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Successful Denovo Implantation And Explanation Of An Old Malfunctioning Micra™ Leadless Pacemaker

Muhammad R Afzal#, Tawseef Dar, Mahmoud Houmsse , Ralph Augostini, Emile G Daoud, John Hummel
#*Division of Cardiovascular Medicine, Electrophysiology Section, The Wexner Medical Center at the Ohio State University Medical Center, Columbus, OH, USA.*

Abstract

The use of leadless pacemakers is rapidly expanding. There is limited experience of extraction of leadless pacemakers. This case describes the successful extraction of an underperforming leadless pacemaker several weeks after initial implantation.

Introduction

Leadless pacemakers are advantageous since implantation is associated with fewer complications compared to a traditional transvenous pacing system. A recent multicenter experience has shown 99% implant success rate, with 48% fewer major complications than traditional pacemakers.[1] However, there is limited experience in the retrieval of leadless pacemakers.[2] This case report describes successful implantation of a new leadless pacemaker followed by extraction of a previously implanted device that had elevated capture thresholds.

Case report:

A 62 years old male with history of permanent atrial fibrillation, tachy-brady syndrome and right pectoral dual chamber pacemaker underwent extraction of transvenous pacemaker due to infection and bacteremia. Due to history of infected device at both right and left pectoral sites, the patient underwent implantation of a leadless pacemaker (Micra Transcatheter Pacing System, Medtronic, Minneapolis). Sensing and capture threshold was satisfactory at implantation but required multiple deployments to attain adequate thresholds. During subsequent follow up, the capture threshold increased gradually with eventual failure to capture at maximum output (5 V at 1 msec) at 3 months of implantation. A decision was made to proceed with extraction of the first device and implantation of a new leadless pacing device. A new leadless pacemaker was implanted in the high septal location (Figure 1). This figure shows that two leadless pacemakers in place. The newly implanted device is located in the high septal location while the older one is located in the right ventricular apex.

Key Words

Leadless Pacemaker, Extraction.

Corresponding Author
Muhammad R. Afzal Division of Cardiovascular Medicine, Department of Internal Medicine, Electrophysiology Section, The Ohio State University Wexner Medical Center, Columbus, OH, USA
Address: 473 W. 12th Ave, Suite 200, Columbus, OH, USA 43210

Extraction procedure:

After successful deployment of the new leadless pacemaker via right femoral vein access, a single-loop snare (EN Snare Endovascular Snare System, Merit Medical Systems, Inc) with an integrated protective sleeve was advanced via the delivery catheter into the right ventricle (Figure 2, left panel). The leadless pacemaker was successfully snared but this was cantered at its entry point into the delivery cup and came free(Figure 2, right panel). Due to concern for distal embolization, the delivery catheter was removed and a steerable sheath (8.5 F Agilis NxT™ Steerable Introducer, St. Jude Medical) with a triple-loop snare (En Snare, endovascular snare systems, Merit Medical Systems, South Jordan, Utah) was advanced into the right ventricle. A coaxial position was confirmed with multiplane fluoroscopy, but rather than using the retrieval loop at the proximal end of th e leadless pacemaker, the triple loop snare was used to entrap the entire body of the pacemaker(Figure 3, , right and left panel). With constant traction, the snare did not slip and successfully retracted the pacemaker from the myocardium (Figure 4, , right and left panel). The device separated smoothly without a pop. The device was then brought into the delivery sheath. The steerable sheath was pulled out of the delivery sheath; however, the leadless pacemaker could not be extracted from the delivery sheath due to the entrapment in the hemostatic valve (Figure 5). Continuing with constant traction to ensure that the pacemaker remained within the sheath, the entire sheath was then removed from the femoral vein and hemostasis was maintained with sutures. A follow up echocardiogram showed no pericardial effusion.

Discussion

This case describes the successful extraction of a leadless pacemaker after successful implantation of a replacement device. According to the manufacturer, nearly 50 such devices have been extracted to-date (personal communications). Due to size of the Micra™ (23 F), the delivery sheath (27 F) is necessary for extraction. Currently, there is no equipment designed specifically for Micra™ extraction. The usual equipment employed for extraction includes the delivery sheath,

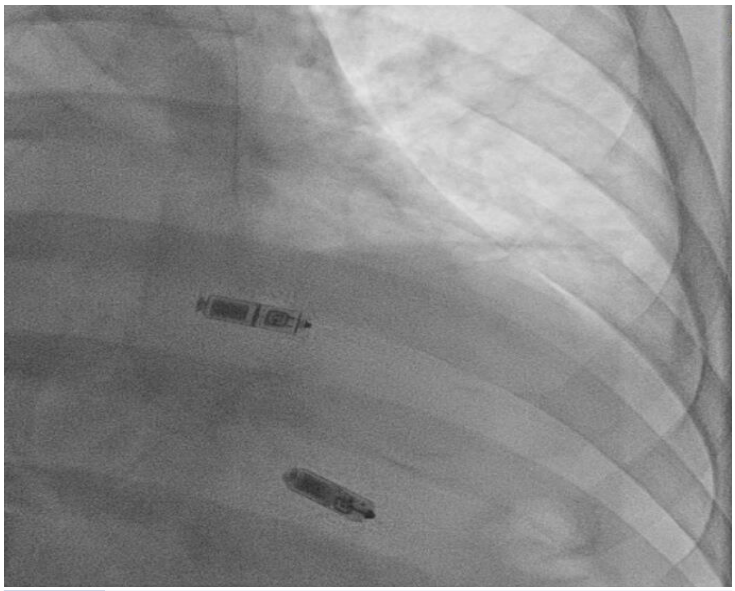

Figure 1: Implantation of a new leadless pacemaker in the high septal location in the presence of an underperforming pre-existing device located in the right ventricular apex.

This figure shows that two leadless pacemakers in place. The newly implanted device is located in the high septal location while the older one is located in the right ventricular apex

delivery catheter and a single or triple-loop snare. There are two recommended approaches for extraction of Micra™. First approach is to advance a single or multiple loop snare and an integrated protective

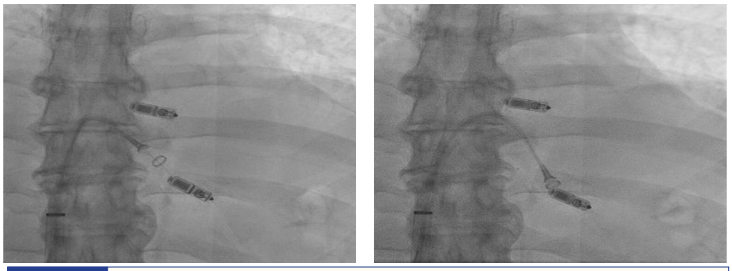

Figure 2: Attempted extraction of leadless pacemaker using the MicraTM delivery catheter

Left panel shows engagement of retrieval feature of the leadless pacemaker using the delivery catheter. Right panel shows the Leadless pacemaker was successfully snared but this was cantered at its entry point into the delivery cup and came free.

sleeve via the Micra™ delivery catheter (which requires removal of the pre-loaded device to load the extraction snare) and engage the

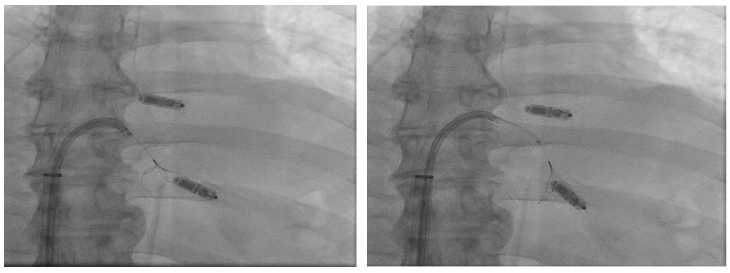

Figure 3: Use of steerable sheath and triple-loop snare to entrap the leadless pacemaker

Left panel shows a steerable sheath (Agilis, St Jude medical) and triple-loop snare in co-axial configuration with leadless pacemaker. The right panel shows that the triple-loop snare is encasing the entire body of the Leadless pacemaker.

proximal retrieval feature of the device (Figure 6). This proximal feature allows the distal cup of the delivery catheter to completely cover the proximal retrieval mechanism of Micra™. Once the delivery cup is snugged on the proximal part of the leadless pacemaker, the device is withdrawn from the tissue into the sheath. However,

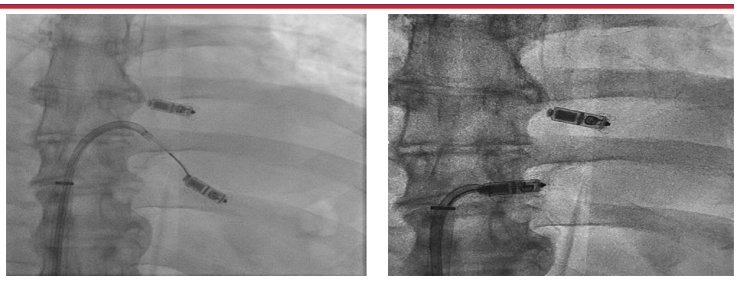

Figure 4: Successful extraction of the leadless pacemaker from the right ventricle using the snare via the steerable sheath

Left panel shows that the triple-loop snare is completely encasing the body of leadless pacemaker. The right panel shows retraction of the leadless pacemake from the myocardium.

engaging the proximal retrieval feature is sometimes challenging. The delivery catheter is unidirectional and steering is limited to only gross movements. The other approach is to use a steerable sheath for better

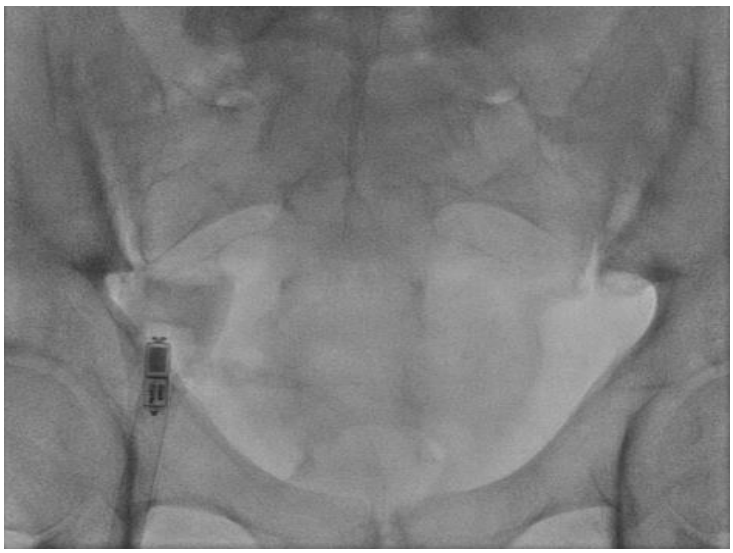

Figure 5: Leadless pacemaker entrapped in the hemostatic valve of the delivery sheath

This image shows the entrapped leadless pacemaker just beneath the hemostatic valve of Leadless pacemaker sheath.

co-axial positioning. A single or triple-lumen snare can be used via the sheath of multiple French sizes and diameters and allows the operator more flexibility. The latter was the successful strategy in this case.

Figure 6: Proximal retrieval feature of the device

This image shows the proximal retrieval feature of leadless pacemaker for deployment of snare. The sheath is outside the body and is upside down.

Factors responsible for inadequate thresholds:

The common reasons for a non-functioning leadless pacemaker device include inadequate insertion of the tines in the trabeculated tissue of right ventricle due to inadequate pressure at delivery. This problem can be circumvented by a radio-iodinated contrast injection to identify a septal region that will tolerate the forward pressure necessary for adequate engagement of the tines. Performing the tug test after implantation usually does confirmation of tine insertion. Per manufacturer, straightening of at least two tines is consistent with adequate implantation. Rarely, infarction of the tissue that includes the location of the leadless pacemaker implant can cause a rise in pacing thresholds as well. The recommended approach is to abandon the leadless pacemaker and place an alternative system. However, if the leadless pacemaker can be safely removed it will allow more area for subsequent implants and decrease the risk of implant infection or embolization as rare as that risk is.

Future directions:

As the experience with retrieval of LPs increases, these devices can be used in place of a temporary pacemaker in pacer dependent patients requiring prolonged course of antibiotics after extraction of an infected cardiac implantable electronic device. Further improvements in the proximal retrieval feature and extraction tools will facilitate this endeavor.

Conclusions:

This case highlights the feasibility of extraction of Micra™ leadless pacemaker at an early stage post-implantation

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