Implantation of a cardiac resynchronization therapy device using the anchor balloon technique in a patient with a tortuous coronary sinus branch

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Introduction
Cardiac resynchronization results in significant clinical improvement in patients with moderate-to-severe heart failure and an intraventricular conduction delay. However, the ability to place stable pacing leads in the coronary sinus tributaries for left ventricular (LV) pacing remains a major limiting factor. The implanting electrophysiologist usually is challenged by a high degree of variability in the coronary venous anatomy. We describe a case of successful delivery of the LV lead to the distal region of a tortuous lateral vein using the anchor balloon technique.

Case report
An 86-year-old woman with nonischemic cardiomyopathy was referred to our hospital with drug-refractory heart failure. Echocardiography showed an enlarged LV with low systolic LV function (LV end-diastolic systolic diameter 58 mm, LV end-systolic diameter 50 mm, LV ejection fraction 29%). New York Heart Association functional class III heart failure was noted. Her plasma B-type natriuretic peptide concentration was 596 pg/mL. Sinus rhythm with a wide QRS complex (153 ms) was seen on the electrocardiogram (Figure 1). Cardiac angiography showed no coronary stenosis. Right cardiac catheterization revealed an elevated pulmonary artery wedge pressure (mean 20 mm Hg) and a low cardiac index (1.87 L/min/m²).

We decided to implant a cardiac resynchronization therapy (CRT) device to resolve the symptoms of decompensated chronic heart failure. A right atrial lead (IsoFlex 1944-52; Abbott, Chicago, IL) and a ventricular lead (Tendril 2088TC-58; Abbott) were positioned at the right atrial appendage and the right ventricle (RV), respectively. The right atrial pacing threshold was 0.75 V at 0.4 ms, and the RV pacing threshold was 0.5 V at 0.4 ms. A slittable outer guide catheter (CPS Direct Universal Wide; Abbott) could easily be inserted into the coronary vein ostium. Coronary venography was then performed. A lateral branch was identified as a candidate vessel for LV lead implantation. However, the lateral branch was tortuous and had severe stenosis with collateral branches.
KEY TEACHING POINTS

- Coronary venoplasty for insertion of the left ventricular (LV) lead is not an uncommon strategy (2%–7% of patients undergo cardiac resynchronization therapy [CRT] device implantation).
- Although balloon venoplasty and/or stenting have been described to facilitate LV lead placement, some cases require other implantation strategies.
- The anchor balloon technique is useful for deep engagement of the guiding catheter in the target vein and contributes to successful LV lead implantation.

(Figure 2A and B). It was impossible to insert a slittable inner guide catheter (CPS Aim Universal SUB-90; Abbott) with the standard approach; therefore, we decided to perform venoplasty to the lateral branch.

The lesion was crossed with a 0.36-mm composite core guidewire for coronary artery intervention (SION blue; Asahi Intecc, Nagoya, Japan) and dilated with a 3.0- × 15-mm balloon (Emerge; Boston Scientific, Galway, Ireland) at 6 atm (Figure 2C). However, the inner guide catheter could not cross the lateral branch. We decided to apply the anchor balloon technique. The 3.0- × 15-mm Emerge balloon (Boston Scientific) was inflated at 6 atm in a distal lesion of the lateral vein and its shaft held with backward force while the inner guide catheter was being advanced. The anchor effect facilitated crossing of the inner guide catheter (Figure 2D). The LV lead (Quartet 1458Q-86; Abbott) was positioned at the midportion of the lateral branch, which was opposite the RV lead (Figure 2E). The LV lead pacing threshold was 2.5 V at 1.0 ms from electrode1-2 without phrenic nerve stimulation. These leads were connected to a CRT pacemaker (Quadra Allure PM3542 pulse generator; Abbott) (Figure 2F). Narrowing of the QRS complex (118 ms) was noted after successful device implantation (Figure 3A).

The patient has subsequently been well (New York Heart Association functional class I, B-type natriuretic peptide 121 pg/mL) and has not experienced any cardiac events. Improvement of cardiothoracic ratio (Figure 3B) and LV reverse remodeling (LV end-diastolic diameter 52 mm, LV end-systolic diameter 41 mm, LV ejection fraction 45%) were also noted after the 8-month follow-up period.

Figure 2  A: Coronary venography in the right anterior oblique view shows angulated and tortuous coronary sinus branches. B: Enlarged view of the square in A. The black arrow indicates the tip of the inner guide catheter. The white arrow indicates severe stenosis with small collateral branches (arrowheads) of the lateral vein. C: The lesion was dilated with a balloon. Balloon indentation (arrowhead) implies insufficient dilation of the lateral vein. D: Application of the anchor balloon technique. The balloon was inflated in a distal lesion of the lateral vein (arrowhead) and its shaft was held with backward force while the inner guide catheter was being advanced. The inner guide catheter was able to cross the tortuous lateral vein (arrow). E: A left ventricular lead was positioned at the midportion of the lateral branch. F: Chest radiograph after device implantation. LV = left ventricular lead; RA = right atrial lead; RV = right ventricular lead.
Discussion

A report on coronary vein angioplasty for LV lead implantations disclosed that coronary vein stenosis was often found in patients with a previous history of cardiac surgery or LV lead implantation. In such challenging cases, coronary venoplasty is one of several promising strategies. Soga et al reported that 4 of 206 patients (1.9%) who underwent CRT implantation required coronary venoplasty for insertion of the pacing lead implant. They were unable to dilate the focal coronary vein stenosis by balloon venoplasty alone in 1 of the 4 patients (25%). A more recent retrospective analysis showed that 17 of 255 patients (6.7%) required coronary venoplasty for insertion of the LV lead. Coronary vein venoplasty was performed in 16 of the 255 patients (6.2%) and stenting in 3 patients (1.2%) to facilitate LV lead placement. Although no complications occurred in these earlier studies, cardiologists need to be aware of intervention-related complications. The higher the balloon pressure, the higher the risk of balloon rupture and perforation of the vein. As another treatment strategy, the snare technique has been established previously. Worley et al reported that the snare does not evoke credentialing concerns and can be easily implemented by most implanting physicians. The snare technique may have been one of the options for the present case.

The anchor balloon technique was initially described by Fujita et al as inflation of a balloon in a distal lesion as its shaft was held with backward force while the guiding catheter was being advanced. This technique is widely available and has facilitated procedural success in challenging cases of coronary and peripheral intervention. Compared with conventional coronary vein interventions, the anchor balloon technique can be performed with relatively low balloon pressure. In patients with angulated and tortuous coronary sinus branches, the anchor technique may improve the success rate of LV lead placement for CRT.

Conclusion

The anchor balloon technique is useful for deep engagement of the guiding catheter in the target vein. This technique contributes to successful LV lead implantation in patients with tortuous coronary sinus branches and/or stenosis of the coronary venous lesions.

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