Use of intracardiac echocardiography as a guide during interventricular septum puncture in a patient undergoing cardiac resynchronization therapy

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Introduction

Cardiac resynchronization (CRT) is a clinically proven therapy in terms of quality of life and mortality for selected patients with heart failure and left ventricular dyssynchrony.[1] The coronary sinus is the most commonly used access for left ventricle (LV) lead positioning in CRT. However, in 5–10% of patients, this approach is not possible because of anatomical variations.[2] Surgical epicardial implantation is considered a valid alternative in such situations, but it is not exempt from mortality and morbidity, with formal contraindication in high-risk patients. Other potential technical approaches are LV endocardial stimulation after interatrial septum (IAS) puncture[3] and the recently described interventricular septum (IVS) puncture technique[4] (Figure 1A). The IVS puncture is a technically challenging technique in which fluoroscopy guidance is frequently insufficient. In this clinical case, we describe the use of intracardiac echocardiography (ICE) as a guide for IVS puncture in a patient undergoing CRT with a previously failed fluoroscopy-guided attempt.

Case description

A 68-year-old woman with a severe nonischemic dilated cardiomyopathy, LV ejection fraction of 30%, demonstrated dyssynchrony (left bundle branch complete block and echocardiographic parameters of dyssynchrony), and New York Heart Association functional class III status was scheduled for CRT. The coronary sinus ostium could not be cannulated, even though a coronary angiography with levy phase was performed. The IAS puncture approach was also unsuccessfully attempted. Because of the patient's high-risk profile, an epicardial surgical approach was ruled out, and we opted for the recently described technique of endocardial IVS puncture.

The procedure was performed as follows: We used a steerable sheath and a 0.032-inch guidewire (Agilis; St Jude Medical, St Paul, MN), positioning its stiff, straight proximal end in front of the IVS. The other end of the guidewire was connected to an electrosurgical generator that delivered radiofrequency pulses while subtle pressure was applied against the IVS. Possibly because of the dilated cardiac chambers and distorted ventricular morphology, we were not able to safely direct the guidewire against the IVS despite multiple fluoroscopy-guided attempts under various radiological projections. We decided to use an ICE probe (AcuNav catheter, Siemens Healthcare, Erlangen, Germany) with right femoral venous access. An ICE probe was advanced to the right ventricle, obtaining a correct visualization of the IVS. This direct visualization of the IVS facilitated its puncture in a middle septal region. We first performed a slightly oblique puncture, advancing the guidewire into the LV (Figure 1B and Supplementary Video 1). When trying to pass the dilator and sheath through the IVS, we withdrew the entire system into the right ventricle. A second ICE-guided puncture was performed in a more basal septal localization with a perpendicular orientation (Figure 1C and Supplementary Video 2) that facilitated the subsequent advancing maneuvers of dilator and sheath into the LV (Figure 1D). The use of ICE allowed us to monitor the rest of the procedure, including the exchange of guidewires and sheaths as well as the final delivery of an active-fixation bipolar pacing lead (Tendril STS, St Jude Medical) to the endocardial LV wall (Figures 2A and Figure 2B and Supplementary Video 3). The procedure was successfully completed without complications, and the patient was

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ABBREVIATIONS **CRT** = cardiac resynchronization therapy; **IAS** = interatrial septum; **ICE** = intracardiac echocardiography; **IVS** = interventricular septum; **LV** = left ventricle

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KEY TEACHING POINTS

- The coronary sinus approach for epicardial cardiac resynchronization therapy (CRT) is not possible in $\leq$10% of patients.
- The endocardial approach is a valid alternative for left ventricular resynchronization.
- Intracardiac echocardiography can be a valuable tool during interventricular septum puncture for endocardial CRT.

presented with this 12-lead electrocardiogram post procedure (Figure 2C).

Discussion

Contrary to the IAS puncture in which the oval fossa acts as an anatomic landmark, IVS puncture is a technically challenging technique that lacks clear anatomic references. In addition, patients undergoing CRT usually have dilated and rotated ventricles with distorted anatomy. This fact prevents the operator from a proper spatial orientation, hampering the IVS puncture if one relies only on fluoroscopy guidance. ICE guidance can provide safety, reducing procedure time and facilitating a correct electrode implant in the lateral wall of the LV. To the best of our knowledge, this is the first case describing the use of ICE for guiding IVS puncture in a patient undergoing LV endocardial resynchronization.

Conclusion

ICE can be a valuable tool during ventricular transseptal puncture for LV endocardial resynchronization in those patients for whom fluoroscopic guidance is unsuccessful.

Appendix

Supplementary data

Supplementary material cited in this article is available online at http://dx.doi.org/10.1016/j.hrcr.2015.06.003.

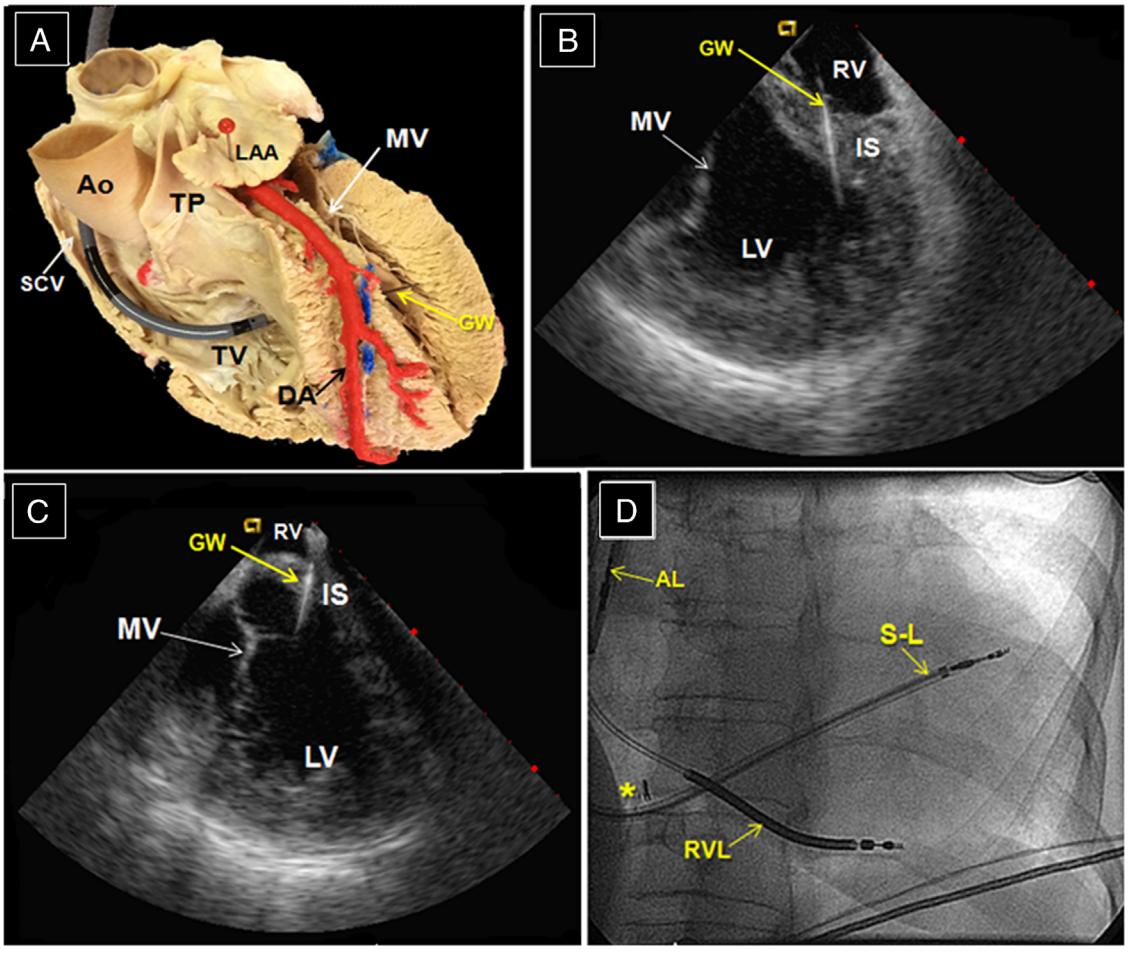

Figure 1 **A:** This dissection is a view from the front displaying the left anterior descending artery (DA) running the anterior interventricular septum. Parts of the ventricular anterior wall were removed. Note the steerable sheath and guidewire (GW) coming from the superior caval vein (SCV) passing through the tricuspid valve (TV) and being placed in the left ventricle after interventricular septum (IS) puncture. **B:** Intracardiac echocardiography image: First puncture performed with a slightly oblique course across the interventricular septum. **C:** Intracardiac echocardiography image: Subsequent puncture performed in a more basal localization with a perpendicular orientation to the interventricular septum. **D:** A fluoroscopic left anterior oblique projection showing a deflectable sheath with an active-fixation bipolar pacing lead (SL) in the left ventricle, a right ventricular lead (RVL), a right atrium lead (AL), and the intracardiac echocardiography probe (*). Ao = aorta; PT = pulmonary trunk; LAA = left atrial appendage; MV = mitral valve; RV = right ventricle.

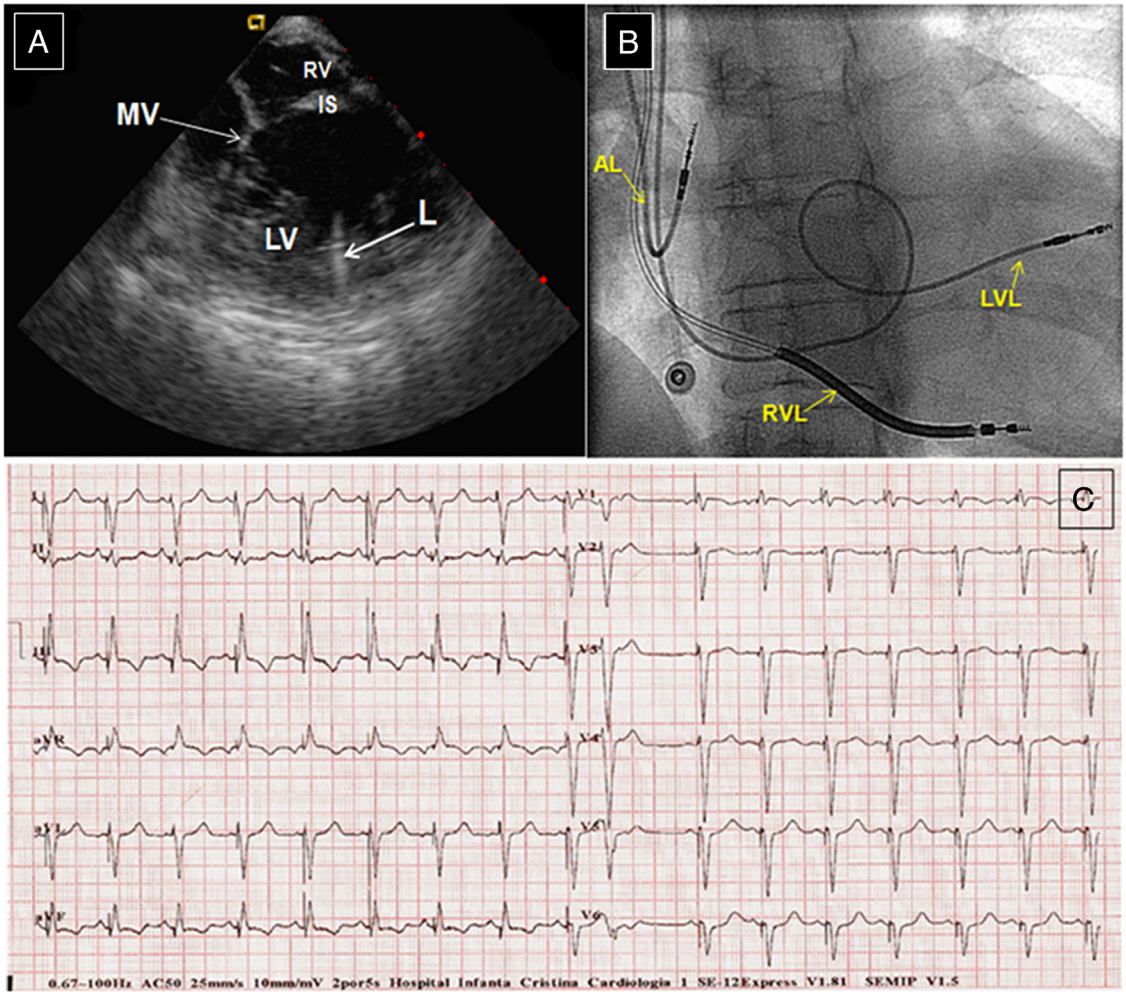

Figure 2 **A:** Intracardiac echocardiography image: Active-fixation bipolar pacing lead (L) delivered into the endocardial wall of the left ventricle (LV). MV = mitral valve; RV = right ventricle; IS = interventricular septum. **B:** Fluoroscopic left anterior oblique projection showing the final lead position into the left ventricle (LVL), a right atrium lead (AL), and a right ventricular lead (RVL). **C:** Post procedure resynchronization electrocardiogram.

References

1. Cleland JGF, Daubert JC, Erdmann E, Freemantle N, Gras D, Kappenberger L, Klein W. Cardiac Resynchronization — Heart Failure (CARE-HF) Study Investigators. The effect of cardiac resynchronization on morbidity and mortality in heart failure. N Engl J Med 2005;352:1539–1549.
2. Gras D, Böcker D, Lunati M, Wellens HJ, Calvert M, Freemantle N, Gervais R, Kappenberger L, Tavazzi L, Erdmann E, Cleland JG, Daubert JC. CARE-HF Study Steering Committee and Investigators. Implantation of cardiac resynchronization therapy systems in the CARE-HF trial: procedural success rate and safety. Europace 2007;9:516–522.
3. Nuta B, Lines I, MacIntyre I, Haywood GA, Biventricular ICD. implant using endocardial LV lead placement from the left subclavian vein approach and transseptal puncture via the transfemoral route. Europace 2007;9:1038–1040.
4. Betts TR, Gamble JH, Khiani R, Bashir Y, Rajappan K. Development of a technique for left ventricular endocardial pacing via puncture of the interventricular septum. Circ Arrhythm Electrophysiol 2014;7:17–22.