



## EDITORIAL COMMENT

# Do we need a new score in order to perform a contemporary percutaneous coronary intervention of a chronic total occlusion?



## Necessitamos de um novo score para fazer intervenção coronária percutânea a uma oclusão crónica total?

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Percutaneous coronary intervention of chronic total occlusions (CTOs) represents the most technically challenging procedure in contemporary interventional cardiology.<sup>1,2</sup> Although large definitive randomized trials are lacking, a growing body of evidence suggests that successful percutaneous CTO revascularization relieves symptoms, improves left ventricular systolic function, reduces the need for surgical coronary bypass, and in the context of complete coronary revascularization improves survival.<sup>3–5</sup> Yet, compared to patients with severely stenotic, but patent vessels, patients with a CTO are more likely to be referred for coronary bypass surgery or medical therapy, and in a published Canadian registry only one in ten patients with a CTO underwent PCI.<sup>6</sup> Historically the success rate of CTO PCI was in the range of 70%.<sup>6–8</sup> This uncertainty regarding the likelihood of success, mixed with the fear of unacceptably high complication rates and prohibitive procedural costs, contribute to the reluctance to percutaneously revascularize CTOs.

The J-CTO Score (Japanese Multicenter CTO Registry)<sup>9</sup> was originally developed to predict the likelihood of successful guidewire crossing within 30 minutes. Independent angiographic predictors of failure (each given one point) that made up the J-CTO score included prior failed attempt, angiographic evidence of heavy calcification, bending within

the occluded segment, blunt proximal stump, and occlusion length  $\geq 20$  mm.<sup>9</sup> CTOs were then graded as easy, intermediate, difficult and very difficult (JCTO Scores of 0, 1, 2 and  $\geq 3$  respectively). Since then the J-CTO score has been found to predict the overall likelihood of CTO PCI success. High J-CTO scores have been shown to correlate with lesions complexity,<sup>10</sup> and may account for the paradox of stagnant CTO PCI success rate over time, which was due to intervening on increasingly complex CTOs.<sup>11</sup>

In this issue of the *Journal*, Inês Aguiar-Ricardo et al.<sup>12</sup> use a new CTO score, CTo-aBCDE, to identify independent predictors of success in CTO PCI with good accuracy.

Patient selection is essential for procedure success.

This was a single-center observational registry. Demographic and clinical data and anatomical characteristics of coronary lesion were recorded. Linear and logistic regression analysis were used to identify predictors of success. A score to predict success was created and its accuracy was measured by receiver operating curve analysis.

A total of 377 interventions were performed (334 patients, age  $68 \pm 11$  years, 75% male). The success rate was 65% per patient and 60% per procedure.

Predictors of success in univariate analysis were absence of active smoking (OR 2.02, 95% CI 1.243–3.29;  $p=0.005$ ), presence of tapered stump (OR 5.2, 95% CI 2.7–10.2;  $p<0.001$ ), absence of tortuosity (OR 6.44; 95% CI 3.02–13.75;  $p<0.001$ ), absence of bifurcation (OR 1.95; 95% CI 1.08–3.51;

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$p=0.026$ ), absence of calcification (OR 3.1; 95% CI 3.10-5.41;  $p<0.001$ ), LAD as target vessel (OR 1.9, 95% CI 1.0-3.5;  $p=0.048$ ), and CTO length  $<20$  mm (OR 3.00, 95% CI 1.69-5.3;  $p<0.001$ ).

Only anatomical factors were independent predictors of success, and an anatomical score (0-11 points) with high accuracy (area under the curve 0.831) was subsequently created. A score  $<3$  was associated with low probability of success (15%), 3-8 with intermediate probability (55%), and  $>8$  with high probability (95%).

In their sample only anatomical characteristics were predictors of success. The creation of a score to predict success, with good accuracy, may enable selection of cases that can be treated by any operator, those in which a dedicated operator will be desirable, and those with an extremely low probability of success, which should be considered individually for conservative management, surgical revascularization or PCI by a team experienced in CTO.

There are several important considerations that are required before applying the CTo-aBCDE CTO score to contemporary CTO angioplasty, particularly if it will eventually be studied and evolve as a predictor of procedural success. With new technologies and techniques, success rates in expert centers above 90% are possible with adoption of the "Hybrid" approach, with very acceptable complication rates. Therefore the decision to revascularize a CTO is a clinical one, based on symptoms, myocardial viability, and patient preference and should not be based on the ease or difficulty of the case. As such the CTo-aBCDE CTO score is useful by identifying highly complex cases that should be avoided by operators early in their CTO PCI learning curve and rather referred to experience operators or to expert centers.

The study cohort had modest success rate of only 60%, very low percentage of retrograde CTO PCI and of controlled antegrade dissection re-entry.

It is important to note that in the present study, dual injection coronary angiography was performed in only 28.5% of cases. Consequently, the incremental value of angiographic scoring systems that systematically employ dual injection, may be exaggerated due to suboptimal baseline angiography without contralateral coronary injection. Single-catheter angiography provides inadequate information. Dual injection is crucial for determining the lesion length, the size and location of the distal target vessel, evaluating whether there is a significant bifurcation at the distal cap, the presence, size, and tortuosity of collateral vessels and for deciding on the optimal CTO PCI strategy. We recommend performing the dual injection angiogram at the time of the diagnostic procedure once a CTO is identified and strongly discourage ad hoc CTO PCI. This allows for a thorough pre-procedural planning. By implementing the "Hybrid Algorithm" the operator who is familiar with all available CTO PCI techniques (antegrade wire escalation, antegrade dissection and re-entry, and retrograde wire escalation and dissection reentry) can decide on the initial, as well as the alternative strategies, in case the initial approach fails, that will provide the safest, most efficient, and most effective way to re-canalize the CTO in a single procedure.

In 2014 a new benchmark for CTO success rates of above 90% has been established. Anatomy dictates how and who

should perform the CTO PCI, not whether the CTO PCI should be attempted. Similarly, lesion complexity no longer dictates the feasibility of CTO PCI, but the strategy for successful CTO revascularization.

Scoring systems can be useful in several ways. First, they provide a quantitative measure of the likelihood of success and complications that can be shared with the patient and help with clinical decision-making. Second, by providing the means for more objective assessment of anatomic and clinical complexity, CTO scores enable better case selection: while seasoned operators can tackle even the toughest of cases with high success rates,<sup>12</sup> operators early in the CTO PCI learning curve can select "simpler" cases, referring the more unfavorable cases to specialized centers, or performing them with the guidance of a proctor. Within the heart team, the decision to revascularize and the optimal strategy can be tailored to each patient, taking into account the objective probability of achieving technical/angiographic success with PCI. Third, CTO scores provide a valuable template for guiding review of the coronary angiogram. At least 15 minutes of careful review and evaluation are essential to understand the lesion and develop a "plan of attack" (primary retrograde vs. antegrade approach, intimal or sub-intimal and wire or crossing device based strategies). Fourth, standardized classification of CTO lesion complexity allows comparison of outcomes with different approaches, between operators, centers, countries and even continents, for both quality improvement and clinical research.

CTO PCI scoring systems can be a tremendous resource for both the novice and experienced CTO operator, to aid with case and approach selection as well as to predict procedural efficiency and the probability for success and even complications. The creation of new scores to suit different CTO practices, and the validation of already existing scoring systems should be encouraged.

## Conflicts of interest

The author has no conflicts of interest to declare.

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