Leadless pacemaker interrogation interference after conversion of a left ventricular assist device

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Introduction

Left ventricular assist device (LVAD) is widely used for some patients with end-stage heart failure who require cardiac implantable electronic devices (CIEDs).[1] Successful leadless pacemaker implantations have been reported with no remote complications.[2,3] However, electromagnetic interference (EMI) in patients with LVAD between the programmer head and leadless pacemaker during implantations has also been reported, which could be solved by repositioning the leadless pacemaker.[4] Here, we report a case of EMI between the programmer head and the leadless pacemaker (Micra VR, Medtronic, MN) after conversion of the LVAD from HeartMate (HM) II (Abbott, St. Paul, MN) to HM 3 (Abbott). Specific programmer head positioning was required to successfully interrogate the pacemaker.

KEY TEACHING POINTS

- Electromagnetic interference between cardiac implantable electronic devices and the programmer head with left ventricular assist device (LVAD) has been reported, with various solutions.
- Turning off the pacemaker is preferred in case of converting HeartMate (HM) II to HM 3 during the surgery to avoid malfunction or inability to interrogate the pacemaker.
- In case of leadless pacemaker interrogation interference, positioning the programmer head at the back of the patient can be useful to maintain a distance from the LVAD to enable interrogation of the pacemaker.

Case report

A 62-year-old male patient with end-stage heart failure due to ischemic cardiomyopathy underwent cardiac resynchronization therapy and HM II implantation. The cardiac resynchronization therapy device had to be extracted owing to device pocket infection. After extraction, the patient suffered from bradycardia even with LVAD support. Because of device infection[5] and because the right ventricle pacing was hemodynamically tolerable,[6] we decided to implant a leadless pacemaker. The procedure was successfully performed, and there was no interference in interrogating between the programmer head and pacemaker (pacing mode: VVI; ventricular sensing threshold: 2.7 mV; ventricular pacing threshold: 0.38 V / 0.24 ms; impedance: 520 ohms; and % pacing: 99.9%).

Despite having received antibacterial therapy, the patient had a high fever after the procedure. Chest computed tomography revealed a fluid surrounding the outflow duct of the HM 2, and gallium scintigraphy showed accumulation at the identical region. We concluded that the fever was due to an infection at the outflow duct of HM II. Hence, we performed mediastinum irrigation of the area and converted from HM II to HM 3. After the operation, we could not interrogate the pacemaker despite a thorough investigation of the whole precordium with the programmer head. When the patient was able to sit upright, we positioned the programmer head on the back of the patient at the opposite side to the normal precordium, where we succeeded in interrogating the pacemaker, which showed no change in the pacemaker parameters. There was no EMI on the electrogram where the interrogation was possible. The patient was afebrile for 2 months and underwent heart transplantation. The patient

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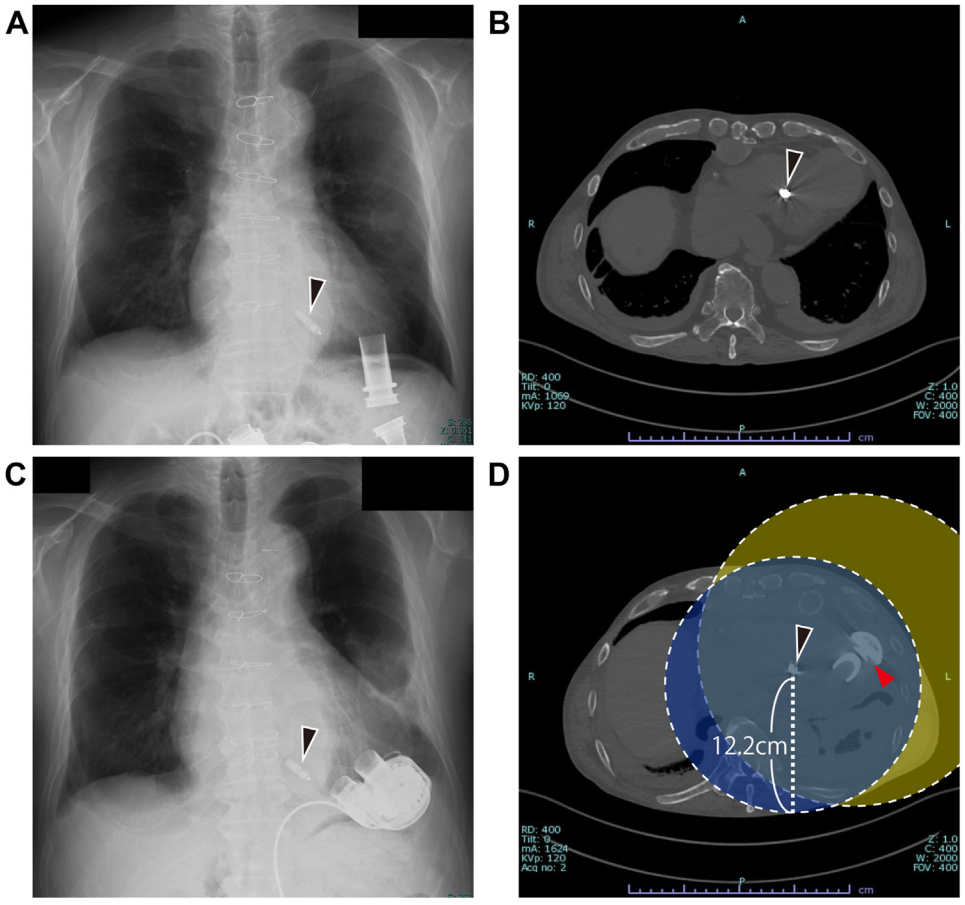

Figure 1 **A:** Chest radiograph with the leadless pacemaker and HeartMate (HM) II. **B:** Axial view of chest computed tomography. HM II is not in the same plane as the leadless pacemaker. **C:** Chest radiograph with the leadless pacemaker and HM 3. **D:** Axial view of chest computed tomography with the leadless pacemaker and HM 3. The blue circle indicates the presumed pacemaker programmable area, and the orange circle is the presumed LVAD EMI area. Black arrowhead: leadless pacemaker head; red arrowhead: HM 3.

provided written informed consent for publication of this case report.

Discussion

To the best of our knowledge, this is the first study to report a conversion from HM II to HM 3 with a leadless pacemaker, resulting in interference of the leadless pacemaker interrogation. EMI between CIEDs and the programmer head with LVAD has been reported, with various solutions, such as increasing the distance between the LVAD and CIED by extending the arm on the ipsilateral side of the CIED,[7] using a Faraday cage made with an iron pan to block the electromagnetic field from the LVAD,[8,9] and changing the rotation frequency of the LVAD under 1300 rpm or over 11,000 rpm to elude the transmission radiofrequency rate of the programmer head when HM II is implanted.[7]

In the current case, the pacemaker could initially be interrogated at the normal precordium position when HM II was implanted (Figure 1A and 1B). However, converting to HM 3 shortened the distance between the leadless pacemaker and the LVAD (Figure 1C and 1D), resulting in EMI between the programmer head and the pacemaker. We could not use a Faraday cage, as the device was in the heart, and the rotation frequency could not be changed because the LVAD was HM 3, which operates between 3000 and 9000 rpm. Hence, we decided to increase the distance between the programmer head and the LVAD, while not changing the distance between the pacemaker and the programmer head. As the pacemaker was in the same horizontal plane as the HM 3 (Figure 1), we interrogated from the back of the patient, maintaining the same distance as from the pacemaker to the precordium, but increasing the distance from HM 3, which we did successfully. As shown in Figure 2, only a narrow range could be interrogated owing to subtle differences in location. We presumed that this location was right outside of the LVAD EMI distance and inside the pacemaker programmable distance (Figure 1D). According to the manufacturer's instructions,[10] the distance for interrogation with Micra and the programmer head should be less than 12.5 cm, which was 12.2 cm to the back in the current case.

Although we were able to finally interrogate the pacemaker, we must take into consideration the possibility that the interrogation may not be established. To avoid the leadless pacemaker being active even when it cannot be interrogated, turning off the pacemaker is preferred in case of converting HM II to HM 3 during the surgery to avoid

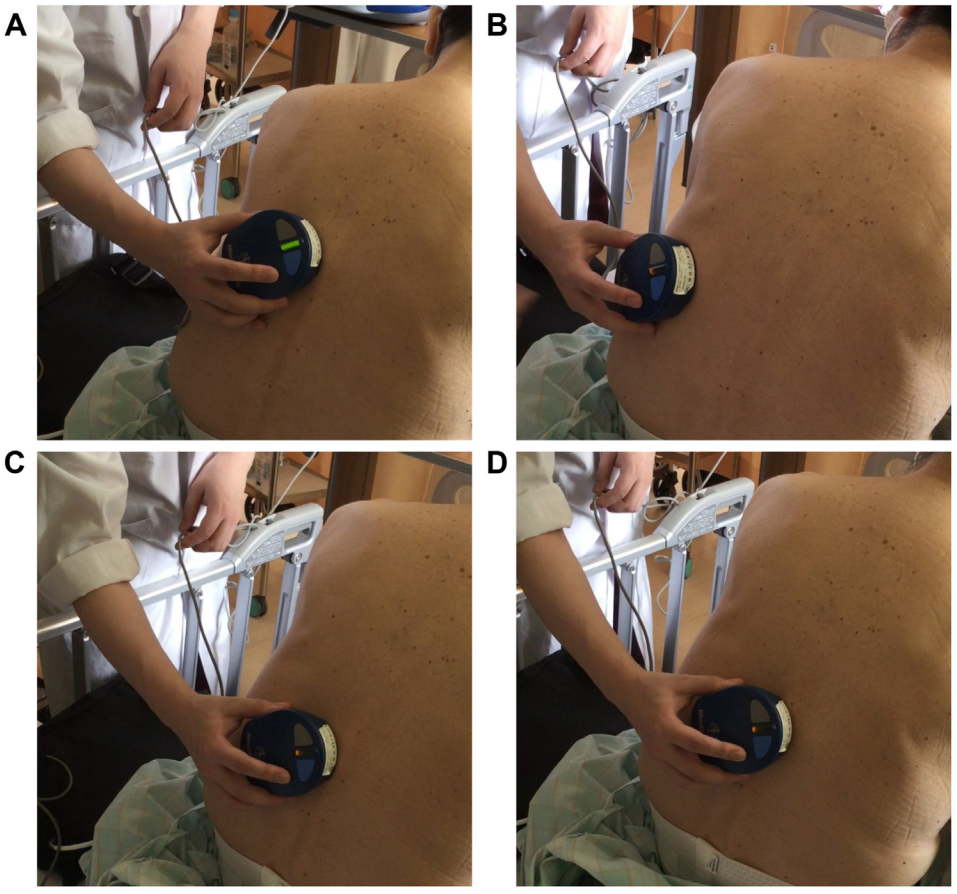

Figure 2 Photographs of the programmer head in slightly different locations. The color of the programmer head is green when interrogation is available (**A**) and orange when it is unavailable (**B–D**).

malfunction or inability to interrogate the pacemaker. If interrogation is not achievable after the operation even from various positions, a transvenous pacemaker or implanting a new leadless pacemaker at the base of the right ventricle and searching for a position where interrogation is available should be considered, although the latter may be challenging.

Conclusion

Various EMIs are common in patients with LVAD. In case of leadless pacemaker interrogation interference, positioning the programmer at the back of the patient is useful to maintain a distance from the LVAD.

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References

1. Han JJ, Acker MA, Atluri P. Left ventricular assist devices. Circulation 2018; 138:2841–2851.
2. Parker AM, Vilaro JR, Aranda JM Jr, Al-Ani M, George P Jr, Ahmed MM. Leadless pacemaker use in a patient with a durable left ventricular assist device. Pacing Clin Electrophysiol 2020;43:1048–1050.
3. Miyazaki Y, Wada M, Yoshitake K, et al. Leadless pacemaker implantation in a patient with a fully magnetically levitated left ventricular assist device. Pacing Clin Electrophysiol 2021;44:1126–1129.
4. Smietana J, Schell A, Pothineni NVK, Walsh K, Lin D. A left ventricular assist device interfering with leadless pacemaker implantation. Pacing Clin Electrophysiol 2021;44:1949–1951.
5. El-Chami MF, Bonner M, Holbrook R, et al. Leadless pacemakers reduce risk of device-related infection: review of the potential mechanisms. Heart Rhythm 2020;17:1393–1397.
6. Meineri M, Rensburg AEV, Vegas A. Right ventricular failure after LVAD implantation: prevention and treatment. Best Pract Res Clin Anaesthesiol 2012; 26:217–229.
7. Jin C, Hsu J, Frenkel D, Jacobson JT, Iwai S, Ferrick A. Unique technique to relieve left ventricular assist device electromagnetic interference with an implantable cardioverter defibrillator. J Cardiovasc Electrophysiol 2021;32:551–553.
8. Jacob S, Cherian PK, Ghumman WS, Das MK. "Pseudo" Faraday cage: a solution for telemetry link interaction between a left ventricular assist device and an implantable cardioverter defibrillator. J Interv Card Electrophysiol 2010; 28:221–225.
9. Sehatbakhsh S, Kushnir A, Kabach M, Kolek M, Chait R, Ghumman W. A case of electromagnetic interference between HeartMate 3 LVAD and implantable cardioverter defibrillator. Pacing Clin Electrophysiol 2018;41:218–220.
10. Micra™ MC1VR01 Clinician manual.Manual Document Number: M991010A001 REV. B. https://manuals.medtronic.com/content/dam/emanuals/crdm/M991010A001B_view.pdf. Accessed August 1, 2022.