EMERGING TECHNIQUES

Coronary Venous Floss: A Novel Technique for Left Ventricular Lead Positioning in Cardiac Resynchronization Therapy

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ABSTRACT. Apical placement of the left ventricular (LV) lead is associated with non-responsiveness to cardiac resynchronization therapy (CRT) and worse clinical outcomes. The objective is to use innovative methods to pursue and ultimately accomplish “good” lead position to optimize effectiveness and responsiveness to CRT. A modified retrograde pull-through technique was used to position the LV lead in a patient referred for CRT. Using two sheaths in the coronary sinus (CS) os and a forceps snare, a loop was formed with the guidewire antegrade through the posterolateral (PL) vein and retrograde through the anterolateral (AL) vein; both ends were controlled by the operator. The lead was inserted over the distal end of the guidewire and advanced through the CS and into the AL vein. The wire was then pulled back through the PL vein until the lead rested at the optimal site. It is worthwhile to invest time, effort and in some cases creativity to use innovative methods such as retrograde and modified retrograde pull-through techniques, and to aggressively pursue optimal lead placement for the greatest clinical benefit.

KEYWORDS. biventricular pacing, cardiac resynchronization therapy, heart failure, left ventricular lead positioning, non-responder, non-responsiveness, retrograde pull-through.

Introduction
A 69-year-old diabetic male with ischemic heart disease and worsening heart failure was referred for cardiac resynchronization therapy (CRT). His cardiac history included an anterior ST elevation myocardial infarction and subsequent bypass graft surgery with aortic valve replacement and left ventricular (LV) endoaneurysmorraphy 5 years previously. An implantable cardioverter-defibrillator with a single-coil lead had been implanted for primary prevention. His estimated ejection fraction was 30% and his QRS interval measured 160 ms. Clinically, he scored a New York Heart Association functional class II on maximum tolerated medical therapy. The patient elected to upgrade to a CRT-D system and was taken to the catheterization laboratory where an LV lead was placed via a modified retrograde pull-through technique as described below.

Coronary sinus (CS) access was achieved using a 65-cm Viking CS diagnostic decapolar catheter with 2-5-2 spacing (C.R. Bard, Inc., Murray Hill, NJ). Counterclockwise rotation of the catheter aligned the unevenly spaced electrodes creating a three-dimensional impression in the 30° left anterior oblique projection. As the catheter was extended into the CS, a 50-cm Attain Command 6250-MB2X sheath (7.2 Fr, Medtronic Inc., Minneapolis, MN) was railed over the catheter into the CS (gentle “dottering” is sometimes required, while retrotraction is applied to the Viking). CS angiography was subsequently performed revealing a small, tortuous anterolateral (AL) vein, demonstrated by our experience to be associated with a greater likelihood of effective CRT response (Figure 1). This vein, however, could not be accessed with a guidewire. A large posterolateral (PL) vein was also identified; however, this vein cours
apically and was not felt to represent the “ideal” site for LV pacing, possibly resulting in non-responsiveness (Figure 2).

Subsequently, the Attain Command 6250-MB2X sheath was placed within the PL branch and a 145-cm Whisper EDS CS-J Hi-Torque guidewire (0.014 in, Guidant Boston Scientific Inc., Natick, MA) was extended through that vessel, advanced retrograde through the small AL vein and further back into the parent CS, taking advantage of collateral venous communication, ultimately approaching the CS os. The lead was then inserted over the proximal end of the wire through the sheath within the

**Figure 1:** Initial coronary sinus angiogram revealing anterolateral branch coronary veins (arrows).

**Figure 2:** Subselective coronary sinus angiography revealing a posterolateral branch coronary vein (arrow).

**Figure 3:** “Standard” retrograde pull-through technique. Direction of lead advancement depicted by arrow; lead is “stuck” in posterolateral coronary branch vein, unable to advance beyond the apex.

**Figure 4:** Arrow directed at snared end of the guidewire at coronary sinus os.
PL vein (Figure 3). The lead was advanced distally within the PL vein as far as possible, reaching a point in the vessel too small to be advanced any further. Lead position remained too apical for effective CRT and rather than perform balloon angioplasty the lead was removed and an alternative approach was attempted.

A second Attain Command 6250-MB2X, (7.2 Fr, 50 cm) sheath was placed near the CS os and a 120-cm vascular retrieval forceps snare, (3.0 Fr, 10-mm snare, Cook Medical Inc., Bloomington, IN) was used to grab and stabilize the distal end of the guidewire and retract it out through the second sheath (Figure 4). At this point both ends of the guidewire were controlled forming a loop antegrade through the PL vein and retrograde through the AL vein.

The lead then was reinserted over the distal end of the guidewire, advanced into the parent CS and further into the AL vein (Figures 5 and 6). The wire was then pulled back through the PL vein until the bipolar electrode pair rested at an appropriate site: “2 o’clock” in the left anterior oblique projection and at the junction of the proximal middle third of the left ventricle in the right anterior oblique projection (Figure 7). After exhibiting good threshold data the sheaths were cut and the leads were secured.

Data from a subgroup analysis of the Multicenter Automatic Defibrillator Implantation Trial—Cardiac Resynchronization Therapy trial demonstrated that apical placement of the LV lead is associated with non-responsiveness to resynchronization therapy. These data further suggested worse clinical outcomes, including higher mortality rates with apical LV lead placement. The overall rate of non-responsiveness has been reported as high as 34% and while other factors, including the presence of scar tissue, have been implicated, we strongly believe that “good” LV lead position is imperative for effective CRT and may be the most important variable in predicting outcome.

Targeting a specific anatomical location in the coronary sinus tree is considered one of the most challenging aspects of CRT device implantation. Ideal positioning is
technically demanding and failure to achieve optimal placement of the LV lead initially can be frustrating. Worley et al\(^2\) described a similarly innovative method of securing the distal end of a guidewire in the coronary sinus using a goose neck snare and a single sheath delivery system. In our case we demonstrate the use of a forceps snare and utilize the added stability of a second delivery sheath for extra support.

It is indeed worthwhile to invest the time, effort and in some cases creativity to use various, alternative methods such as venous balloon angioplasties, retrograde pull-through\(^3\) and modified retrograde pull-through techniques, described herein, to aggressively pursue the greatest clinical benefit.

**References**