Angiographic Predictors of Success of Revascularization by Percutaneous Coronary Intervention (PCI) Using the Japanese Chronic Total Occlusion Score

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ABSTRACT:

BACKGROUND:

Chronic total occlusions (CTOs) are considered as the most complex lesions to treat via percutaneous coronary intervention (PCI), due to the indications, costs and technical difficulties related to these procedures. As a consequence, only about 10% of all coronary artery diseased patients (CAD), clinically eligible for revascularization, are currently being treated via percutaneous coronary intervention (PCI). The majority is treated either medically or by coronary artery bypass graft (CABG) surgery.

OBJECTIVE:

This study sought to estimate the value of application of J- CTO score as a model to stratify the complexity and predict success rates at Iraqi Center for Heart Disease.

METHODS:

One hundred patients with chronic total occlusion were enrolled in this study form October 2014 - May 2015 who were attending Iraqi Center for Heart Disease. Data were collected on demographic, clinical and angiographic characteristics and reviewed by experienced Chronic total occlusions(CTO) operators. Descriptive analyses were performed using Statistical Package of Social Sciences (SPSS) to assess the relationship between procedural success and any variable of the demographic, angiographic and/or clinical characteristics. The level of significance was set at 95% or higher.

RESULTS:

Sixty-one patients out of 100 patients (61%) had a successful PCI. Univariate analyses showed significant differences of Electrocardiography and number of diseased arteries with J-CTO score between the group with successful PCI compared with those with failed PCI.

Angiographically, using Japanese chronic occlusion score we found that a “blunt stump” (42 vs. 75%, p=0.001), “calcifications” (37 vs.70%, p=0.003), “tortuosity” (21 vs. 67%, p=0.001), “CTO length” (44 vs. 84%, p=0.000) and a “re-attempt” (33 vs. 65%, p=0.036) all had a significant negative impact on procedural outcome.

CONCLUSION:

The J-CTO score is valuable tool for predicting successful revascularization of chronic total occlusion by Percutaneous coronary intervention (PCI).

KEYWORDS: Japanese chronic total occlusion (J-CTO),Percutaneous coronary intervention (PCI).

INTRODUCTION:

Coronary heart disease is the most common cause of death in the world, A round one in five men and one in seven women die from the disease.

Cholesterol plaque can build up in the arteries of the heart and cause ischemia which means the heart is not getting enough blood flow and oxygen. If a plaque blocks an artery, a heart attack can result [(1)] . The age of chronic total occlusion (CTO), the presence of bridging collaterals, and the J-CTO score (Multicenter CTO registry in Japan), among others, have traditionally been considered predictors of PCI failure for CTOs [(2)]. Presence of a total occlusion was the strongest independent predictor of incomplete revascularization after PCI (hazard ratio [HR], 2.70; 95% confidence interval [CI], 1.98-3.67; P<.001) [(3)] .The J-CTO (Japanese - chronic total occlusion score) registry cohort used to

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establish a scoring method for determination of difficulty in guidewire (GW) crossing through CTO lesions. This is a multicenter, prospective, non-randomized registry to which 12 representative Japanese medical centers contributed from April 2006 to November 2007 [4].Coronary CTO is characterized by heavy atherosclerotic plaque burden within the artery, resulting in complete (or nearly complete) occlusion of the vessel. Although the duration of the occlusion is difficult to determine on clinical grounds, a total occlusion must be present for at least 3 months to be considered a true CTO[5].Patients with CTO usually have collateralization of the distal vessel on coronary angiography, but these collaterals may not provide sufficient blood flow to the myocardial bed, resulting in ischemia and anginal symptoms [6, 7]. Independent predictors of failure to cross the lesion within 30 minutes were the presence of calcification, tortuosity in the occluded segment, blunt proximal cap, occlusion length ≥20 mm, and previous failed attempts. One point is recorded for each of the independent predictors present, and the CTO is categorized as easy (J-CTO score 0), intermediate (score 1),difficult (score 2) and very difficult (score ≥3) [8].They decided to give 1 point to each variable to maximize simplicity for clinical use. For each lesion, all applicable score values were summed to obtain a total difficulty score for that lesion (J-CTO score). This rule was then used to categorize the patients into 4 groups with varying likelihood of successful GW crossing within 30 min:

Easy (J-CTO score of 0);
Intermediate (score of 1);
Difficult (score of 2);
Very difficult (score of ≥3).

The probability of successful GW crossing for each group (easy, intermediate, difficult, and very difficult) was 87.7%, 67.1%, 42.2%, and 10.0%, respectively[9,10,11] .

Source: Cardiovascular Interventions. JACC. 2011;4(2).

AIM OF THE STUDY:

The present study aims to evaluate the application of J- CTO score as a model to stratify the complexity and predict success rates in patients with CTO attending Iraqi Center for Heart Disease.

PATIENTS AND METHODS:

Cross sectional observation study which recurrent 100 cases who were enrolled from patients who had appointment for CTO revascularization at Iraqi Center for Heart Disease, Medical City, Baghdad, for the period from the 1st of October,2014 to 1st of May 2015.

All patients who were admitted to the Iraqi Center for Heart Diseases and were diagnosed to have CTO more than 3 months and more duration, regardless their ages and gender during the study period were included in the research. Patients who had one or more of the following were excluded:-

1. Estimated duration of total occlusion less than 3 months.
2. Stent ISR.
3. CTO with undetermined length and CTO of bypass vessels.
4. General contraindication to PCI.

A special form of questionnaire had been constructed by the researcher to comprise the required data. It include the general information comprised demographic characteristics of the studied sample such as: age, gender, as well as smoking habits. It also contains past medical history of the participants.

A brief history and physical examination was achieved to detect important clinical signs, and base line investigation was done ECG, Echo-cardiograph studies and diagnostic coronary angiogram were performed, their angiogram was discussed by experience interventional cardiologist and angiographic data include tapered, presence of calcification, bending > 45 degree, occlusion length and numbers of previous attempt, then we calculated their total J-CTO score.

The questionnaire also include the result of PCI, target vessels, single or multi-vessels were diseased and cause of failure if incomplete revascularization.

The decision to attempt PCI of a CTO (versus continued medical therapy or surgical revascularization) requires an individualized risk/benefit analysis, encompassing clinical, angiographic, and technical considerations. Clinically, the patient's age, symptom severity, associated comorbidities (e.g. diabetes mellitus and chronic renal insufficiency), and overall functional status are major determinants of treatment strategy. The technical probability of achieving successful recanalization of the PCI without complications, as well as the anticipated restenosis rate, must also be strongly factored into the decision making process. Angiographically, the extent and complexity of coronary artery disease should be considered.

The definition of total occlusion is abrupt termination of the epicardial vessel with TIMI flow grade 0 or 1.

The success was label as restoration of TIMI flow grade 2 or 3 without in hospital major adverse cardiac events. The patients received loading dose of 300 mg aspirin, 600 mg of clopidogrel and a bolus dose 5000 _1000 units of unfractionated heparin was given during the procedure.

All the procedures were performed using femoral technique, the antegrade approach was the strategy in all cases. The decision to select catheters type adjudicated by interventionist to get the best support for procedure.

The interventionist applied step up approach using wires of moderately increased stiffness at the beginning with subsequent shift to wires of greater stiffness. The balloon catheters with smallest profile were always used at the initial pre dilatation and stent implantation was performed for all success CTO revascularization with DES.

Statistical Analysis:

The obtained data were processed by applying Statistical Package of Social Sciences (SPSS) impacted program version 19.

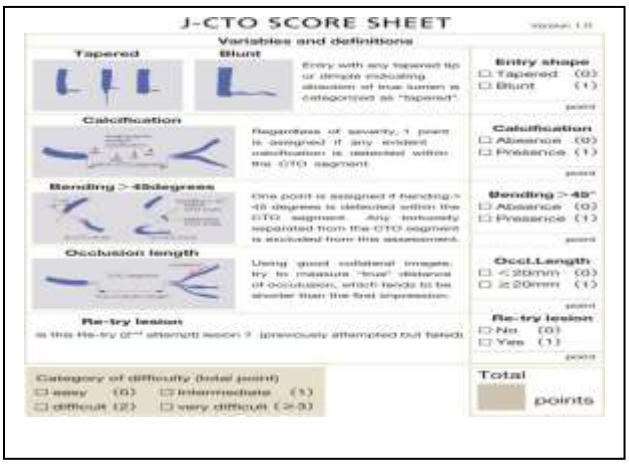

Figure 1: J-CTO score sheet: a calculation sheet for J-CTO (Multicenter CTO Registry of Japan) scoring. Angiographic definitions of each variable are summarized and illustrated. The total score is identified as the "J-CTO score."

RESULT:

The present study included a sample of 100 patients during the study period, 17% were total score zero, 33% were total score 1, 32% were total score 2 and 18% were total score more than 3. The mean age of patients was 58.7±10 years. Mean age of males patients (57.6±10 years) compared with the females' mean age (62.6±8 years).

Male patients represented 78% of the sample while female were 22%.

The present study showed that there were no statistically significant association between the J-CTO score and each of the following:

- The age of the patients (p=0.595)
- Gender (p=0.083)
- Smoking habit(p=0.454)
- Diabetic(p=0.254)
- Hypertension(p=0.323)
- Heart failure (ejection fraction equal or less 40%)(p=0.207)
- and the target vessels (p=0.113).

On other hand, the J-CTO score, had a statistically significant association with :

- normal ECG and ischemic changes(p=0.023).
- number of diseased arteries (p=0.044).
- the result for revascularization (p=0.000).

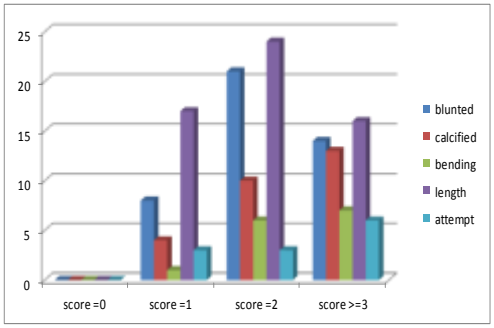

Fig 2: Show each score with their parameters of total score in study sample.

Table 1: The success rate according to total score.

Result	Success		failed		Total	P-value
Total score	No.	Rate	No.	Rate		
Total score = 0	16	94%	1	6%	17	P = 0.000
Total score = 1	30	91%	3	9%	33	
Total score = 2	14	44%	18	56%	32	
Total score >= 3	1	6%	17	94%	18	
Total	61	61%	39	39%	100	

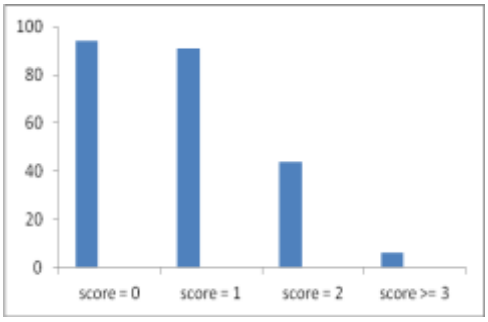

Fig 3: Display the distribution of success rate in different total score.

Table 2: Total score status according to ECG change.

Total score		=0	=1	=2	>=3	Total	P-value
Normal ECG		11(10*)	18(17*)	7(6*)	11(1*)	47(34*)	0.023
Ischemic change		6(6*)	15(13*)	25(8*)	7(0*)	53(27*)	
Ischemic change	Ant. MI	3	8	11	2	24	
	Inf. MI	2	6	9	5	22	
	ST change	1	1	5	0	7	
Total		17(16*)	33(30*)	32(14*)	18(1*)	100(61*)	

* mean patients with success results

Table 3 :Total score status according to number of diseased artery.

Total score	=0	=1	=2	>=3	Total	P -value
Single vessel	12(11*)	21 (20*)	13 (7*)	10 (1*)	56 (39*)	0.044
Two or more vessels	5 (5*)	12(10*)	19 (7*)	8 (0*)	44(22*)	
Total	17(16*)	33 (30*)	32 (14*)	18(1*)	100 (61*)	

* mean patients with success results

Table 4:The success rate with each variable of total score.

Result	Success		Failed		Total	p-value
Total score	No.	Rate	No.	Rate		
Blunted	18	42%	25	58%	43	P=0.001
Tapered	43	75%	14	25%	57	
Calcified	10	37%	17	63%	27	P=0.003
Not calcified	51	70%	22	30%	73	
Bending > 45	3	21%	11	79%	14	P=0.001
Bending < 45	58	67%	28	33%	86	
Length > 20mm	25	44%	32	56%	57	P=0.000
Length < 20mm	36	84%	7	16%	43	
Attempt	4	33%	8	67%	12	P=0.036
No previous attempt	57	65%	31	35%	88	
Total	61	61%	39	39%	100	P=0.000

DISCUSSION:

The present study was designed to assess the role of patients' J- CTO score for assessment of the complexity of PCI and procedural success rate. J-CTO score is being simple, easy to remember, clinically applicable, and used as a analyst to select patients who might be more likely to benefit from cardiac recanalization [12].

Thirty–six percent of the referred cases were at age 55-65 years, this might be due to the fact that the incidence of ischemic heart disease is usually increasing by age [13, 14]. Resting ECG was done for every CTO candidates before PCI. Forty – seven percent (47%) showed normal ECG records and (53%) had ischemic changes and showed a significant association with higher J- CTO score(p=0.023). The success rate for patients had normal ECG was 72% in comparison to the success rate for patients who had ischemic changes in their ECG (51%) and abnormal resting ECG changes show significant association with failure of revascularization (p=0.011), this may be an early predictor for association of ECG with J-CTO score and success rate, this results need further evaluation.

In single diseased vessel the success rate reach to 70% with significant difference (0.04), also this study prove that a significant association between CTO score and number of diseased arteries either single or multivessels (p=0.044). This result agree

with Syrseloudis et al[15] who found that multivessel disease were significant predictors of failure for PCI in CTO lesion.

The fact that J-CTO score is an independent predictor of failure of PCI for CTO and has a good

predictive accuracy as stand-alone risk score was achieved by Giuseppe Ferrante [16] when he assessed the hypothesis that the J-CTO score is a useful risk score for the prediction of procedural failure of PCI for CTO in a different cohort of patients.

Despite being commonly encountered in patients undergoing coronary angiography [17, 18], recanalization of a CTO is attempted in only 10% to 15% of patients undergoing percutaneous coronary intervention [19]. CTO PCI procedures may be lengthy and complex, with elevated radiation exposure, increased contrast load, lower procedural success rate, and a higher risk of complication when compared with non-CTO elective PCI [20, 21]. Moreover, there is uncertainty as to the prognostic impact of percutaneous CTO revascularization so that Percutaneous treatment of chronic total occlusion (CTO) remains a challenge

CONCLUSION:

The J-CTO score is a useful model and easily applicable to stratify the complexity of lesion and for grading lesion difficulty in interventional chronic total occlusion (CTO) treatment.

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