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Early Detection of Subclinical Aortic Valve Endocarditis with the CardioMEMS Heart Failure System

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Male, 79
Final Diagnosis: Infective endocarditis
Symptoms: Leg edema
Medication: —
Clinical Procedure: —
Specialty: Cardiology

Objective: Unusual clinical course

Background: The CardioMEMS Heart Failure System is a well validated tool to optimize management of systolic and diastolic heart failure and has been shown to reduce the risk of hospitalization by 37%. We are reporting a unique case of acute aortic valve insufficiency as a first sign of endocarditis, detected early in a patient with the CardioMEMS device.

Case Report: A 79-year-old man with dual bioprosthetic mitral and aortic valve replacement and non-ischemic cardiomyopathy had a CardioMEMS Heart Failure System implanted 2 months following valve replacement surgery. The CardioMEMS System detected a gradual but steady increase in the pulmonary artery pressures while the patient was completely asymptomatic. A transthoracic echocardiogram demonstrated evidence of severe aortic valve regurgitation and mobile vegetation. The diagnosis of infective endocarditis was made with evidence of methicillin-sensitive *Staphylococcus aureus* bacteremia and involvement of the bioprosthetic aortic valve. The patient ultimately underwent treatment with intravenous antibiotics and redo aortic valve replacement.

Conclusions: While the CardioMEMS Heart Failure System is effective in reducing readmission rates for patients with class III heart failure, it can detect early hemodynamic changes from conditions other than congestive heart failure. Our case illustrated the CardioMEMS-assisted early diagnosis of infective endocarditis prior to clinical deterioration.

MeSH Keywords: Endocarditis • Heart Failure • Hemodynamics

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Background

The CardioMEMS Heart Failure System (CardioMEMS, St Jude Medical, Atlanta, Georgia, USA) is an implantable and wireless hemodynamic monitoring system that measures ambulatory pulmonary arterial pressure in patients with congestive heart failure (CHF) [1], which can help in the maintenance of optimal fluid status and decrease the hospitalization rate for patients with systolic and diastolic class III CHF. It was approved by the Food and Drug Administration (FDA) on May 28th, 2014 after the Champion Trial demonstrated its benefit in reducing hospitalization in patients with recurrent admission for CHF by 37% [1]. A study of 550 Medicare patients implanted with this device showed a 49% reduction in total heart failure hospitalizations, and a 58% reduction in all-cause 30-day readmission rate [2]. The benefit of this monitoring device was also proven in a non-trial setting of 2000 patients with heart failure, where it significantly reduced pulmonary arterial pressures [3].

The CardioMEMS Heart Failure system is an implantable wireless sensor, relatively small in size, which utilizes radiofrequency energy as a source of power to measure the PA pressure. It is implanted percutaneously into the distal pulmonary artery. It is currently indicated for wireless monitoring of pulmonary arterial pressure in patients with NYHA class III with 1 or more admissions for CHF in the year prior to implantation.

The implantation of CardioMEMS is relatively safe, with a 2% reported risk of adverse events, divided into device-/system-related complications (1%), and procedural-related complications (1%) [1]. These included bleeding events, readmission related to anticoagulation complications, and system delivery failure. At our institute, we have successfully implanted 75 patients with NYHA functional class III with 1 or more admissions for class III CHF in the year preceding implantation, regardless of their ejection fraction.

In this case report, we present an unusual clinical situation where the CardioMEMS Heart Failure System assisted in the early detection of subclinical aortic valve (AV) endocarditis.

Case Report

A 79-year-old man with history of hypertension, hyperlipidemia, permanent atrial fibrillation on anticoagulation, dual bioprosthetic mitral valve (MV) and AV replacement for severe degenerative mitral and aortic regurgitation, and non-ischemic cardiomyopathy, underwent placement of the CardioMEMS Heart Failure System because of recurrent admissions for congestive heart failure and fluid overload. His course was complicated with left upper-extremity cellulitis/phlebitis at a venous access site (IV), and, later, fever and sepsis with positive blood

culture for methicillin-sensitive *Staphylococcus aureus* (MSSA), for which he received intravenous antibiotics. A local wound culture also grew MSSA. An initial transesophageal echocardiogram (TEE) showed no evidence of valvular involvement (Figure 1A, 1B). The patient improved clinically and was then discharged home. Over the next 10 days, the CardioMEMS Heart Failure System detected a gradual but steady increase in pulmonary artery pressures (Figure 2) and the patient was called to come to the hospital for further evaluation. On initial evaluation, the patient had noticed mild swelling in his legs, but denied shortness of breath. His blood pressure was 95/55 mmHg, heart rate of 81 beats/min, respiratory rate of 16 breaths per minute, and pulse oximetry of 93% on room air. Physical examination revealed scattered crepitations in both lungs, with a grade II systolic murmur in the left sternal border, and a faint early diastolic murmur in the right sternal border. There were 1–2+ pitting edemas bilaterally. A chest x-ray showed mild pulmonary vascular congestion. A transthoracic echocardiogram (TTE) demonstrated normal bioprosthetic MV with evidence of moderate-severe AV regurgitation and mobile vegetation, findings which were confirmed on a subsequent TEE (Figure 1C, 1D). Blood cultures grew MSSA. A diagnosis of infective endocarditis was made given the recurrence of MSSA bacteremia and involvement of the bioprosthetic AV. The patient ultimately underwent prolonged treatment with intravenous antibiotics and redo AV replacement. He gradually recovered and was doing well on follow-up appointments over the next 18 months.

Discussion

Repeat hospitalization from heart failure presents a clinical challenge as well as a large economic burden. It remains the leading category for Medicare expenses, with approximately \$1.75 billion spent on heart failure readmissions in 2011 in the United States [4]. Ambulatory hemodynamic monitoring with the CardioMEMS Heart Failure System has proven efficacy in monitoring pulmonary arterial pressures and heart rate, which reflect fluid status in patients with New York Heart Association Functional Class III, regardless of their ejection fraction [5], thus significantly decreasing the number of heart failure hospitalizations.

At our institution, we have successfully implanted more than 75 patients with the CardioMEMS Heart Failure System, with an excellent safety profile. Hemodynamic data are monitored for all patients and intervened upon when a definite trend of increase in the pulmonary arterial diastolic pressure is detected, with adjustments in diuretic dose and often with other heart failure therapy as well.

While the main advantage is reduction in repeat hospitalization rates, this device may have additional benefits. Having an

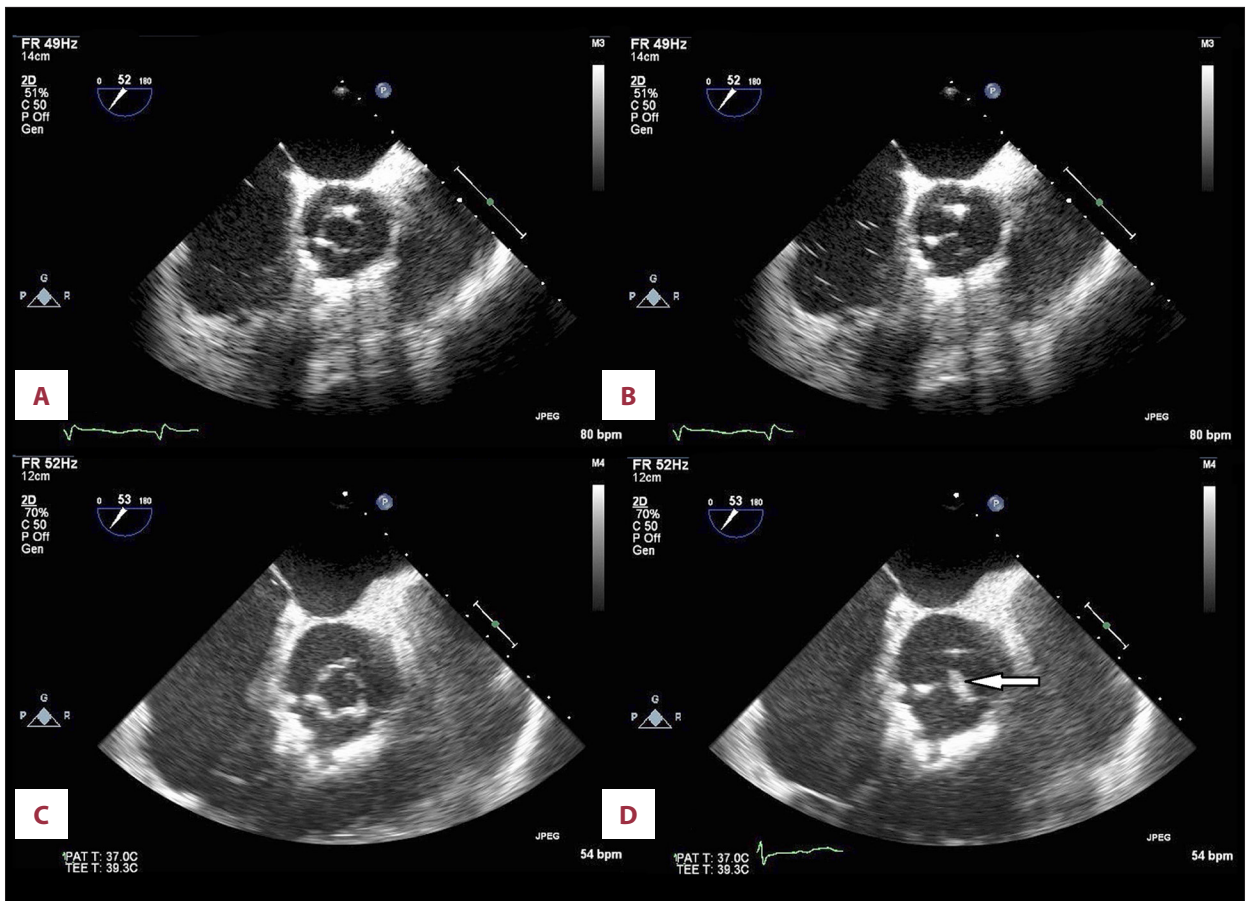


Figure 1. Transesophageal echocardiogram with short axis view of the aortic valve. (A) Initial TEE showing prosthetic aortic valve in systole, normal appearing. (B) Initial TEE showing prosthetic aortic valve in diastole, normal appearing. (C) Follow-up TEE showing prosthetic aortic valve in systole. (D) Follow-up TEE showing prosthetic aortic valve in diastole, with vegetation attached to the junction of the right and left coronary cusps (arrow).

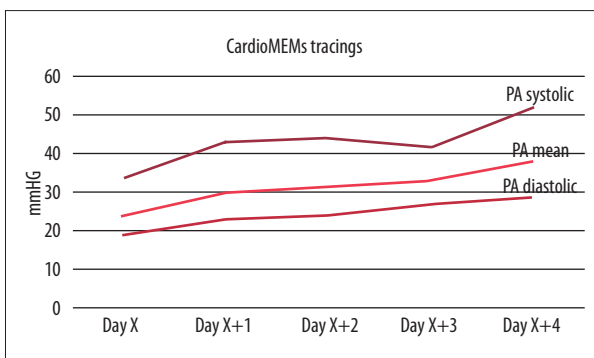


Figure 2. Measurements of pulmonary arterial pressures showing an increase in the mean and diastolic pulmonary arterial pressures over a 5-day period. Measurements were obtained through the Merlin.net™ Patient Care Network. PA – pulmonary artery.

implanted hemodynamic monitoring system can provide additional information which may be crucial in timely intervention and management and can ultimately affect outcomes.

In this case, our patient was asymptomatic but was noted to have increasing diastolic and mean pulmonary pressure readings; indicating early fluid overload as a harbinger of heart failure. The work-up revealed evidence of infective endocarditis causing severe aortic insufficiency even before clinical symptoms had developed.

In our patient, the most likely etiology for infective endocarditis was cellulitis/phlebitis at the IV access site, with local wound culture growing MSSA with subsequent MSSA bacteremia and finally seeding of the bioprosthetic AV.

Diagnosing infective endocarditis may be a medical challenge because blood cultures are negative in 2.5–31% of cases, delaying the diagnosis and posing therapeutic issues [6]. Our patient was treated accordingly in a timely manner, thereby potentially favorably affecting the clinical outcome. Despite the fact that the patient needed another surgery for replacing the infected aortic valve, early detection and antibiotic administration may have played a major role in controlling the infection

and preventing more serious complications, like abscess formation or extension of infection to the mitral valve, which may have affected the operative outcome and overall prognosis [7].

At our institute, this was the only complication we had among the 75 patients implanted with the CardioMEMS Heart Failure system, despite the fact that it was not specifically related to device implantation nor anticoagulation post-procedure, giving a rate of 1.3% for complications, which is within the reported rate of adverse events associated with this relatively new device.

Conclusions

The CardioMEMS Heart Failure System is effective in reducing readmission rates for CHF, with a relatively safe profile and

adverse events rate of 1–2%, mainly related to device implantation and post-procedural management.

The system can detect early hemodynamic changes from conditions other than CHF. Our case illustrated the CardioMEMS-assisted diagnosis of subclinical infective endocarditis, which we believe helped achieve a better clinical outcome.

While the use of this device is currently limited to CHF patients, our case illustrates its potential role in other clinical conditions, which may expand the use of the CardioMEMS Heart Failure System in the future.

Conflicts of interest

None.

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