Rare disease

Perforation of the right ventricle during cardiac resynchronisation therapy upgrade not related to a coexisting persistent left superior vena cava

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Summary

Right ventricle (RV) perforation is a complication that may arise during device implants. We present the case of a patient undergoing cardiac resynchronisation therapy upgrade that was complicated with an RV perforation. The lead was successfully repositioned with a good final outcome. Despite being uncommon, persistence of the left superior vena cava is the most frequent venous cardiac anomaly and may pose challenges during the implant procedure, namely when the right superior vena cava (RSVC) is absent. Still, in this patient it was not related to the event, as the leads were advanced through the RSVC.

BACKGROUND

Perforation of the right ventricle (RV) is among the possible complications resulting from lead utilisation. Multidetector CT (MDCT) scan has an important role in the diagnostic work-up of this situation and for planning the best therapeutic approach.¹

Persistence of the left superior vena cava (LSVC) has a low prevalence, occurring from 0.3% in the overall population to 2.8% to 4.3% in individuals with cardiac congenital abnormalities, but is the most common venous cardiac anomaly.² Owing to anatomical reasons it may pose a technical challenge in patients undergoing cardiac resynchronisation therapy (CRT) implants, namely when the right superior vena cava (RSVC) is absent.

CASE PRESENTATION

A 66-year-old woman was referred to our institution for a CRT upgrade. She had been implanted with a VVIR pacemaker using the right subclavian venous approach 20 years ago due to intermittent complete atrioventricular block. Over the years, she gradually increased her RV pacing percentage, and was now on 100% apical RV pacing with heart failure and an LV ejection fraction of 37%, with normal coronary angiogram.

She was upgraded into an CRT-P (cardiac resynchronisation therapy pacemaker) (Boston Contak Renewal H 140, St. Paul, MN, USA) device using a left-sided approach through the RSVC. New leads were inserted for the right atrium (active fixation Guidant Flexend 2, model 4097, Boston Scientific, St. Paul, MN, USA), left ventricle (LV) and RV (active fixation Guidant Flexend 2, model 4097, Boston Scientific). Tunnelization of the 20-year-old RV electrode was avoided.

Placement of the LV lead (Guidant Easytrak 2, Boston Scientific) was technically demanding due to the massive size of the coronary sinus that resulted in difficult opacification of this chamber. The coronary sinus was cannulated with the aid of a sub-selection catheter and the lead

was then placed in a posterolateral vein not far from the coronary sinus, due to the absence of other lateral branches (figures 1 and 2).

The new RV lead was placed in the apex, away from the old one. The remaining procedure was uneventful but after attaching the leads to the device, we found loss of capture of the RV and thorax x-ray confirmed lead dislodgement.

The patient remained haemodynamically and clinically stable. Echocardiography revealed minimal effusion but could not confirm the location of the electrode. A 16-slice MDCT scan was performed to confirm migration of the electrode. No other adequate venous branches were found for the LV electrode.

Lead repositioning was performed, carefully and uneventfully, retrieving the RV electrode and placing it in a new more basal location. Echocardiography showed no relevant effusion after the procedure.

OUTCOME AND FOLLOW-UP

Predischarge ECG showed a successful electrical resynchronisation and recovery of atrioventricular (AV) synchrony. Three months after the procedure the LV ejection fraction had risen to 45% and New York Heart Association (NYHA) had improved from III to II.

DISCUSSION

Perforation may occur in 0.5–1.2%^{3 4} of pacemaker implants, either during the procedure or, less frequently, days to weeks after. The RV apex seems to be a high-risk spot, due to its thinner wall (frequently <3 mm). Elderly and frail patients (body mass index <20) seem to be more prone to this complication. Concomitant use of a temporary transvenous pacemaker, active fixation leads (with retractable screw) and longer procedure times have also been associated with this complication.^{3 4} However, this may occur even when correct technique and flexible and passive fixation leads are used.

Figure 1 (A and B)—Fluoroscopy at 30° LAO show the persistent left superior vena cava draining into the coronary sinus and the posterolateral branch where the left ventricle electrode was placed. Original placement of the two right ventricle (RV) electrodes is also shown. Panel C—PA thorax x-ray shows displacement of the new active fixation RV lead (black arrow). Panels D and E—Multidetector CT (MDCT) reconstruction images show the presence of the new RV lead outside the myocardium (black arrow). Panel F—MDCT sagittal reconstruction shows the persistent left superior vena cava (white arrow). Panels G and H—preprocedure and predischarge ECG showing 31.8% shortening of the paced QRS interval (from 220 to 150 msec) and recovery of AV synchrony.

Regarding this patient, we highlight that the perforation had no relationship to the LSVC issue since the RV electrode was not placed through the coronary sinus. Moreover, no electrodes were placed via the LSVC. MDCT has become the imaging modality of choice for the detection of lead perforation.¹ In our patient it has allowed us to carefully plan the extraction that was accomplished by simple traction and rescewing of the electrode into a new location, with no complications.

In centres where this technique is not available or not used as a routine a high clinical suspicion along with echocardiography and chest radiography are the key to diagnosis. Changes in pacing and sensing threshold, impedance, loss of capture, chest pain, hypotension and muscle or diaphragm stimulation are important indicators of this complication. Chest radiography usually shows changes in lead curvature and lead tip position, which sometimes can be outside the cardiac silhouette.

Figure 2 Panels A–C—3D reconstruction multidetector CT images showing different views (left lateral, anterior and posterior) of the left superior vena cava (white arrows) originating from the innominate vein and draining into the coronary sinus.

Echocardiography may show the presence of a pericardial effusion and the electrode tip in the pericardium, features that are highly suggestive.

The LSVc usually drains directly to the right atrium through the coronary sinus, which has a large calibre and few tributaries.⁵ Access to the coronary sinus through the right atrium is theoretically straightforward since the *ostium* is very large. Still, in this patient the massive size of the coronary sinus resulted in difficult opacification, which hindered the cannulation process, since we do not use intracavitary signals during the implant. Instead, we used a sub-selection catheter, and once inside the coronary sinus an angiography allowed us to confirm our location. Catheterisation of the coronary sinus branches is difficult since they may have an acute takeoff angle and inferior-to-superior direction,⁶ which markedly increases the difficulty of LV lead placement in patients receiving CRT therapy, namely when accessing the coronary sinus through the LSVc. In our report we have chosen the only available lateral branch, avoiding the placement of an epicardial lead. Despite being in a posterolateral position, we observed a successful electrical resynchronisation with shortening of the paced QRS.

We have decided to preserve the old generator during the first months (programmed in VVI 30 bpm), since the patient is dependent on pacing and we want to make sure that the new electrodes are stable before removing it.

Learning points

- ▶ Perforation of the right ventricle (RV) is among the possible complications resulting from lead utilisation.
- ▶ Multidetector CT scan is the imaging modality of choice for detecting this complication.
- ▶ Clinical assessment, echocardiography and chest radiography also provide important information for diagnosing RV perforation.
- ▶ Simple traction and placement of the lead in a new position may be enough to solve the problem.
- ▶ Persistence of the left superior vena cava has a low prevalence but is the most common venous cardiac anomaly.
- ▶ Implanting the left ventricle lead is technical demanding in these patients, namely when the right superior vena cava is absent.

Competing interests None.

Patient consent Obtained.

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