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Influence about the flow of distal branch after intervention of the right coronary artery chronic total occlusion

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ABSTRACT

Objective: Limited data are available for the clinical outcomes after the recanalization of right coronary artery (RCA) chronic total occlusion (CTO). The study aims to assess the clinical outcomes in the antegrade flow of the distal branch after successful RCA CTO percutaneous coronary intervention (PCI).

Methods: Between January 2002 and December 2012, 538 patients who underwent RCA CTO PCI were enrolled. The clinical outcomes as myocardial infarction (MI), target vessel revascularization, cardiac death, major adverse cardiac events, and all-cause mortality, were compared to the antegrade flow of distal branch after successful RCA CTO PCI.

Results: The CTOs were located in proximal segments (57.6%), mid segments (27.5%) and distal segments (14.9%). The average Syntax score was 18.4 ± 9.6 and 47.8% patients had a Syntax score greater than 27.5. A total of 62.8% patients had final thrombolysis of myocardial infarction (TIMI)-3 flow of distal branch, 16.9% patients had final TIMI-3 flow of only one major branch, 11.3% patients had TIMI-1-2 flow, and 8.9% patients had no antegrade flow. The incidence of periprocedural MI was lower in both side branches were preserved (13.9% vs. 23.0% and 18.8%, $p = 0.01$). The clinical outcomes were similar between the groups with and without good antegrade flow of distal side branch. End stage renal disease (ESRD) and left ventricular ejection fraction (LVEF) <40% predicted three-year cardiac death.

Conclusions: There is no significant difference of clinical outcomes when distal side branches of RCA are recanalized successfully. ESRD and LVEF <40% were the predictors for three-year cardiac death.

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1. Introduction

Percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) has become one of the most challenging procedures for interventional cardiologists in the recent era. The successful recanalization of CTO in patients with viable myocardium decreases the need for bypass surgery, reduces anginal symptoms, and associated with improved long-term survival [1–4]. PCI devices and techniques for CTO have improved in the current era [5], and multiple pilot studies have reported excellent outcomes, especially with the use of drug-eluting stents and newly developed technique and devices [4–18]. Our study compared the clinical outcomes between differently final antegrade TIMI flow after recanalization of RCA CTO PCI.

The differences between the treatment of CTOs in the three major coronary arteries have been compared in recent studies [19]. CTOs in the RCA have angiographic characteristics that include significantly longer lesion length, increased angulation degree, more calcification and bridging collaterals, and relatively lower success rates [19]. Another multicenter CTO PCI registry showed that the LCX was the least common target vessel and had a lower procedural success rate than lesions in the RCA and LAD [20]. Long-term survivals after CTO PCI also have been analyzed based on the artery treated, and two pilot studies revealed that successful LAD CTO PCI and LCX CTO PCI both had survival benefits [21,22].

RCA CTO PCIs accounted for an estimated 30–50% of CTO PCI attempts in previous studies [19–21]. The specific angiographic characteristic of the two major downstream side branches, the posterior descending artery (PDA) and the posterolateral branch (PLB), makes successful RCA CTO PCI more challenging. We are not aware of reported data that examine the patency of both PDA and PLB after successful RCA CTO PCI. The study aims to assess the clinical outcomes in the antegrade flow of the distal branch after successful RCA CTO PCI.

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2. Methods

2.1. Patient enrollment and exclusion criteria

This retrospective study protocol was approved by the Institutional Review Board of Kaohsiung Chang Gung Memorial Hospital in Taiwan. CTO was defined as TIMI grade 0 flow for more than 3 months, with the presence of typical angina or reversible myocardial ischemia on a thallium stress study. During the period from January 2002 to December 2012, a total of 1688 CTO lesions received PCI: 36.0% were at RCA, PDA, and PLB; 0.7% were at left main; 45.7% were at LAD, diagonal branch; and 17.5% were at LCX and OM branch. A total of 538 consecutive patients who underwent PCI for RCA CTO of a native coronary artery were reviewed coronary angiography and charts.

Three groups were classified by the post-recanalization antegrade TIMI flow (Fig. 1). Group A included the patients with both PDA and PLB TIMI-3 flow after PCI. Group B1 included the patients with only PDA or PLB TIMI-3 flow after PCI. Group B2 included the patients with both PDA and PLB TIMI-1–2 flow with or without collaterals. Group D included the patients with both PDA and PLB no flow with or without collaterals. Group A and group B1 was defined as successful groups, and group B2 and group C was defined as failure groups. The baseline demographics, angiographic characteristics, and procedural outcomes were compared between good antegrade flow of distal branches (group A) and only one or no good antegrade flow of distal branches (group B1 and group B2).

2.2. Definitions

The duration of occlusion was estimated by a history of angina, a history of myocardial infarction (MI) in the same territory, or previous angiography. The characteristics of each CTO lesion were defined according to the Syntax score and J-CTO score based on the complexity of the coronary artery disease. CTO lesion length was measured with three methods: from the proximal occlusion to the distal retrograde filling from contralateral collaterals, using a dual injection technique; from the start of the filling of the bridging collaterals to the distal vessel reconstruction; or from the length of the lesion visible after the guidewire crossing. The retrograde approach was defined as the introduction of the guide-wire into the collateral channels (CCs), which were connected to the target CTO vessel distal to the lesion. Retrograde success was

achieved when the retrograde guide-wire successfully entered the distal portion of the CTO segment. Angiographic success was defined as a residual stenosis $\leq 30\%$ by visual analysis in the presence of grade TIMI 3 flow. In addition, the distal wire position was documented to be in the true lumen by either a coronary angiogram or intravascular ultrasound (IVUS) examination.

MACE was defined as MI, TVR, and cardiac death.

2.3. Coronary angiogram, IVUS, Syntax score, and J-CTO score interpretation

All coronary angiograms and IVUS were independently interpreted by a cardiologist who was blinded to the procedure. The Syntax scores and J-CTO scores were sent to a blinded and independent core angiographic laboratory for analysis.

2.4. Medications and other interventional materials

Each patient was pretreated with aspirin and clopidogrel and received weight-adjusted heparin dosing to keep the activated clotting time (ACT) more than 250 s each hour. The guide-wires used included Ultimate Bros 3 g (Asahi, Japan), Miracle 3 g (Asahi, Japan), Miracle 6 g (Asahi, Japan), Miracle 9 g (Asahi, Japan), Conquest (Asahi, Japan), Conquest Pro (Asahi, Japan), and Gaia-1, 2, 3 (Asahi, Japan) called stiff-wires. The microcatheters included Transit catheters (Cordis, USA), Finecross catheters (Terumo, Japan), Corsair catheters (Asahi, Japan), and the Ryuji over-the-wire balloon (Terumo, Japan). The re-entry devices for antegrade dissection reentry (ADR) technique such as stingray balloon and wire were not available in our study.

2.5. One-year and three-year clinical outcome endpoints

The primary endpoints of MI, TVR, cardiac death, MACE and all-cause mortality were compared in the patients with or without a good antegrade flow of distal branches. All of the events were identified according to the Academic Research Consortium definitions [23].

2.6. Statistical analysis

Study variables were reported as the mean \pm standard deviation for continuous variables and as percentages for categorical variables. The

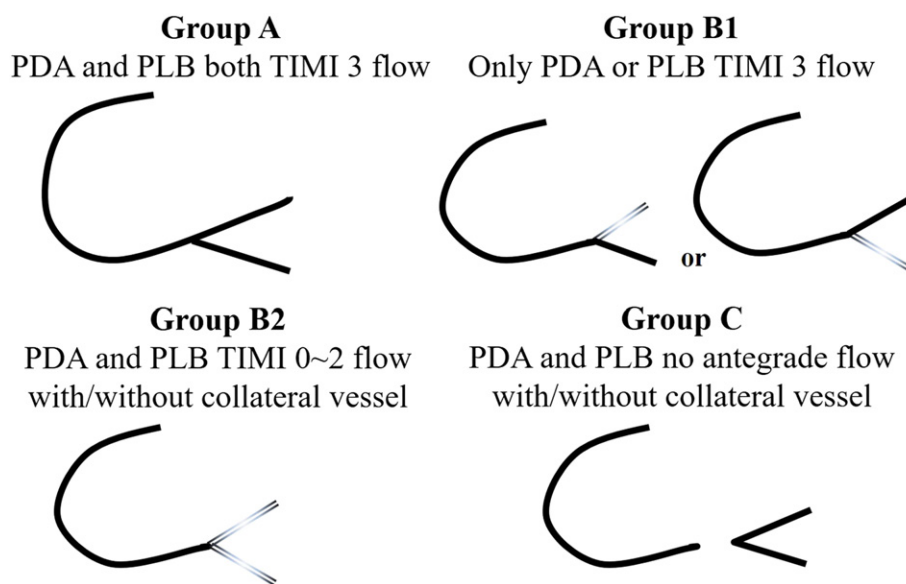


Fig. 1. Four groups were classified by the post-recanalization antegrade TIMI flow. Group A included the patients with both PDA and PLB TIMI-3 flow after PCI. Group B1 included the patients with only PDA or PLB TIMI-3 flow after PCI. Group B2 included the patients with both PDA and PLB TIMI-1 ~ 2 flow with or without collaterals. Group C included the patients with both PDA and PLB no flow with or without collaterals.

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