Usefulness of Intraprocedural Coronary Computed Tomographic Angiography During Intervention for Chronic Total Coronary Occlusion

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Although intraprocedural coronary computed tomographic angiography (CCTA) allows for scanning during intervention without relocation of the patient, studies have yet to report on its use during chronic total occlusion (CTO) intervention. Therefore, we investigated the role of CCTA during CTO intervention, particularly whether CCTA could be used to evaluate the location of guidewires. A total of 61 patients scheduled for elective CTO intervention were consecutively enrolled and underwent CCTA and on-site analyses during intervention. Transverse axial and the curved multiplanar images in a 360-degree view were interactively used together to identify the location of guidewires, along with the adjustment of window condition. Intracoronary contrast injection was used for specific cases requiring enhancement of the distal part of the CTO. Most CCTAs were performed to confirm the location of a single guidewire; CCTA was also performed to evaluate parallel (3 patients) or retrograde wires (5 patients). The initial identification rate for guidewire location was 56% with immediate transaxial images, but it significantly increased to 87% after interactive on-site uses of the curved multiplanar images ($p < 0.001$). Cases in which guidewire location could be predicted with CCTA evaluation show a numerically higher success rate than those that could not (83% vs 63%) but not statistical significance ($p = 0.174$). The mean time for CCTA evaluation and mean radiation dose were 8.6 minutes and 2.9 mSv, respectively. No specific complications occurred after CCTA and CTO procedures. Intraprocedural CCTA for identifying the location of the guidewires is feasible and safe when used for various CTO procedural steps. **(Am J Cardiol 2016;117:1868−1876)**

Guidewire crossing is the key to successful chronic total occlusion (CTO) recanalization.[1−4] The use of intraprocedural imaging devices (e.g., intravascular ultrasound) is helpful, but CTO lesions can be fully evaluated only after guidewire and imaging catheter crossing through the CTO.[3−6] Moreover, the tip of a guidewire cannot be evaluated under side mirroring systems equipped with current imaging devices. We built a coronary computed tomographic angiography (CCTA) system in the catheterization room (Yonsei University College of Medicine, Seoul, Korea) that allows for CCTA and coronary angiogram to be performed without taking patients off the table at any time during the intervention.[7] Although preprocedural CCTA is helpful for CTO intervention, no data exist regarding the use of intraprocedural CCTA during CTO procedures.[1,8,9] We investigated the role of intraprocedural CCTA during CTO intervention, with emphasis on whether CCTA could be used to evaluate the location and path of the CTO guidewires.

Methods

A prospective single-center design was used for this study. From January 2014 to December 2014, patients scheduled for CTO intervention who had no specific contraindications for intraprocedural CT scanning were consecutively enrolled. CTO was defined as obstruction of a native coronary artery with Thrombolysis In Myocardial Infarction flow grade 0 and an estimated duration $\geq$3 months based on the clinical history or previous coronary angiography results.[4,6] All patients had typical chest pain or positive stress test results in various functional studies. According to Japan−Chronic Total Occlusion score, CTO lesions were classified as easy (score = 0), intermediate (score = 1), difficult (score = 2), and very difficult (score $\geq$3).[10] The Institutional Review Board of the

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See page 1875 for disclosure information.

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Figure 1. CCTA system. CCTA system consisting of a CT scanner *(A)* moving forward and backward on a railroad system and a coronary angiography system *(B)* moving left and right *(A)*. For an intraprocedural CCTA, the coronary angiogram system moves backward and then the CT scanner moves forward *(B* and *C)*. MSCT = multislice CT.

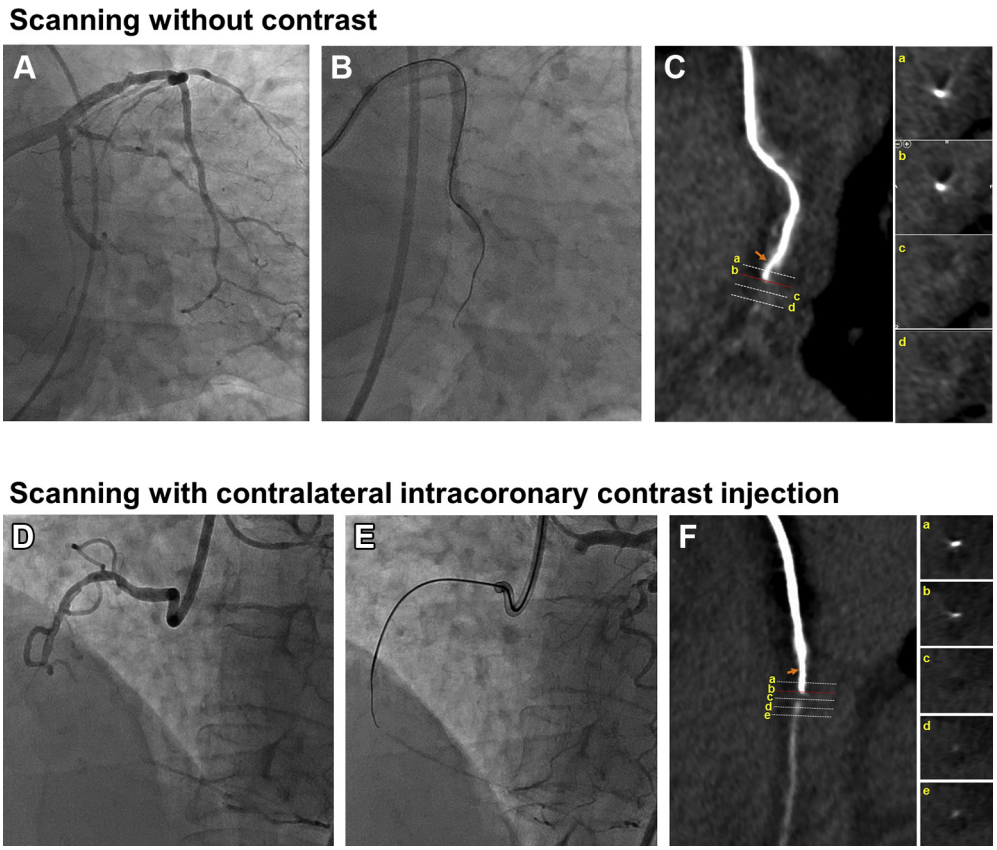

Figure 2. Comparison of CCTA images with or without intracoronary contrast injection. When CCTA evaluation was performed without contrast injection *(A* to *C)*, the determination of the vascular contour was difficult at the location crossing the guidewire tip level (b to d in *C*). Using intracoronary contrast injection *(D* to *F)*, the distal portion of the guidewire tip was enhanced by contrast filling of collateral channels. The course of the artery was then clearly visible and the guidewire tip location was more easily recognizable (b to d in *F*). Preprocedural angiographic findings *(A* and *D)*; angiogram indicating the guidewire location, before CCTA *(B* and *E)*; C-MPR images *(C* and *F)* and the matched cross-sectional images (a to e). The *red broken line* and *orange arrow* indicate the wire-tip level and guidewire, respectively.

Yonsei University College of Medicine approved this study. Each enrolled patient received a detailed explanation of the study and provided written informed consent to participate.

We recently reported the first CTO case using the CCTA system.[7] The CCTA system comprises a 640 multislice CT scanner applying double-slice technology (Aquilion ONE; Toshiba Medical Systems, Otawara, Japan) and a coronary angiography system and allows for scanning to be performed during intervention without moving the patient on the table (Figure 1). The CT system has a wide detector width of 16 cm, which allows for a full cardiac CT data set to be acquired within a single heartbeat. In the present study, CT scan was performed using a cranial-to-caudal acquisition with prospective electrocardiogram gating using the following parameters: collimation and slice thickness, 0.5 mm; reconstruction increment, 0.5 mm; tube rotation time, 0.275 seconds; tube voltage, 100 kV(p); current, dose modulation; and reconstruction field of view, 180 mm. The