Successful coronary vein lead implantation by intravascular ultrasound guidance in a patient with life-threatening contrast medium anaphylaxis

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Introduction

Cardiac resynchronization therapy (CRT) is an effective treatment for patients with symptomatic chronic heart failure (HF), a wide QRS complex, and reduced left ventricular ejection fraction. CRT produces electrical and mechanical resynchronization leading to QRS shortening and left ventricular reverse remodeling.[1] CRT has also been shown to improve HF symptoms, reduce HF-associated hospitalization, and lead to a better survival rate. Coronary vein (CV) venography during the CRT device implantation procedure is necessary to evaluate the anatomy of the CV; however, the use of contrast medium for CV lead implantation is generally contraindicated in patients with severely impaired renal function or a medical history of adverse effects to contrast media. The side effects of a contrast medium vary from mild allergic reactions, such as nausea or a rash, to life-threatening anaphylaxis. Furthermore, premedication with steroids cannot always prevent these adverse effects.[2] Implantation strategy of a CV lead for patients with a severe allergy to a contrast medium has not yet been established. In this study, we report a case of intravascular ultrasound-guided CV lead implantation without CV venography in a patient with life-threatening contrast medium anaphylaxis.

Case report

A 51-year-old man with a dilated phase of hypertrophic cardiomyopathy was referred for management of severe HF. The patient was dependent on a continuous intravenous dobutamine infusion. According to our country's guidelines, CRT was indicated for 132 ms with a QRS configuration indicative of an intraventricular conduction disturbance pattern and left axis deviation, a left ventricular ejection fraction of 25%, and a NYHA class IV HF symptom, regardless of continuous dobutamine administration. However, the patient had a history of life-threatening contrast medium anaphylaxis that had occurred during a previously conducted contrast-enhanced computed tomography scan. Symptoms such as an urticarial rash and erosion on the skin and oral mucosa had occurred on this occasion. Therefore, the use of contrast medium was contraindicated for this patient. Consequently, we planned a CV lead implantation under the guidance of intravascular ultrasound (IVUS) without CV venography, described as follows.

A guiding catheter was cannulated into the great cardiac vein by intracardiac electrogram guidance using a 6F decapolar electrode catheter (Inquiry; Abbott, IL). A 0.014-inch guidewire (Whisper; Boston Scientific, Natick, MA) was then advanced into the anterior interventricular vein, and an IVUS catheter (EAGLE EYE; Volcano, San Diego, CA) was deployed over the wire. The IVUS imaging revealed an anterolateral (AL) CV branch, and the location of the bifurcation point was also confirmed on the fluoroscopic image (Figure 1). The guidewire was successfully advanced into the AL branch and reached the main CV via a posterolateral (PL) CV branch. Therefore, at least 2 CV branches (AL and PL) were confirmed. Then, the guidewire was advanced into the PL, and IVUS revealed an approximately 34.5 mm length and 2.0−3.8 mm diameter of the PL (Figure 2). A decapolar electrode catheter was inserted into the PL using an inner catheter, and an acceptable pacing threshold without phrenic nerve stimulation (PNS) was obtained. The intracardiac electrogram revealed sufficiently delayed local electrical activation, and the interval from the onset of the QRS complex to local electrical activation (Q-LV) was 104 ms. Next, a quadripolar CV lead

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KEY TEACHING POINTS

- In patients undergoing cardiac resynchronization therapy (CRT), coronary vein (CV) venography is necessary to evaluate the venous anatomy for a CV lead implantation.
- In the presented case, the patient, who underwent CRT device implantation, had a history of life-threatening anaphylaxis to contrast medium; therefore, CV venography was contraindicated.
- CV lead placement by intravascular ultrasound (IVUS) guidance without CV venography was planned for this patient.
- IVUS within the great cardiac vein revealed an anterolateral (AL) side branch, and a guidewire was successfully advanced into the AL branch. The guidewire eventually reached to the main CV via a posterolateral (PL) branch.
- IVUS revealed vessel diameter and length of the PL branch, and a quadripolar CV lead with the best electrode distance was selected. After comparison of the local electrical activation and pacing threshold between AL and PL branch, the CV lead was successfully placed at the optimal left ventricular pacing site within the PL branch.
- CV lead placement by IVUS guidance can be safe and feasible. This CV lead implantation technique without CV venography can be a useful solution for patients who require CRT device implantation, in whom contrast medium is contraindicated.

(Sentus pro-MRI OTW QP S; Biotronik, Berlin, Germany) was advanced into the AL branch, and this area showed a higher pacing threshold of more than 5 V with PNS and a shorter Q-LV interval compared with the Q-LV interval obtained within the PL branch. The selected quadripolar CV lead had a 60 mm total electrode distance from the distal to the proximal electrode; therefore, the CV lead was unsuitable for the PL and easily dislodged during removal of the guiding catheters. Finally, the other quadripolar CV lead (4674, AcuityX4 spiral S; Boston Scientific) with a total electrode distance of 35.5 mm, which was nearly equal to the PL length measured by IVUS, was successfully placed at the latest activation site.

After the CV lead placement, the atrioventricular delay interval (AVD) and interventricular delay interval (VVD) were optimized according to the narrowest QRS complex using fusion with intrinsic conduction. The final device programming was DDD with a lower rate at 70/min and an upper tracking rate at 130/min. The sensed AVD and the paced AVD were programmed at 120 ms and 150 ms, respectively. The VVD programming was right ventricular pacing preceding left ventricular pacing by 60 ms. In addition, MultiPole Pacing (Biotronik, Berlin, Germany), which enables left ventricular pacing using 2 different electrodes within the quadripolar CV lead, was turned on. The QRS duration was shortened significantly from 136 ms to 116 ms after optimization of device programming (Figure 3). Two months after the successful CRT implantation, echocardiography showed a 30% reduction in left ventricular end-systolic volume (from 160 mL to 106 mL), which is consistent with the general definition of a super-responder. After discharge, his HF symptoms and ventricular arrhythmia were well controlled, and there has been no history of readmission for HF worsening or arrhythmic events for 14 months.

Discussion

In this case report, we performed successful implantation of a CV lead by IVUS guidance without CV venography in a patient with life-threatening contrast medium anaphylaxis. CRT nonresponder rate has been reported to be more than 30% of CRT patients, and a suboptimal CV lead location could be one of the reasons for nonresponse to CRT.[3] CV lead implantation at the latest activation site has been proposed as an optimal pacing site, leading to better CRT response,[4] and the Q-LV interval has been commonly used for measurement of local electrical activation. For better placement of the CV lead, CV venography is necessary to evaluate the various patterns of CV anatomies to determine the number of branches, angulation of side branches, and the vessel sizes and lengths.[5] However, there has been no established method to recognize the existence of CV branches and to implant a CV lead at the optimal pacing site in patients for whom contrast medium is contraindicated; to overcome these issues, we decided to perform CV lead placement using IVUS.

IVUS imaging of the great cardiac vein demonstrated the number of side branches, whereas IVUS imaging of side branches revealed the vessel diameter and length. This was important information to ensure better selection of lead shape for stable fixation and correct electrode distance. Hoffmeister and colleagues[6] first reported IVUS-guided bipolar CV lead implantation; however, a quadripolar CV lead has more electrical repositioning to allow the site with high pacing threshold or PNS to be avoided and enables multiple point pacing with recent CRT devices. Therefore, evaluation of CV anatomy and the use of a quadripolar CV lead are preferable today.

Adequate evaluation of branch bifurcation and the length and diameter of CV branches by IVUS for CV lead implantation was feasible, and this technique can be an alternative solution for patients requiring CRT implantation, in whom contrast medium is contraindicated. Severely impaired renal function could be another reason for contrast medium use contraindication, and HF patients with reduced ejection fraction often present with renal impairment as a comorbidity.[7]

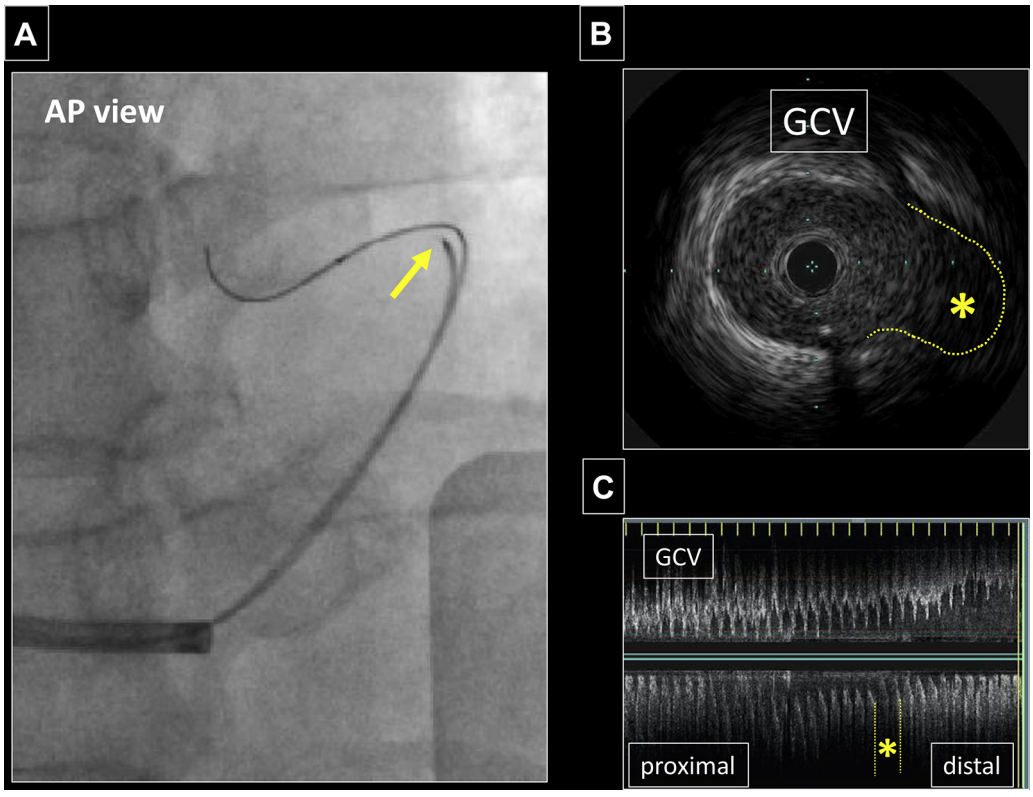

Figure 1 **A:** Intravascular ultrasound (IVUS) deployed from a distal portion of the great cardiac vein (GCV). IVUS images in **B:** the short-axis view and **C:** the longitudinal view reveal an anterolateral branch. The yellow arrow indicates the location of IVUS at the bifurcation of the anterolateral branch. Asterisks and dotted lines also indicate the anterolateral branch on IVUS images.

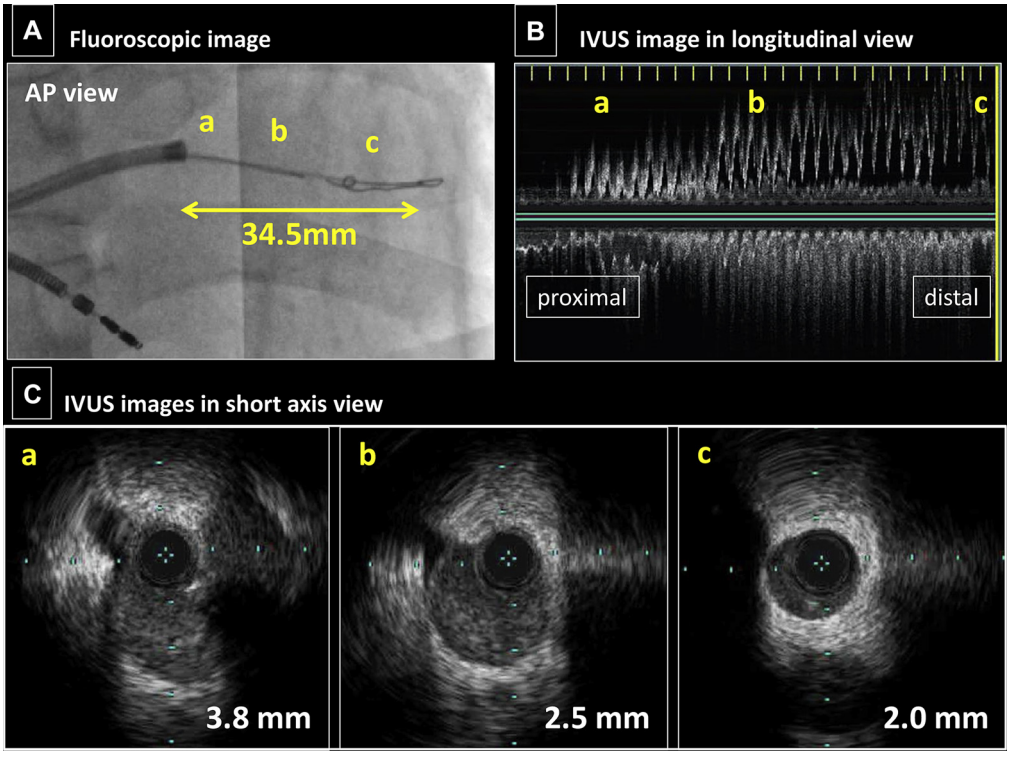

Figure 2 Fluoroscopic image of intravascular ultrasound (IVUS) deployment in the posterolateral (PL) branch (**A**), and IVUS images within the PL branch in longitudinal view (**B**) and short-axis view (**C**). Double-sided arrow indicates the approximate length of PL branch. Representative IVUS images in short-axis view were evaluated at the ostium of PL (a), basal portion (b), and mid portion (c).

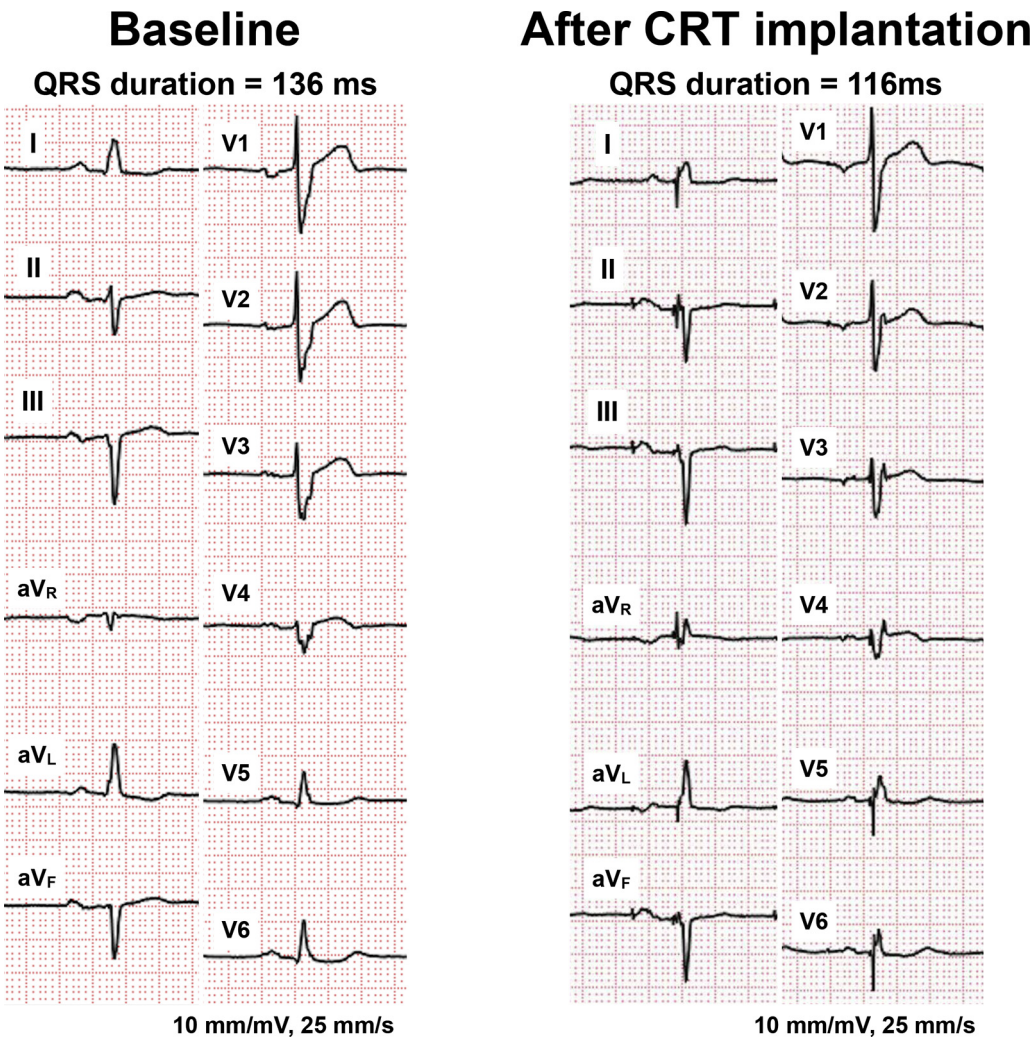

Figure 3 Twelve-lead electrocardiogram at baseline (left side) and after cardiac resynchronization therapy (CRT) (right side). The QRS duration was shortened after CRT from 136 ms to 116 ms.

Therefore, the CV lead implantation technique using IVUS guidance can be useful for these patients.

The clinical course after CRT was remarkable. The present case revealed a baseline 12-lead electrocardiogram with non–left bundle branch block type and a QRS duration of less than 150 ms. This resulted in a class IIb classification, indicating the need for CRT according to the recent guidelines produced by the Heart Rhythm Society. However, his HF symptoms were immediately improved, and successful discontinuation of dobutamine administration was achieved after CRT. Echocardiography assessment after CRT revealed remarkable left ventricular reverse remodeling with a 30% reduction in left ventricular end-systolic volume; therefore, the patient met the general criteria of a super-responder. Optimal CV lead placement at the site with late electrical activation and the use of multiple-point pacing has shown to reduce the nonresponder rate.[4,8] Moreover, AVD/VVD optimization based on shortening of the QRS duration during CRT pacing has been proposed as a predictor for favorable clinical outcomes after CRT.[9] All of these factors may have contributed to the super-responder status in this patient.

In conclusion, CV lead implantation by IVUS guidance can be a useful solution for patients who require CRT, in whom contrast medium is contraindicated.

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