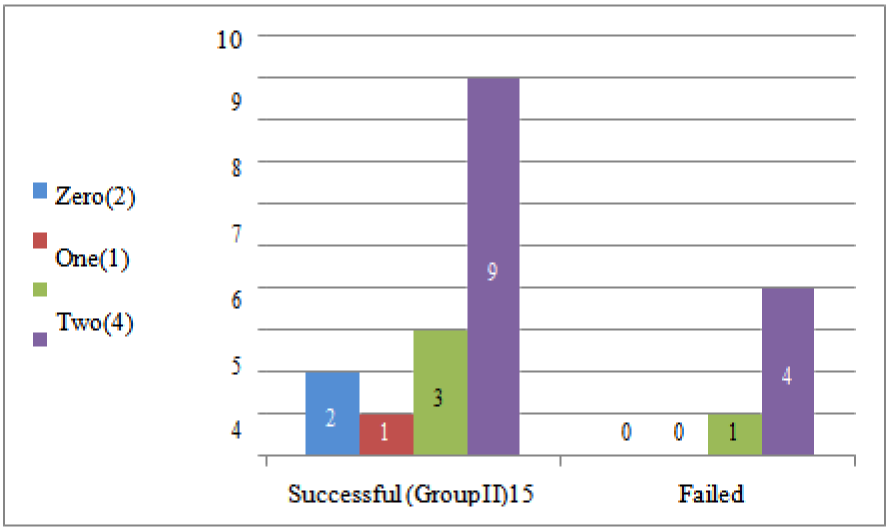

Fig (4) : Impact of KCCT score on revascularization result.

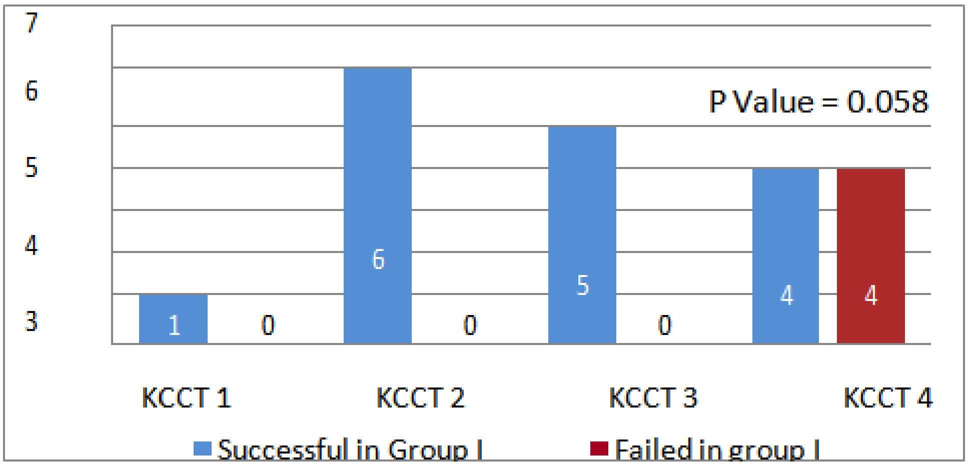

Table (11): Impact of KCCT score on revascularization result			
KCCT score by MSCT	Result of PCI in Group I		P value
	Successful (16)	Failed (4)	
One	1	0	0.058
Two	6	0	
Three	5	0	
Four or more	4	4	

Table (12): Impact of CT RECTOR score on revascularization result			
CT retractor	Result of PCI in Group guided by MSCT CA		P value
	Successful (16)	Failed (4)	
Zero (2)	2	0	0.229
One (6)	6	0	
Two (5)	4	1	
≥Three (7)	4	3	

V. Discussion

The exact incidence of CTOs in the general population is still unidentified. CTOs has been reported in 15- 30% of all patients undergoing coronary angiography. [12,18,19]Despite this high incidence, CTO PCI is not routinely attempted primarily due to poor CTO PCI success rates, which have led to the development of novel techniques, equipment, devices and imaging. [20, 21]There are different imaging modalities that can help the success of CTO PCI. Angiographic imaging in CTO will remain essential to predict procedural success, patient selection, procedural planning and follow-up. [22]Evaluation of CTO lesion with CT coronary angiography (MSCT CA) may help to better select patients that would benefit from percutaneous revascularization.

Our results demonstrated that, coronary MSCT-CA reliably visualizes the occluded coronary segment identifying and evaluating morphological (e.g., amount disruption of calcification) and anatomical (e.g., tortuosity, length) features of the occlusion. Two- and Three-dimensional reconstructions enable visualization of the exact vessel trajectory with accurate measurement of the occlusion length and precise mapping of vessel tortuosity. Also, it can be used to identify ostial occlusions that may be missed in invasive angiography. By contrast, a number of these lesion features cannot be often well clarified by conventional ICA. These results were in accordance of results of several studied which have demonstrated that, most of previously reported poor features of PCI success CTO cases can be easily identified by MSCT-CA. [10,11]

Calcification is a characteristic feature of high difficulty level of CTOs, it adds difficulties at all steps PCI procedure, hindering successful guidewire passage, lesion pre-dilation, and sufficient stent expansion. [22]Several studies have constantly demonstrated that coronary MSCT-CA is more sensitive to detect, quantify, and localize calcification compared with ICA. [23-26] The present study showed MSCT-CA showed higher sensitivity in the rate of detection of calcification lesion compared with CAG (69.6% vs. 43.4%, P>0.05). Also, the current study showed that, the length of occluded lesion could be successfully measured by MSCT-CA (10.1±5.5 mm), but not by ICA. Earlier study by Mollet et al. [27] reported that, occlusion length >15 mm were independent predictors of guidewire crossing failure in a series of 47 lesions. Another small MSCT-CA study conducted by Soon et al. [24]included 39 patients with 43 chronically occluded vessels; they found that calcification >50% of vessel cross-section was the only independent correlate of unsuccessful PCI, conferring a 10-fold higher risk for procedural failure.

Our results have demonstrated that the features of CTO, including length of occluded segment, location and extent of calcification, orientation and path of the CTO, could be identified by MSCT, suggesting its role in assessing CTO features. To plan and define the optimal working view angle that reveals the target lesion with minimal foreshortening, 3-D vascular reconstruction images for CTO lesion can be used .Previous studies have shown that, the information obtained by MSCT-CA pre- procedural will be helpful to predict the success rate of CTO recanalization and to design optional procedural strategies and guide the operation of PCI. [24 ,28, 29]

Our results demonstrated that, occlusion length was a statistically significant parameter reflecting overall procedure successes occlusion. Length more than 22 mm carries an increased incidence of failure; occlusion length was more accurate measured by MSCT-CA than with ICA. These data were in accordance with the results of Fujino and Otsuji (2017). [30]

Current study results were concordant with **J-CTO** study, in which the optimal cutoff of MSCT-CA occlusion length for successful guide wire crossing ≤30 minutes was ≥14.6 mm. (table 9). From the present study we could state that, J-CTO score could predict procedure difficulty level. The results of the present study showed that, when MSCT-CA was used to calculate J-CTO score more powerful prediction of procedure outcome could be detected.Our results were in accordance with several previously studies. [11,28,31-35]

The results of the current study were matched with those of KCCT score and CT RECTOR. (table 10,11) Clinicians may find the CT-RECTOR score particularly useful to better estimate the time required for PCI, specifically in patients with poor CTO visualization by ICA. The ability of MSCT-CA to assess anatomy, perfusion, and viability in a one assessment makes it a potential tool that predicts not only the possibility of successful PCI but also the clinical significance of CTO revascularization. [12]

VI. Conclusions

In conclusion we have demonstrated that, MSCT-CA reliably visualizes the occluded coronary segment, detection of presence of side branches and is able to identify and quantitatively evaluate morphological and anatomical features of the occlusion which might provide some valuable information on the nature of CTO lesion. MSCT-CA based scores had developed for prediction of a successful procedure (J-CTO, CT RECTOR AND KCCT). We recommended that, MSCT-CA based scores had developed for prediction of a successful procedure (J-CTO, CT RECTOR AND KCCT).Although MSCT-CA is an effective tool, its use implies exposure to radiation and contrast material, therefore, do not believe it should be routinely applied in all patients with CTO. Its use should be limited to particularly complex cases (very long tortuous occlusions, with severe calcification) or previous revasculrization failures.

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