

## Contemporary Techniques for Coronary Chronic Total Occlusions Revascularisation: Sharing Experience in a Global World

Proceedings of a satellite symposium held at EuroPCR on May 20th – 23rd 2014 in Paris

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### Abstract

Chronic total occlusions (CTO) are the most challenging lesions treated by interventional cardiologists. A symposium at EuroPCR 2014 discussed factors influencing the success of percutaneous intervention (PCI) in CTO. Current treatment paradigms suggest that one or two vessel disease should be treated by PCI while three-vessel disease requires surgery if complete revascularisation cannot be achieved with PCI. In patients with CTO and multi-vessel disease timing is key, and evidence of ischaemic burden and expected completeness of revascularisation is required before PCI is undertaken. Other factors affecting procedural success include the available equipment and expertise of the operator. Flexibility in strategy selection is also important as it is frequently necessary to switch strategies during the procedure. The presentation included two live cases that illustrated the complexity of this procedure.

### Keywords

Coronary artery disease, chronic total occlusion, percutaneous intervention

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## Introduction and Objectives

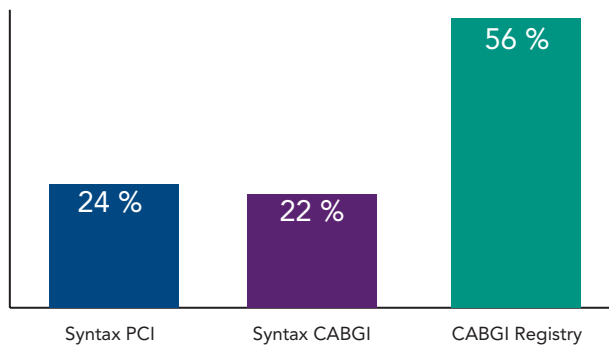
A symposium, chaired by Dr Heinz Joachim Büttner of Freiburg-Bad Krozingen (Germany) and Dr Masahisa Yamane of St Luke's International Hospital (Tokyo, Japan) took place at EuroPCR, Paris on May 23rd, 2014. Its objectives were as follows: to learn how to improve the success of percutaneous intervention (PCI) in chronic total occlusion (CTO) by matching techniques to anatomical and clinical characteristics; to improve procedural skills in CTO and complex PCI by sharing experience with established operators during transmitted live cases; to understand why bioabsorbable polymer or polymer-free sirolimus-eluting stents can improve long-term benefit in patients undergoing complex and CTO PCI and how to use imaging modalities to facilitate CTO recanalisation.

Chronic total occlusions remain the most challenging lesions treated by interventional cardiologists. Approximately 30 % of all coronary angiograms in patients with coronary artery disease (CAD) show a CTO.<sup>1</sup> These represent around 24 % of the patient population treated by PCI and 22 % of those treated by coronary artery bypass graft (CABG) according to the Synergy between PCI with Taxus™ and

cardiac surgery (SYNTAX) study. The majority of patients with CTO (56 %) are denied PCI and sent to surgery (see *Figure 1*).<sup>2</sup> Successful recanalisation of a CTO is a strong independent predictor for reduced long-term mortality in patients with three vessel disease (3VD) but not with 1+2VD.<sup>3</sup> In patients with multi-vessel disease and ST-elevation myocardial infarction (STEMI) undergoing primary PCI in the Harmonising outcomes with revascularisation and stents in acute myocardial infarction (HORIZONS-AMI) trial, a CTO in a non-infarct-related artery was an independent predictor of early mortality. The presence of a CTO in a non-IRA was also an independent predictor of increased late mortality up to three years.<sup>4</sup> A meta-analysis of randomised clinical trials and observational studies suggested that complete revascularisation is the optimal strategy in both CABG and PCI in patients with multi-vessel disease.<sup>5</sup>

Despite the improving success rates of PCI in CTO, they are still inferior compared to non-occlusive CAD. There is a great diversity in the complexity of the CTO lesion and the J-CTO (Multicenter CTO Registry of Japan) score has been developed as a model to stratify

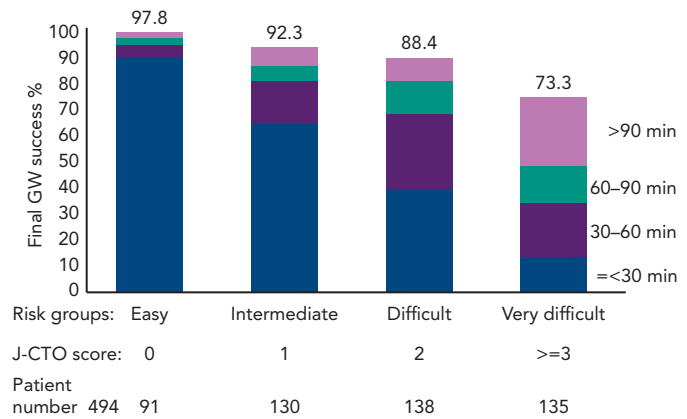
Figure 1: The SYNTAX study – Proportion of Chronic Total Occlusions in Patients Selected for Percutaneous Intervention of Coronary Artery Bypass Graft



PCI = Percutaneous Intervention; CABGI = coronary artery bypass graft. Source: Serruys, 2009.<sup>2</sup>

the complexity and predict expected success rates. According to that model there are four difficulty groups: easy (J-CTO score of 0), intermediate (score of 1), difficult (score of 2) and very difficult (score of  $\geq 3$ ), (see Figure 2).<sup>6</sup> Score points were determined by assigning one point in the presence and zero in the absence of each of the following angiographic characteristics: calcification, intra CTO bending, blunt stump, occlusion length  $>20$  mm and a previously failed lesion. Guidewire manipulation time and success rates for different J-CTO scores are shown in Figure 2.

Figure 2: Guidewire Manipulation Time and Success Rates for Different Multicenter CTO Registry of Japan Scores



J-CTO = Multicenter CTO Registry of Japan; GW = Guidewire. Source: Morino, 2011.<sup>6</sup>

Recanalisation techniques include the antegrade (single wire, parallel wire, intravascular ultrasound [IVUS] navigated, and their variations), the retrograde that require collateral crossing, CTO entering, wire (re)entry beyond CTO via reverse CART (controlled antegrade and retrograde tracking (CART), direct wire crossing kissing wire and their variations, and the dissection re-entry techniques that they can be used both antegrade and retrograde. ■

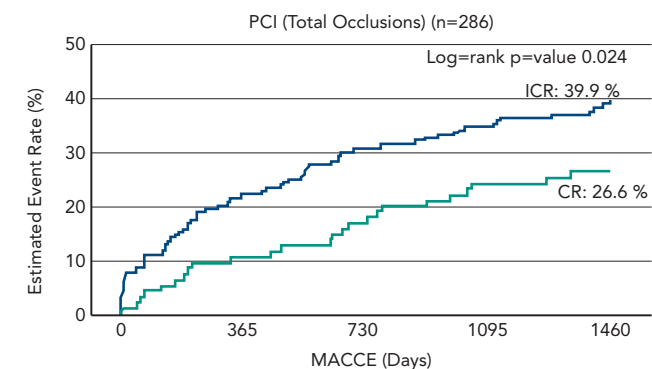
## Adequate Patient Selection is Key to Ensure Success and Benefit of Coronary CTO PCI

Dr Gerald Werner from the Darmstadt Hospital (Germany) discussed the importance of patient selection in the PCI of coronary CTOs. Several questions should be addressed in the assessment of whether a patient with CTO will benefit from PCI. Is the patient symptomatic in terms of angina, dyspnoea or exercise limitation? Is there evidence of a prior MI? According to the EuroCTO club consensus document, recanalization of CTOs is indicated in symptomatic patients that have no history of previous MI. In case of previous MI viability should be documented in the area provided by the occluded artery and the myocardium at risk should be more than 10%.<sup>7</sup>

In terms of predicting patient benefit, the Euro CTO recommendations state that we should treat patients with CTO as any other CAD patients, provided the operator is experienced enough and that that the expected success rates are in the range of 80%. In a meta-analysis of CTO recanalisation, successful attempts were associated with symptomatic relief.<sup>8</sup> Ischaemic burden is also reduced following PCI of CTO, and the decrease is greater at higher ischaemic burden. Conversely, in patients with a lower ischaemic burden, the treatment benefit was less considering the presence of potential complications and treatment costs related to the procedures.<sup>9</sup> It has been suggested that in the setting of CTO, we should select patients for PCI with ischaemic burden  $>10$  % of myocardium, to achieve certain benefit.<sup>9</sup> Individual patient data should be always taken into account.

In multi-vessel disease and CTO, it is necessary to determine which lesion causes the symptoms, and also to obtain evidence of ischaemic burden and expected completeness of revascularisation. In the SYNTAX trial incomplete revascularisation is associated with an increased rate

Figure 3: MACCE Event Rate in Complete (CR) and Incomplete Revascularisation (ICR) of CTO



MACCE = major cardiac and cerebrovascular events. Source: Farooq, 2013.

of major cardiac and cerebrovascular events (MACCE, see Figure 3) and the presence of CTOs is an important contributor to the incomplete revascularisation.<sup>10</sup> The residual SYNTAX score is an angiographic tool that can quantitate the level of the completeness of revascularisation. A residual SYNTAX Score exceeding eight was associated with high mortality (35.3 % all-cause mortality at five-years,  $p<0.001$ ).<sup>11</sup>

Current treatment paradigms suggest that one or two vessel disease favours PCI while three-vessel disease requires surgery if complete revascularisation cannot be achieved with PCI. So, what if we can achieve complete revascularisation? This needs to be built into the guidelines. The strategy of the EuroCTO club in multi-vessel disease with CTO, is a staged procedure for non-CTO first, with the goal of complete revascularisation. ■

## Ensuring Procedural Safety and Good Long-term Results in Complex PCI Procedures

Dr Nicolaus Reifart from Frankfurt, Germany, gave a presentation focussing on CTO and complex PCI procedures. Before undertaking PCI, all risks need to be addressed, and other options such as optimal medical therapy should be considered. Case selection should also be tailored to level of experience of the operator. Dr Reifart suggested that a level C operator is one who has undertaken less than 500 PCIs and should only undertake PCI of simple lesions and simple bifurcations. A level B operator has undertaken 500–1000 PCIs and can therefore attempt more complex procedures such as complex bifurcations, moderate calcified lesions and some cases of CTO. Only a level A operator, i.e. one who has performed more than 1000 PCIs, including 300 CTO, might undertake complex cases such as long and highly calcified lesions and complex CTOs including retrograde. If a level C operator attempts a level A task, he/she is less likely to be successful and may cause harm to the patient.

Other considerations for procedural safety are the use of premedication and the amount of contrast used. The volume of dye used in a PCI procedure should not exceed 4–6 x the glomerular filtration rate (GFR). In terms of procedural time, completion within 60 min in 90 % of cases is expected. It is important to prepare for complications such as pericardial effusion. Finally, stent selection is important; the operator must decide which stent type and size is appropriate for the patient and the lesion. Contemporary DES should be considered for all CTO procedures.

### Live Case from Instituto Cardiovascular/ Hospital Clínico San Carlos – Madrid, Spain Case 1: RCA CTO in multi-vessel disease. Operators: George Sianos, Antonio Fernandez-Ortiz

A case was presented of a 78 year-old man with hypertension, effort angina over the last month and resting chest pain. He had a severe calcified lesion in the proximal left anterior descending artery (LAD)

and total occlusion of the right coronary artery (RCA). His SYNTAX score was 30. The LAD was treated first and the RCA was deferred for a second procedure performed life during the meeting.

A PCI procedure of the RCA was undertaken, with the aim of implanting the Coracto™ sirolimus-eluting stent with biodegradable polymer. The right femoral access approach was taken using a 7 Fr guiding catheter for the donor artery and the right radial artery using a 6 Fr guiding catheter for the occluded artery. The CTO length was 10-15 mm with presence of some calcification. A procedural plan was presented: if one approach failed the next would be tried. An antegrade approach was initially used, with a plan to shift to retrograde if needed. During the procedure, the antegrade wire entered the subintimal space, and the wire could not cross to the distal true lumen, necessitating the retrograde approach to achieve final success. Two Coracto™ sirolimus eluting stents were successfully implanted with a very good final result.

### Live case from Instituto Cardiovascular / Hospital Clínico San Carlos - Madrid, Spain Case 2: LAD CTO in single-vessel disease. Operators: Javier Escaned, Luis Nombela-Franco

This case was a 63 year-old man with a single-vessel CTO. The coronary angiogram showed occlusion of the LAD at a bifurcation of a large first diagonal branch.

A PCI procedure of the LAD was undertaken, with the aim of implanting the Cre8 amphilimus polymer free eluting stent. The procedure started with the use of IVUS to guide the puncture of the proximal cup with contemporary CTO guidewires. The procedure was not conceded during dedicated transmission time and continued further, but later had to be abandoned for a second attempt in the future. ■

## Take-home Message

Dr Yamane concluded the session by emphasising the key messages. Patients with CTO and significant ischemia are at risk of MACE and have a clear indication for PCI. In terms of CTO and multi-vessel disease, timing is important, and much depends on whether complete revascularization can be achieved, the available equipment and expertise of the operator. It is important to be strict in terms of activated clotting time (ACT) monitoring and to be flexible

in strategy selection; it is frequently necessary to switch strategies during the procedure. Safety and long-term outcomes should always be the priority in any procedure. In terms of stent selection, once the vessel is open in a CTO, it is essential to use thin-strut biodegradable polymer or polymer free drug-eluting stents (DES) that exert low-restenosis rates, as restenosis rates are still high in CTO patients. ■

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