ESC European Society of Cardiology

European Heart Journal - Case Reports (2022) **6**, 1–4
https://doi.org/10.1093/ehjcr/ytac113

CASE REPORT
Heart failure

Large pulmonary artery pseudoaneurysm after CardioMEMS implantation: a case report

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Received 9 August 2021; first decision 4 September 2021; accepted 8 March 2022; online publish-ahead-of-print 22 March 2022

Background CardioMEMS heart failure (HF) system is an implantable wireless pressure sensor that is placed in a branch of the pulmonary artery (PA) for remote monitoring of PA pressures in patients with HF. Pulmonary artery injury/haemoptysis can occur during the sensor placement.

Case summary An 80-year-old male patient with HF with reduced ejection fraction (20%) underwent CardioMEMS HF system implantation for recurrent shortness of breath. He developed haemoptysis and dyspnoea during the procedure, which was managed with furosemide. The patient's computerized tomographic angiography showed a 3.4 cm pseudoaneurysm with active extravasation from the superior segmental branch of the left PA due to injury during device placement. The decision to embolize the pseudoaneurysm was made after a multi-disciplinary team meeting and discussion with the patient. The embolization procedure was carried out successfully with the final left pulmonary angiogram showed complete stasis and no further filling of the pseudoaneurysm sac.

Discussion The incidence of mortality in patients with PA injury from CardioMEMS devices is high, and therefore prompt diagnosis and management are critical. Pulmonary artery pseudoaneurysms are uncommon and present with haemoptysis. Transcatheter embolization has been shown to be a practical, effective, and safe therapeutic option in stable patients.

Keywords CardioMEMS • Pseudoaneurysm • Embolization

ESC Curriculum 2.1 Imaging modalities • 7.4 Percutaneous cardiovascular post-procedure

Learning points

- CardioMEMS heart failure system implantation can be associated with pulmonary artery (PA) injury and lead to haemoptysis.
- Large PA pseudoaneurysm in a haemodynamically stable patient can be managed with transcatheter embolization.

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Handling Editor: David Duncker
Peer-reviewers: Marta Cvijic; Milenko Zoran Cankovic; David Niederseer
Compliance Editor: Lavanya Athithan
Supplementary Material Editor: Michael Waights

Timeline

0 days	CardioMEMS heart failure system is placed Haemoptysis and dyspnoea during the procedure managed with intravenous furosemide Post-procedure chest radiograph showed right-sided pleural effusion managed with thoracocentesis
2 days later	Admitted for recurrent post-procedure haemoptysis episodes and computerized tomographic angiography showed 3.4 cm pseudoaneurysm with active extravasation from the superior segmental branch of the left pulmonary artery
5 days later	Patient underwent successful transcatheter embolization of the pseudoaneurysm
10 days later	Patient was stable with no further haemoptysis episodes and was discharged

Introduction

CardioMEMS heart failure (HF) system (Abbott, Abbott Park, IL, USA) is an implantable wireless pressure sensor that is placed in a branch of the pulmonary artery (PA) for remote monitoring of PA pressures in patients with HF. In hospitalized patients with HF, patients across a spectrum of ejection fraction have similarly poor 5-year survival and risk of readmission.[1] The CHAMPION trial demonstrated a 37% reduction in HF hospitalizations as was seen in NYHA Class III HF patients with recent HF hospitalizations if haemodynamic monitoring was used.[2] Based on this trial, the US Food and Drug Administration (FDA) has approved the device for this subgroup of HF patients, and it has also been endorsed by the European Heart Failure guidelines.[3–5] Device implantation has been found to be safe with a very low rate of adverse events.[2,6,7]

Case presentation

An 80-year-old male with HF with reduced ejection fraction (EF, 20%) due to ischaemic cardiomyopathy NYHA Class III symptoms and a recent admission for HF was referred for CardioMEMS implantation. He has a past medical history of atrial fibrillation, moderate chronic obstructive pulmonary disease (COPD), chronic kidney disease, peripheral artery disease, and implantable cardiac defibrillator placement. Heart failure was being managed with metoprolol tartrate 25 twice a day (b.i.d.) and torsemide 10 mg every other day, for atrial fibrillation he was receiving apixaban 5 mg b.i.d., and for COPD he was receiving a combination of fluticasone, umeclidinium, and vilantero along with ipratropium–albuterol. Echocardiogram showed an EF of 20% with moderately dilated left ventricular cavity, mild mitral regurgitation, and moderate to severe tricuspid regurgitation. Apixaban and clopidogrel were held 24 h before the procedure. During the deployment procedure, the PA systolic/diastolic/mean pressures were 52/21/36 mmHg, respectively, and the pulmonary capillary wedge pressure was 23 mmHg. The CardioMEMS device was deployed in the left lower lobe segmental PA. The patient developed haemoptysis and dyspnoea during the procedure and was given intravenous furosemide 80 mg for suspected acute pulmonary oedema in the cardiac catheterization laboratory, after which the patient reported considerable improvement. Post-procedure chest radiograph showed right-sided transudative pleural effusion, which was managed with thoracocentesis along with new consolidation in the mid-left lung on the side of the device placement (*Figure 1*).

Laboratory testing post-procedure showed down-trending haemoglobin from 9.9 to 6.1 gm/dL and international normalized ratio of 2.1 even after transfusion of 1 unit of packed red blood cell (pRBC) and two units of fresh frozen plasma (FFP). The blood urea nitrogen (BUN) was 45 mg/dL and creatinine were 1.6 mg/dL. To further manage post-procedure haemoptysis, the patient was transferred from the community-based hospital to a tertiary-care centre. On evaluation, injury to the distal branch of the PA during CardioMEMS placement was suspected. The patient developed intermittent episodes of small-volume haemoptysis with ongoing conservative management (intravenous fluids, supplemental oxygen therapy, pRBC, and FFP transfusion). As the patient was considered stable, he was taken for a computerized tomographic angiography (CTA), which showed a 3.4 cm pseudoaneurysm with active extravasation from the superior segmental branch of the left PA (*Figure 2A–C*). After a multi-disciplinary meeting with the patient, embolization of the pseudoaneurysm was planned by the interventional radiology service.

For the pseudoaneurysm embolization procedure, ultrasound-guided right common femoral vein access was obtained. The pulmonary angiogram showed a large pseudoaneurysm arising from a branch supplying the superior segment of the left lower lobe in the

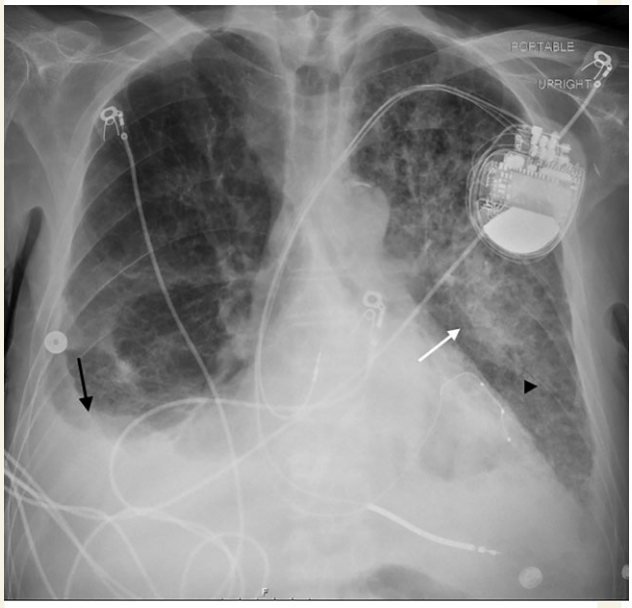

Figure 1 Chest radiograph shows a new left mid-lung consolidation (white arrow), right-sided pleural effusion (arrow), and left lower lobe pulmonary artery CardioMEMS device (arrowhead).

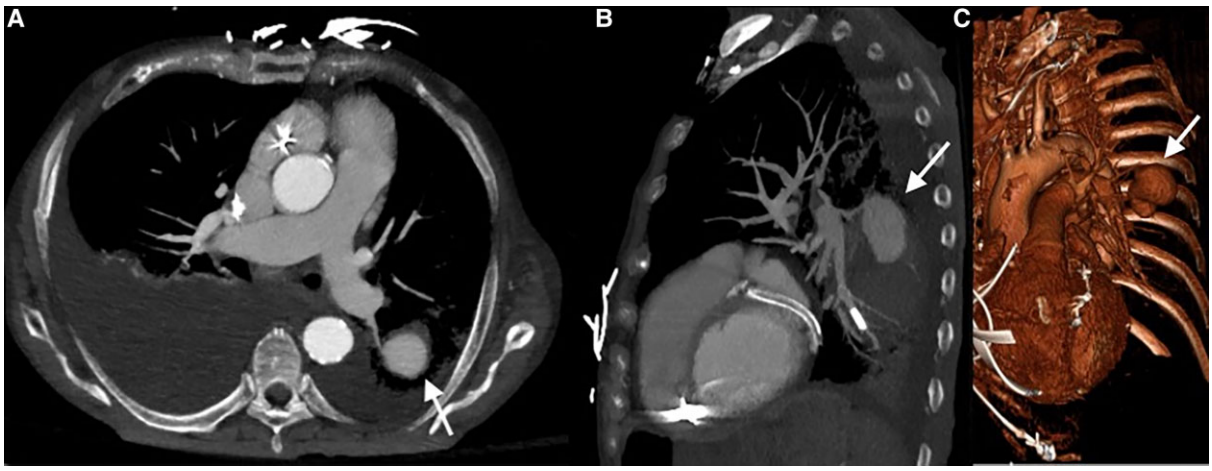

Figure 2 (*A–C*) Chest computerized tomographic angiography showing a 3.4 cm pseudoaneurysm (arrow) with active extravasation from the superior segmental branch of the left pulmonary artery in axial view (*A*), sagittal view (*B*), and 3D reconstructed (*C*). In (*B*), the location of the implant is different from the branch of the pulmonary artery with the pseudoaneurysm which shows that the arterial injury was during wire/catheter manipulation before the implant was deployed in the lower lobe branch of the pulmonary artery.

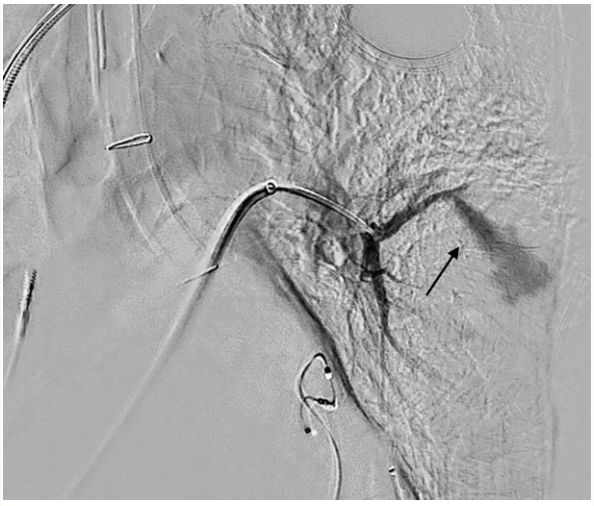

Figure 3 Selective pulmonary angiogram showing a large pseudoaneurysm (arrow) arising from a branch supplying the superior segment of the left lower lobe in the left mid-lung.

left mid-lung (*Figure 3*). The decision to perform coil embolization was made, a 2 mm coil was placed in the distal PA branch beyond the pseudoaneurysm neck, a coil scaffold was created across the neck using a 40 mm × 6 cm detachable ruby framing coil (Penumbra, Alameda, CA, USA), and a 3 mm × 1.2 cm coil was placed along the proximal aspect of the inflow feeding artery along with multiple additional 2 mm packing coils. The final left pulmonary angiogram showed complete stasis and no further filling of the pseudoaneurysm sac (*Figure 4*). The patient was extubated and transferred to the intensive care unit for monitoring and conservative management (intravenous fluids, pRBC, torsemide 20 mg started).

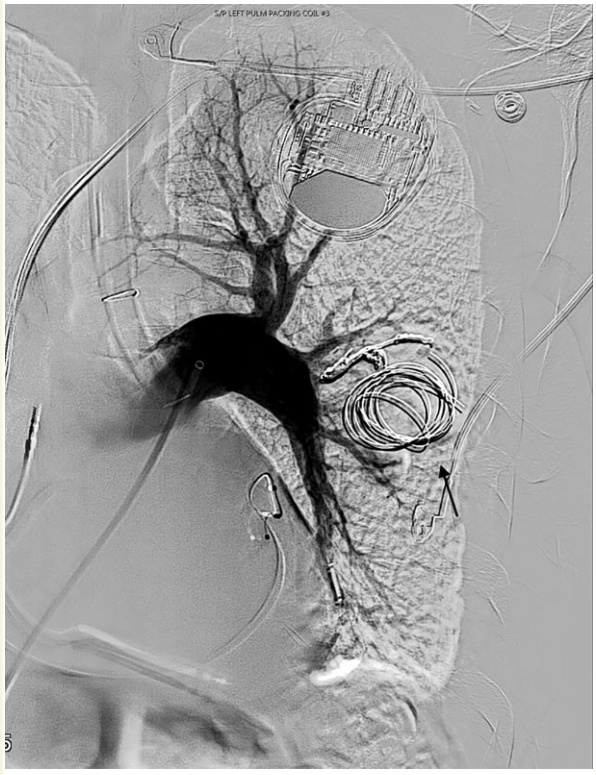

Figure 4 Post-embolization angiogram shows coils (arrow) at the location of the pseudoaneurysm with its complete exclusion.

Investigations the following day showed improvement in dyspnoea with stabilization of haemoglobin (7.9 mg/dL) and improvement of creatinine (1.44 mg/dL) and BUN (38 mg/dL), after which the patient was discharged home.

Discussion

Heart failure is one of the leading causes of hospitalizations in patients aged older than 65 years in the USA and a major health issue with a global prevalence of 40 million hospitalizations in 2015.[8] CardioMEMS is a novel wireless pressure-sensitive device that the FDA approved in 2014 to help monitor PA pressure with the help of microelectromechanical systems technology.

In the first 3 years after FDA approval, a total of 5500 CardioMEMS device implants were performed in the USA, and in these, 28 (0.5%) reports of PA injury/haemoptysis were identified.[7] Several possible mechanisms can cause PA injury and cause haemoptysis in patients undergoing CardioMEMS implantation. The most common cause of injury is due to migration of the catheter nose cone or wire.[9] In addition, PA walls of patients with HF are friable and more prone to injury due to the fragmentation of the internal elastic lamina and deposition of disorganized extracellular matrix.[9] The type of wire used for selecting pulmonary arteries can have a bearing on the risk of iatrogenic injury. Glidewires, due to their hydrophilic coating, are notorious for causing dissections and perforations if the operator does not respond adequately to the tactile feedback during the procedure.[10] In our case, the segmental PA branch injured is spatially distant from the branch in which the device was placed (*Figure 2B*), and therefore, we assume the injury occurred not from the device placement itself but from the preceding wire–catheter manipulation. Finally, the use of peri-procedural anticoagulation can worsen haemoptysis if caused due to any of the causes mentioned previously.

Strategies to decrease the risk of complications in patients undergoing CardioMEMS placement include careful patient selection, identification of the appropriate length and diameter PA branch, operator with adequate training who understands the advantages and disadvantages of the different tools and devices, and also has the resources and ability needed to identify and manage complications.

The incidence of mortality in patients with PA injury from CardioMEMS devices is high, and therefore prompt diagnosis and management are critical.[1,6] Pulmonary artery pseudoaneurysms are uncommon and are most commonly acquired and associated with cardiovascular disease. The most common presentation of pseudoaneurysms is haemoptysis, and it can range from severe acute haemorrhage to an incidental finding of imaging. Computerized tomographic angiography is helpful in prompt diagnosis of PA pseudoaneurysms. Treatment options for these pseudoaneurysms include surgical ligation, wedge resection, lobectomy; however, minimally invasive endovascular interventions like embolization and stent-graft placement are preferred. In our patient, the PA pseudoaneurysm was managed with transcatheter embolization as the patient was stable, and this has shown to be a practical, effective, and safe therapeutic option.

Conclusion

This case report describes the first documented case of PA pseudoaneurysm due to CardioMEMS implantation successfully managed by coil embolization. Although rare, complications of CardioMEMS implantation can be significant and require early recognition and expedited management.

Lead author biography

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Supplementary material

Supplementary material is available at *European Heart Journal—Case Reports* online.

Consent: The authors confirm that written consent for submission and publication of this case report, including images and associated text, has been obtained from the patient in line with COPE guidance.

Conflict of interest: None declared.

Funding: None declared.

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