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Successful percutaneous retrieval of a leadless pacemaker due to an acute rise in pacing threshold

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ABSTRACT

Leadless cardiac pacemakers (LCP) have become available recently. Both its acute and long-term performance in a large population of patients remain to be tested. Subacute rise in pacing threshold has been reported as an uncommon complication. On the other hand, the retrieval technique for LCP with passive fixation mechanism has not been previously described in details. Herein we report a newly recognized complication of an acute rise in pacing threshold very soon after implantation of an LCP without radiographic dislodgement. Percutaneous retrieval of this LCP with passive fixation mechanism was successful using a novel technique with the cryoballoon steerable sheath and a snare.

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1. Case report

Recently, miniaturized and self-contained leadless cardiac pacemakers (LCP) have become available [1,2]. The design of these new devices is fundamentally different from conventional cardiac pacing systems [3]. Both its acute and long-term performance in a large population of patients remain to be tested [1,2]. On the other hand, the need for LCP retrieval has been reported to be 0.1% in passive fixation device [1] and 1.3% in active fixation device [4]. However, the details on the retrieval technique for LCP with passive fixation mechanism has not been reported. Herein we report a patient with an acute rise in pacing threshold very soon after LCP implantation without radiographic dislodgement and percutaneous retrieval was successful using the cryoballoon steerable sheath and a snare.

A 66-year-old woman with sick sinus syndrome underwent implantation of an LCP with passive fixation mechanism (Micra Transcatheter Pacing System, Medtronic, Inc., Minneapolis, MN, USA) when her submuscular abdominally-placed pacemaker generator, surgically implanted after an episode of left pectoral pacemaker pocket infection 10 years ago, approached battery depletion. The LCP was deployed in the right ventricle (RV) via a deflectable delivery system. It was initially implanted at RV apical septum with unsatisfactory pacing threshold (1.63V@0.24 ms) and was recaptured and implanted at high RV septum (Fig. 1). The stability was confirmed with pull-and-hold test. The electrical parameters were satisfactory (R-wave 10.8mV, pacing threshold 0.75V@0.24 ms, impedance 570Ω). The tether was cut and pulled out smoothly. However, an acute rise in pacing threshold (0.75 → 1.38 → 1.63 → 2.2V@0.24 ms) was observed gradually over 30 minutes. There was no radiographic dislodgement. Percutaneous retrieval was attempted by placing a 3F 20mm snare (Amplatz Goose neck microsnare, Plymouth, MN, USA) through the deflectable delivery system. The proximal retrieval feature was successfully caught with the snare loop. However, the LCP could not be aligned with the recapture cone of the delivery system despite multiple manipulations. The delivery system was removed and a 15F steerable cryoballoon sheath (FlexiCath Advance, Medtronic, Inc., Minneapolis, MN, USA) was placed in RA through the introducer system. The steerable sheath was manipulated across the tricuspid valve and into the RV. A 7F 20mm snare was placed inside the steerable sheath. The proximal retrieval feature of the Micra LCP was successfully caught with the snare loop (Fig. 2) and the steerable sheath, together with the LCP, was pulled into the introducer system and outside the body. The retrieved Micra LCP was examined and no defect or blood clot was observed. A new delivery system was used and a Micra LCP was subsequently implanted at mid-RV septum with satisfactory electrical parameters (R-wave 8.6mV, pacing threshold 0.5V@0.24 ms, impedance 690Ω) and stability. The electrical parameters remained stable with an

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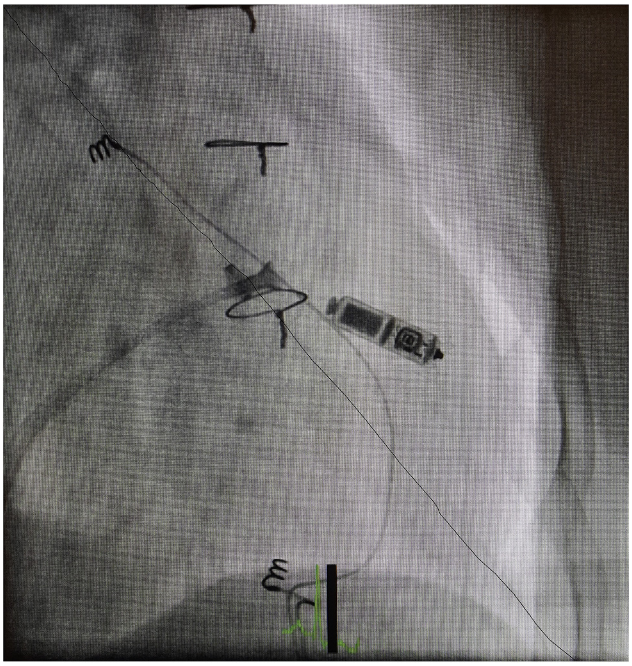

Fig. 1. Micra leadless cardiac pacemaker implanted at high right ventricular septum with good stability and electrical parameters before the tether was cut.

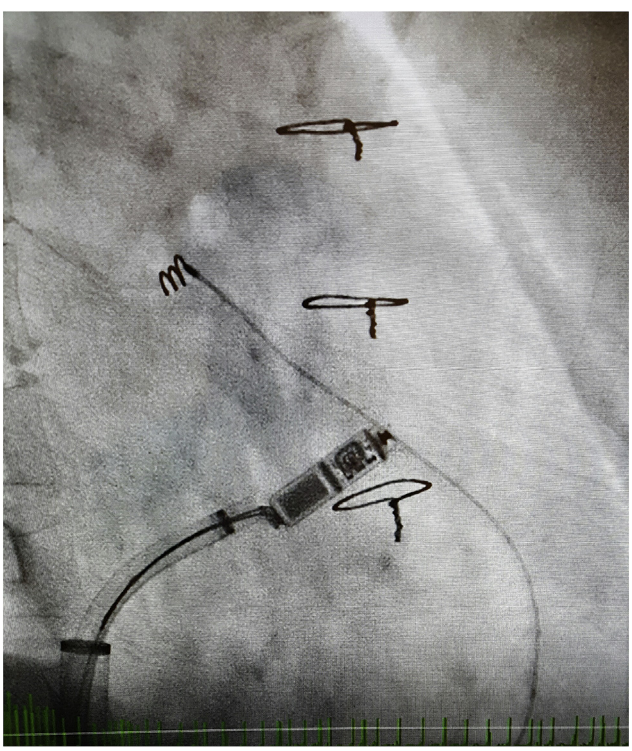

Fig. 2. Successful percutaneous retrieval of the Micra leadless cardiac pacemaker with a 15F cryoballoon steerable sheath and a 7F 20mm snare.

observation period of 30 minutes and the tether was cut. On one-month follow-up the electrical parameters remained satisfactory (R-wave 8.6mV, pacing threshold 0.62V@0.24 ms, impedance 600Ω) and the patient had no symptoms suggestive of pacemaker syndrome.

2. Discussion

Subacute rise in pacing threshold of Micra LCP has been reported as an uncommon complication [1,5]. Interestingly, no radiographic dislodgement was observed in all cases. Acute rise in pacing threshold of Micra LCP without radiographic dislodgement within 30 minutes of implantation as we observed, to the best of our knowledge, has not been reported previously. While it may be related to the technical difficulty in implanting Micra LCP in this patient, the structural design of this new device may also play a role. Although both the surface area of the cathode and the cathode-to-anode spacing are comparable between Micra LCP and a conventional pacing lead, the position and length of the tines are remarkably different. The cathode is slightly behind the domes of the four 8.1mm-long tines in Micra LCP but the tines are only 2.5mm in length and situated 2mm proximal to the cathode in a conventional pacing lead. The position of the cathode in Micra LCP is thus more recessed. Together with the more lengthy and flexible tines of Micra LCP, the cathode may be more prone to slight dislodgement compared with that of a conventional pacing lead during vigorous myocardial contraction. This slight degree of dislodgement may not be evident radiographically and is not significant for a structurally normal heart. However, in diseased myocardium with multiple areas of poor pacing threshold as in this patient reported herewith, it may result in an acute rise in pacing threshold. It is thus advisable for a short period of observation, e.g. 30 minutes, for the stability of electrical parameters before cutting the tether in patients with multiple RV sites of high pacing threshold or diseased myocardium.

In general, it is recommended that percutaneous retrieval of Micra LCP to be performed with a 3F snare introduced via the delivery system and perfect alignment between the recapture cone and the device has to be achieved before the device can be recaptured. However, in our patient, alignment could not be achieved and we have shown that the use of the cryoballoon steerable sheath and a 7F snare is a feasible alternative approach. The main caution in applying this approach is the potential risk of damaging the tricuspid valve leaflets by Micra LCP during retrieval.

3. Conclusions

We have observed a previously unreported complication of an acute rise in pacing threshold very soon after implantation of Micra LCP which did not dislodge radiographically. While it may be related to the technical difficulty encountered in our patient, the structural design of the device may also contribute especially in patients with high pacing threshold at multiple RV sites and diseased myocardium. Percutaneous retrieval of Micra LCP with the cryoballoon steerable sheath and a 7F snare is a feasible alternative technique in case the conventional approach of using the original delivery system and a 3F snare fails.

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