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Case Report

CardioMEMS monitoring device migration: A rare complication ☆,☆☆

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ABSTRACT

We present a rare case of CardioMEMS device migration six years post-implantation. Much is still being learned about endothelization of pulmonary vasculature and this case highlights the importance of device surveillance and device-related complications.

Introduction

Heart failure is a significant public health issue worldwide, affecting millions and significantly increasing healthcare costs. Despite advances in medical therapy, many patients with heart failure continue to experience frequent hospitalizations, decreased quality of life, and high mortality rates [1]. To improve the management and reduce hospital readmission for heart failure exacerbations, new technologies have been developed to allow for early detection and prompt intervention [1]. One such technology is CardioMEMS, a type of Ambulatory Hemodynamic Monitoring (AHM), best described as a wireless implantable hemodynamic monitoring system that allows for real-time pulmonary artery pressure (PAP) monitoring [1–3]. This device is implanted using a Swan Ganz catheter via right heart catheterization to the inferior pulmonary artery, allowing for real-time measurements of systolic, diastolic and

Glossary of terms: AHM, Ambulatory hemodynamic monitoring; PAP, Pulmonary artery pressure; PA, Pulmonary arterial; GDMT, Guideline-directed medical therapy; RHC, Right heart catheterization; CI, Cardiac index; PCWP, Pulmonary capillary wedge pressure.

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pulmonary artery pressure readings [1]. As pulmonary artery pressures typically rise weeks prior to a symptomatic heart-failure exacerbation, CardioMEMS allows for early medication adjustment and up-titration, effectively reducing heart failure hospitalizations, improve patient outcomes and decreasing cost [1,4].

Despite its great utility, complications related to chronic implantation of a CardioMEMS device have been described, such as device migration from original implantation site. In this report, we describe a rare case of CardioMEMS monitoring device migration six years after implantation.

Case presentation

The patient is a 64-year-old male with known history of CAD status post-CABG with multiple subsequent PCIs, ischemic cardiomyopathy with a left ventricular diastolic dysfunction (EF 60%-65%), hypertension, hyperlipidemia and recurrent hospitalizations for congestive heart failure exacerbations. In the past year alone, he presented to the emergency department on three different occasions with symptoms consistent with acute on chronic heart failure exacerbation, including weight gain and dyspnea. During each episode, he underwent diuresis and GDMT was subsequently up titrated. After a risk benefit discussion with the patient and due to recurrent hospitalizations secondary to heart failure exacerbations, the patient agreed to implantation of a CardioMEMS monitoring device for continuous hemodynamic monitoring with the goal to more accurately guide treatment plan and reduce recurrent hospitalizations.

In the years following placement of the device, GDMT was optimized utilizing a weekly review of his Pulmonary Arterial (PA) pressures. The patient's functional abilities continued to improve, and he was able to carry out activities of daily living without significant limitations. However, six years after initial placement, mean PA pressures from the CardioMEMS device were unobtainable and waveforms were severely dampened and unrecognizable. Weeks later, the patient began to experience noticeable weight gain (around 25 lbs), shortness of breath and difficulty fitting in clothing. A preliminary CT, as shown in Fig. 1, was obtained as there was suspicion the CardioMEMS device may no longer be transmitting pressure readings from the inferior pulmonary artery, as originally placed. As shown in Fig. 1, it appeared the CardioMEMS device may have migrated from original positioning in the inferior pulmonary artery to a more inferior and lateral position. This data, along with transmission of the abnormal pressure waveforms, raised a high suspicion for device migration from original positioning. The patient underwent right heart catheterization (RHC) for device recalibration and con-

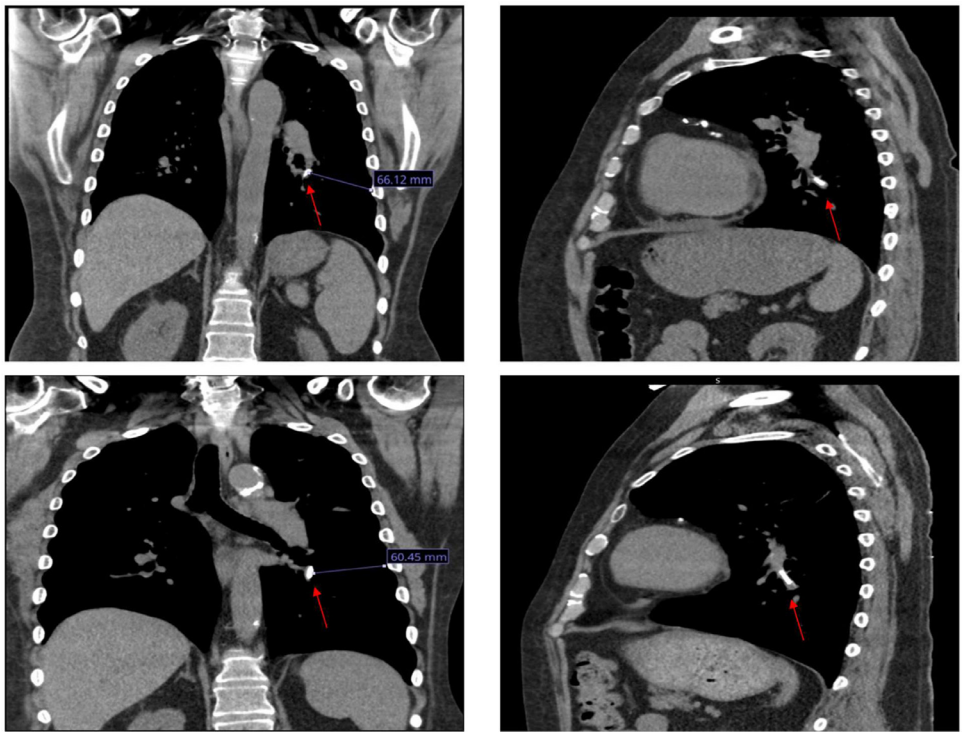

Fig. 1 – Sagittal versus coronal view of CT chest 6 years apart. Top images were taken shortly after original CardioMEMS device placement to confirm positioning, while bottom images were taken after migration of device to confirming inferior migration of the device 6 years later. Note positioning of the CardioMEMS device in reference to the 7th rib 6 years post-placement. The device appears more medial and superior to originally placed. This abnormal placement was first suspected by abnormal pulmonary artery waveforms first noted on the CardioMEMS device and reaffirmed via the images above and later confirmed via right heart catheterization.

firmation of placement. A Swan-Ganz catheter was passed into the right atrium and right ventricle and pressure measurements were obtained in both chambers. The catheter was then advanced further and pulmonary capillary wedge pressures were obtained. A blood sample was obtained from the pulmonary artery and Fick's cardiac output was calculated to be 5.86 L/min. The CardioMEMS device was successfully re calibrated and positioned using this data. Accurate pulmonary artery pressure readings along with adequate waveforms were again obtainable. The patient tolerated recalibration and positioning of the device without complications. The patient's functional status has since improved and GDMT continues to be adjusted based on CardioMEMS pressure reporting.

Discussion

AHM is a promising tool used for heart failure management allowing for real-time monitoring of hemodynamic parameters in the outpatient setting. Several clinical trials and observational studies have demonstrated benefits, including a reduction in heart failure hospitalizations, comprehensive costs and overall improving patient outcome [4–6]. The Multisensor Chronic Evaluation in Ambulatory Heart Failure Patients (MultiSENSE) study found a significant reduction of all-cause hospitalizations secondary to heart failure [5]. Similarly, in the CardioMEMS Heart Sensor Allows Monitoring of Pressure to Improve Outcomes in NYHA Class III Heart Failure Patients (CHAMPION) trial, AHM using a wireless pulmonary artery pressure sensor was associated with a significant reduction in heart failure hospitalizations compared to standard care [4]. While CardioMEMS has demonstrated efficacy and safety in clinical trials, like any medical device, it is not without potential complications. The most commonly reported adverse outcomes of CardioMEMS implantation are bleeding, infection, and thrombosis [4]. Injury to the pulmonary artery wall is also a possible complication; however, this is uncommon. Late migration of the CardioMEMS monitoring device within one year of implantation has been previously reported, leading to inaccurate transmission of PA pressure readings and interfering with optimal medical management. Current guidelines for device implantation recommend deploying the device in a branch with $>$ 7 mm diameter to avoid migration. However, this may not be enough to prevent complications as other factors, including device thrombosis/embolization. Device malfunction, although uncommon, could result from endothelialization of the CardioMEMS device sensor leading to inaccurate PA pressure readings [7,8].

We report a rare complication of very late device migration six years after implantation (Fig. 1). Migration was confirmed by normalization of pressure readings post-recalibration and placement of the device. Late device migration has been reported, occurring within one year of device implantation [7,9]. Rali et al. first described the late migration of the CardioMEMS sensor in a 70-year-old man with a history of HFpEF (NYHA Class III) and multiple hospitalizations for heart failure. He underwent placement of the CardioMEMS sensor, which was placed in a branch of the left pulmonary artery. Around four months after the procedure, no signals or readings were generated from the device, and a chest X-ray confirmed that the device had migrated to the right lung; however, the patient did not sustain any adverse events [9].

The second case involved a 79-year-old male with multiple comorbid conditions, including cardiomyopathy with New York Heart Association (NYHA) class II-III symptoms that prompted placement of a CardioMEMS device. Deployment of the CardioMEMS device was uneventful, recorded waveforms exhibited good quality and he was discharged in stable condition. Over the following six months, the patient remained free from heart failure-related hospitalizations and regularly transmitted readings from the CardioMEMS device, which indicated well-controlled pulmonary artery (PA) diastolic pressure. However, after six months, the transmitted waveforms from the CardioMEMS device were dampened, although the patient did not exhibit any symptoms. Angiography revealed the device had migrated distally from its original placement site and wedged at the vessel bifurcation. No evidence of thrombus was detected. The device was then recalibrated using a pulmonary artery catheter. Non-invasive methods can also be used for recalibration of the CardioMEMS device such as echocardiography. In such case, a pulmonary regurgitation jet, along with mean pulmonary artery and diastolic pulmonary artery pressures can be used to determine pulmonary artery systolic pressures. Although this non-invasive method can be used for recalibration, it is limited by adequate echocardiography windows. The patient was discharged in stable condition and continued to receive follow-up care as an outpatient. On follow-up at six months, the CardioMEMS device continued to transmit data used to manage the patient's heart failure [7].

Conclusion

Our case highlights a rare and noteworthy complication of very late migration of the CardioMEMS monitoring device six years after implantation. Although CardioMEMS has shown promising results in improving heart failure management and reducing hospitalizations, it is essential to be aware of potential device-related complications. Late device migration, although uncommon, can lead to inaccurate transmission of pulmonary artery pressure readings, hindering optimal medical management and potentially affecting patient outcomes. This case emphasizes the importance of vigilance in monitoring patients with implanted devices and underscores the need for further research and surveillance of long-term device performance and safety.

Patient consent

The patient has consented to his medical course being used for a case report and educational purposes.

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