Implantation of the Micra leadless pacemaker in a patient with a low body mass index of 16

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Abstract

A 71-year-old female patient has a history of complete heart block and recurrent pacemaker site infection requiring multiple pacemaker explanations. A leadless pacemaker using passive fixation was inserted into the right ventricular apex via a transvenous approach without complications. This case illustrates the feasibility of implanting a leadless pacemaker system in a small-sized adult with a low body mass index of 16 (weight: 33.7 kg, height: 145 cm) which may have potential application in elderly Asian subjects.

INTRODUCTION

The leadless pacemaker (LP) technology is a new development in cardiac pacing. The entire pacemaker device is implanted inside the right ventricle (RV) without the need of a subcutaneous pocket to contain the pacemaker generator. Non-randomized studies of LP using passive and active fixation have demonstrated 99.2 and 95.8% implantation success rate, respectively, and 4.0 and 6.4% major complication rate 6 months after implantation, respectively [1–3]. One potential disadvantage of LP is the relative large size delivery sheath, for the LP using passive fixation, the outer diameter of the delivery sheath is 27 Fr or 9 mm. This causes concern on the safety of LP implantation in small body size patients. In this report, we describe a patient weighing 33.7 kg, which is amongst the smallest person in the world in whom a LP has been implanted without complications.

CASE REPORT

A 71-year-old, Asian lady presented with complete heart block with a dual-chamber, rate-modulated transvenous permanent pacemaker (PPM) inserted in the left side in 2012. In May 2015, erosion of the pacemaker through the skin with pocket effusion was noted. The PPM generator was removed but the PPM leads were left in situ. A new ventricular single-chamber rate-modulated (VVIR) transvenous pacemaker was subsequently inserted in the right side in June 2015.
Two months later, she presented with a 1.5 cm abscess at the old PPM site on the left side. Transesophageal echocardiogram demonstrated vegetation over the tricuspid valve and one of the pacing leads. Complete removal of her PPM system including extraction of all pacemaker leads was performed by percutaneous method and she was managed with temporary transvenous pacing. Implantation of a LP using passive fixation, Micra™ (Medtronic Inc., Minnesota, USA), was performed under local anesthesia on Day 23 after PPM removal. Adequate hydration was maintained with pre-procedure intravenous fluid. No imaging of the femoral vein was performed prior to or during the implantation. A 27 Fr delivery sheath was carefully introduced percutaneously after progressive dilatation of the right femoral vein access. No excess resistance was noted, nor was pain reported by our patient during passage of the delivery sheath through the venous system. The LP was successfully implanted at a single attempt without any technical difficulties at the low right ventricular septum. The pacing threshold was 0.63 V at 0.24 ms, sensitivity was 7.0 mV and impedance was 460 Ohm at implantation.

DISCUSSION

The prior infection of PPM using both side of the subclavian vein posed significant limitations on access for another transvenous system. However, the small body build of the patient raised concerns as to whether the femoral vein can accommodate a 27 Fr delivery sheath. The LP using active fixation with an 18 Fr delivery sheath was not considered because of the limitation in availability. A prior population-based ultrasound study has shown that femoral vein size is significantly smaller in Asian compared to other ethnicities [4]. Furthermore, femoral vein size independently correlates with height and body mass index (BMI) [4]. Using the model derived from multivariate analysis of the ultrasound study, the femoral vein size of our patient was estimated to be 8.53 mm, which is smaller than the diameter of the delivery sheath [4]. However, the femoral vein diameter is expected to increase by 17% with Valsalva maneuver, equals to 9.98 mm, due to the distensibility of femoral vein. The distensible nature of venous system may also give some flexibility on the actual size of delivery sheath that it can accommodate. Imaging was not routinely performed to assess the femoral vein size in our institution. However, this is deemed essential when there is difficulty in negotiating the delivery sheath into the right atrium as shown in previous case report [5]. On post-hoc analysis of the passive fixation LP study, patients with cardiac injury from the implantation procedure (BMI of 24.5) have on average a smaller body size than patients (BMI of 27.6) without cardiac perforation [1]. Extra precaution should be paid in patient of small BMI, especially in the presence of other risk factors of cardiac injury including female sex, age older than 75 years, history of cardiovascular disease, chronic obstructive pulmonary disease, and chronic lung disease [1]. Another concern for small body built patient is the number of device that the RV can accommodate. Study using human cadaver has demonstrated that at least three LPs can be placed in human RV without interference from each other [6]. Even in smaller size RV it is likely that more than one LP can be placed if necessary.

Our case demonstrated that LP insertion in a small-sized adult was technically challenging but possible with a favorable outcome. Future improvements could include downsizing the size of the delivery sheath and adjustment of the sheath tip curve for small-sized patients.

ACKNOWLEDGMENTS

We thank the patient for permitting us to publish this case.

CONFLICT OF INTEREST STATEMENT

None declared.

FUNDING

G.T. is supported by the Croucher Foundation of Hong Kong.

ETHICAL APPROVAL

Not applicable.

CONSENT

Informed, written consent has been obtained from the patient.

REFERENCES

1. Reynolds D, Duray GZ, Omar R, Soejima K, Neuzil P, Zhang S, et al. A leadless intracardiac transcatheter pacing system. N Engl J Med 2015;374:533–41.
2. Reddy VY, Knops RE, Sperzel J, Miller MA, Petru J, Simon J, et al. Permanent leadless cardiac pacing: results of the LEADLESS trial. Circulation 2014;129:1466–71.
3. Reddy VY, Exner DV, Cantillon DJ, Doshi R, Bunch TJ, Tomassoni GF, et al. Percutaneous implantation of an entirely intracardiac leadless pacemaker. N Engl J Med 2015;373:1125–35.
4. Froncek A, Criqui MH, Dennenberg J, Langer RD. Common femoral vein dimensions and hemodynamics including Valsalva response as a function of sex, age, and ethnicity in a population study. J Vasc Surg 2001;33:1050–6.
5. Lau CP, Lee KL. Transcatheter leadless cardiac pacing in renal failure with limited venous access. Pacing Clin Electrophysiol 2016;39:1281–4.
6. Omdahl P, Eggen MD, Bonner MD, Iaizzo PA, Wika K. Right ventricular anatomy can accommodate multiple micro transcatheter pacemakers. Pacing Clin Electrophysiol 2016;39:393–7.