Heart, Lung and Circulation (2019) **28,** 1452–1453
1443-9506/04/$36.00
https://doi.org/10.1016/j.hlc.2019.08.003

EDITORIAL

Considerations for Treating Patients With Chronic Total Occlusion of Coronary Arteries

James J.H. Chong, MBBS, PhD, FRACP [a,b,c*], **Sujitha Thavapalachandran, MBBS, FRACP** [a,b,c], **Andrew T.L. Ong, MBBS, PhD, FRACP** [b,c]

[a]Centre for Heart Research, Westmead Institute for Medical Research, Sydney, NSW, Australia
[b]Department of Cardiology, Westmead Hospital, Sydney, NSW, Australia
[c]Sydney Medical School, University of Sydney, Sydney, NSW, Australia

Chronic total occlusion (CTO) of a major epicardial coronary artery is a common finding, reported in some series as occurring in up to 20% of patients with coronary disease undergoing coronary angiography [1]. With rates potentially being this high, it is disappointing that it remains unknown whether CTOs have similar benefit from percutaneous coronary intervention (PCI) to non-CTO coronary lesions. This is largely because CTO patients were previously excluded from most revascularisation trials [2]. Historically, it would have been common not to consider PCI [3] and this would have been justified by the limited evidence-based data available, low success rate, lack of well-defined approach and prolonged procedure time. However, the clinical landscape has now changed. With new interventional advances, especially with guidewires, microcatheters and new techniques, there has been an ever increasing interest in attempting to open chronically occluded epicardial coronary arteries and this has been accompanied by increased procedural success rates [4,5].

However, such patients often present a clinical dilemma. Factors which are paramount to the decision whether to intervene include: i) will opening the chronically occluded artery improve prognosis? ii) Is it procedurally possible to reopen the occluded vessel? and, iii) are the risks of a more complex interventional procedure outweighed by the potential gains?

In this issue of *Heart, Lung and Circulation*, three review articles address these questions. These articles are a result of the ANZCTO meeting held in June 2018 at Liverpool Hospital, Sydney when over 150 delegates congregated over live cases and seminars sharing knowledge and advances in CTO management.

Will Opening the Chronically Occluded Artery Impact Prognosis?

Allahwala et al. [6] provide a constructive critique of current observational and randomised studies assessing the efficacy of CTO PCI. This provides us a clear perspective of the established evidence-base for what is still referred to as the "final frontier" in PCI. A number of clinical benefits with CTO revascularisation in non-randomised observational studies are discussed, including reduction in mortality, improved left ventricular ejection fraction, reduced ischaemia burden and improved anginal symptoms. However, the authors acknowledge that the lack of randomisation in many studies prevents any definitive conclusions being made. To add to the perplexity, where there have been randomised CTO PCI trials (EXPLORE, DECISION-CTO and EURO-CTO), the results appear to contradict. This may only increase the confusion around which patients would benefit from PCI. The authors of this review, published in this issue, outline the possible reasons for the contrasting results. They conclude that, given the current paucity of randomised data, CTO PCI should be reserved for symptom alleviation rather than prognostic benefit except in the setting of extensive ischaemia.

https://doi.org/10.1016/j.hlc.2019.03.014, https://doi.org/10.1016/j.hlc.2019.04.004, https://doi.org/10.1016/j.hlc.2019.05.004
*Corresponding author at: Department of Cardiology, Westmead Hospital, Westmead Institute for Medical Research, 176 Hawkesbury Road, Westmead, Sydney, NSW, 2145, Australia. Tel. 61-2-98456795, fax: 61-2-94755155., Email: james.chong@sydney.edu.au
© 2019 Published by Elsevier B.V. on behalf of Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) and the Cardiac Society of Australia and New Zealand (CSANZ).

Is it Possible to Re-Open the Occluded Artery?

For the interventionalist, low procedural success and high complication rates may be underpinned by a lack of experience. In this regard, resources for sharing knowledge are very important. In this issue, Wu et al. [7] give an excellent ''how to'' guide filled with tips for interventional cardiologists with lesser experience in CTO PCI. The authors discuss the technical aspects of antegrade and retrograde wiring approaches. Proximal cap puncture, CTO body traversing, distal cap exit, retrograde CTO body wiring and reverse controlled antegrade and retrograde subintimal tracking are all covered. The assembly of important practical CTO wiring strategies and case examples in this state-of-the-art review by the Asia Pacific CTO Club is excellent reading for the beginner CTO operator to systemically improve their technical skill and consequently better their procedural and clinical success rates.

Are the Risks of a More Complex Interventional Procedure Outweighed by Potential Gains?

Chronic total occlusion PCI clearly comes with higher procedural risk than non-CTO PCI due to higher lesion and technical complexity [8]. However, risks are also increased for the proceduralist and the catheter laboratory staff. The increasing procedural complexity of CTO PCI leads to a significant increase in radiation exposure [9]. Consequently, intensifying efforts to reduce radiation exposure for both patient and operator is paramount. Ison et al. [10] highlight the evidence for potential dangers of radiation exposure including cataracts in interventionalists. They emphasise the importance of real-time intraprocedural dose monitoring, radiation dose minimisation strategies (maximise protective shielding, limit fluoroscopy, avoid magnification, use of collimation and filters), up-to-date imaging systems and ongoing staff education for radiation dose management. For the patient, radiation-induced skin injury, albeit an infrequent complication is often neglected due to delayed presentation following radiation exposure. The authors suggest routine follow-up of patients and quality assurance for high dose procedures. Finally, Ison et al. remind us that, "the focus within the cardiac catheter laboratory must be the balance between imaging quality and radiation dose; the aim being to perform a diagnostic and successful procedure, whilst minimising the dose to the patient and the proceduralist".

Conclusions

With new technological advances in CTO PCI, we now have an unprecedented opportunity to treat patients with CTO. With conflicting evidence in tackling CTOs, these decisions need to be tailored towards individual patients on a case-by-case basis. These decisions should take into account patient factors (including other options such as maximal pharmacotherapy or coronary bypass surgery) and institution/operator experience with CTO PCI. The three review manuscripts in this issue of *Heart, Lung and Circulation* will help general and interventional cardiologist readers understand the evidence-base for CTO PCI, improve the technical skills of CTO operators as well as increase awareness of radiation safety.

References

[1] Fefer P, Knudtson ML, Cheema AN, Galbraith PD, Osherov AB, Yalonetsky S, et al. Current perspectives on coronary chronic total occlusions: the Canadian Multicenter Chronic Total Occlusions Registry. J Am Coll Cardiol 2012;59:991–7.

[2] Strauss BH, Shuvy M, Wijeysundera HC. Revascularization of chronic total occlusions. J Am Coll Cardiol 2014;64:1281–9.

[3] Hochman JS, Lamas GA, Buller CE, Dzavik V, Reynolds HR, Abramsky SJ, et al. Coronary intervention for persistent occlusion after myocardial infarction. N Engl J Med 2006;355:2395–407.

[4] Tajti P, Burke MN, Karmpaliotis D, Alaswad K, Werner GS, Azzalini L, et al. Update in the percutaneous management of coronary chronic total occlusions. JACC Cardiovasc Interv 2018;11:615–25.

[5] Patel VG, Brayton KM, Tamayo A, Mogabgab O, Michael TT, Lo N, et al. Angiographic success and procedural complications in patients undergoing percutaneous coronary chronic total occlusion interventions. JACC Cardiovasc Interv 2013;6:128–36.

[6] Allahwala UK, Ward MR, Brieger D, Weaver JC, Bhindi R. Indications for Percutaneous Coronary Intervention (PCI) in Chronic Total Occlusion (CTO): have we reached a DECISION or do we continue to EXPLORE After EURO-CTO? Heart Lung Circ 2019;28:1484–9.

[7] Wu EB, Tsuchikane E, Lo S, Lim ST, Ge L, Chen J-Y, et al. Chronic total occlusion wiring: a state-of-the-art guide from the Asia Pacific chronic total occlusion club. Heart Lung Circ 2019;28:1490–500.

[8] Brilakis ES, Banerjee S, Karmpaliotis D, Lombardi WL, Tsai TT, Shunk KA, et al. Procedural outcomes of chronic total occlusion percutaneous coronary intervention. JACC Cardiovasc Interv 2015;8:245–53.

[9] Suzuki S, Furui S, Kohtake H, Yokoyama N, Kozuma K, Yamamoto Y, et al. Radiation exposure to patient's skin during percutaneous coronary intervention for various lesions, including chronic total occlusion. Circ J 2006;70:44–8.

[10] Ison GR, Allahwala U, Weaver JC. Radiation management in coronary angiography: percutaneous coronary intervention for chronic total occlusion at the frontier. Heart Lung Circ 2019;28:1501–9.