

Case report on ambulatory pulmonary pressure monitoring: an attempt to reduce readmissions for heart failure with preserved ejection fraction

María Angullo-Gómez, Ainhoa Robles-Mezcua *, Víctor Manuel Becerra-Muñoz, and José Manuel García-Pinilla

Servicio de Cardiología, Hospital Universitario Virgen de la Victoria, Universidad de Málaga, Instituto de Investigación Biomédica de Málaga-IBIMA, CIBERCV, Campus de Teatinos s/n, 29010 Málaga, España

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Background

Despite many recent advances in heart failure (HF) therapies, there remains an unmet need in patients with HF with preserved ejection fraction (HFpEF) for adequate treatment and follow-up, with the potential to reduce associated mortality and morbidity. Increased intracardiac and intrapulmonary pressures have been shown to precede the onset of symptoms of decompensated HF by several days or even weeks, so there have been several attempts to influence the prognosis of HF by monitoring through various methods. One of these is ambulatory pulmonary pressure monitoring to guide treatment in anticipation of decompensation.

Case summary

We present the case of a 65-year-old woman with rheumatic valve disease and mechanical aortic and mitral prosthesis since 2003 and pacemaker since 2014, with development of severe tricuspid regurgitation in 2018 and with new valve implantation and multiple decompensations of HFpEF despite optimal medical treatment. Under follow-up in the Heart Failure Unit and after multiple unsuccessful treatment adjustments, it was decided to implant a pulmonary artery pressure monitoring device—CardioMEMS®—in order to optimize patient follow-up and treatment. The procedure was carried out without complications and early optimization of treatment was possible, resulting in a significant reduction in decompensations and admissions for HF.

Discussion

Ambulatory pulmonary pressure monitoring is shown to be a safe and effective option to anticipate treatment of heart failure decompensation even with preserved left ventricular ejection fraction, with a significantly positive impact on hospital readmissions and consequent benefit on morbidity and mortality.

Keywords

Heart failure • Preserved ejection fraction • Decompensated • Pulmonary artery pressure monitoring • Case report

ESC Curriculum

4.9 Multivalvular disease • 5.3 Atrial fibrillation • 5.9 Pacemakers • 6.1 Symptoms and signs of heart failure • 6.3 Heart failure with preserved ejection fraction

Learning points

- In the management of heart failure, we know the importance of anticipating decompensation to avoid hospitalization and the resulting benefit in morbidity and mortality.
- Increased pulmonary pressure often precedes the onset of symptoms of decompensated heart failure, even by several days or weeks.
- Ambulatory pulmonary pressure monitoring allows early readjustment of medical treatment, which could lead to a reduction in re-hospitalizations for heart failure even in patients with preserved ejection fraction.

* Corresponding author. Tel: +951032636, Fax: +34951032636, Email: ainhoa.mezcua@gmail.com

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Introduction

Despite many recent advances in heart failure (HF) therapies, there remains an unmet need in patients with HF with preserved ejection fraction (HFpEF) for appropriate treatment and follow-up, with the potential to reduce associated mortality and morbidity. The decrease in patient survival after each hospital admission for decompensation is also well known, along with a large impact on morbidity and quality of life.^{1,2} Increased intracardiac and intrapulmonary pressures have been shown to precede the onset of symptoms of decompensated HF by several days or even weeks,³ so there have been several attempts to influence the prognosis of HF by monitoring through various methods. One of these is ambulatory pulmonary pressure monitoring to guide treatment and anticipate HF decompensation.

Timeline

April 2003	Age	Aortic-valve and mitral-valve mechanical prosthesis
	46	
April 2014	Age	Permanent atrial fibrillation with rapid ventricular response AV node ablation and single chamber pacemaker
	57	
October 2017 to November 2018	Age	Numerous admissions at the emergency services because of congestive heart failure
	61	
		Tricuspid valve regurgitation due to interposition of the pacemaker lead and concomitant severe pulmonary hypertension.
		Normal function of previous prostheses. Preserver ejection fraction
May 2019	Age	Right heart catheterization: moderate precapillary and postcapillary pulmonary hypertension.
	62	
January 2020	Age	Heart team meeting: tricuspid-valve porcine bioprosthesis
	63	
February 2020 to October 2020	Age	Recurrent medical treatment readjustments Persistence and worsening of symptoms despite optimization of treatment, several admissions in hospital
	64	
October 2020	Age	Implantation of a pulmonary artery pressure monitoring device -CardioMEMS®-
	65	
Since November 2020	Age	Pulmonary pressure-guided treatment setting
	65	
		Anticipation of heart failure decompensation
		No new hospitalizations

Case presentation

We report the case of a 65-year-old female with HFpEF for rheumatic heart disease since 2003. She was independent for activities of daily

living, who did not have known toxic habits, and was allergic to digoxin, atenolol, and fentanyl. She presented several cardiovascular risk factors—hypertension, dyslipidaemia, and obesity. She was first studied by a cardiologist in 2003 due to rheumatic heart disease, which led to cardiac surgery in 2003, undergoing the implantation of an aortic-valve mechanical prosthesis and a mitral-valve mechanical prosthesis. From 2014, she suffered from numerous episodes of permanent atrial fibrillation with rapid ventricular response. Heart rate could not be controlled despite the use of high doses of beta blockers and, eventually, an AV node ablation and a single chamber pacemaker implantation were undergone (*Figure 1*). In 2018, she had numerous admissions at the emergency services because of congestive HF.

Physical examination revealed a discrete holosystolic murmur best heard at the lower left sternal border and signs of pulmonary congestion and peripheral oedema.

The left ventricular ejection fraction was preserved (>50%) with no changes in follow-up and normal function of the two previous prostheses. However, severe tricuspid valve regurgitation due to the interposition of the pacemaker lead and concomitant severe pulmonary hypertension were evident (*Supplementary material online, Videos S1 and S2*).

Given the appearance of severe valvular heart disease with the patient being very symptomatic and with multiple admissions, we began the study to find the best treatment option. Coronary angiography was performed to rule out the presence of coronary artery disease and to study the severity and aetiology of the pulmonary hypertension. Right heart catheterization indicated moderate precapillary and moderate postcapillary pulmonary hypertension. After discussing her case at the heart-team meeting and an optimization of the patient's condition, a porcine tricuspid valvular tricuspid bioprosthesis was implanted in January 2020, which was performed without significant complications.

Subsequently, the patient began close follow-up by our advanced HF unit, with optimization of treatment and health education regarding lifestyle modification and flexible diuretic regimen. During follow-up, the patient required recurrent readjustments of the medical treatment by the HF nurse specialist and the cardiologist. Within this year, the patient had to be continuously assisted due to persistence and worsening of her symptoms despite optimization of her treatment and had to be repeatedly admitted for HF decompensation.

Given this situation of multiple decompensations, the possibility of implanting a pulmonary arterial pressure monitoring device—CardioMEMS®—was considered, with the aim of optimizing patient follow-up and treatment in an attempt to reduce decompensations and admissions for HF, because we had no more possibilities for medical treatment or device optimization. The case was presented in session with a multidisciplinary heart team (clinical cardiologists, haemodynamic cardiologists, cardiac surgeons, and anaesthetists), approving the procedure, which was carried out in October 2020 without incidents (*Figures 2 and 3, Supplementary material online, Videos S3 and S4*).

The CardioMEMS® device is a wireless device that is implanted percutaneously in the pulmonary artery (PA). Using a pillow-shaped electronic console, the patient transmits PA pressure (PAP) readings to a secure online database, which can be accessed by the managing cardiologist. In our case, the procedure was performed via the right femoral vein using a 12F sheath and a double Proglide® system was used to close it. Subsequently, the patient was enrolled in an education programme to successfully perform daily measurements at home.

Since the implantation of the CardioMEMS®, our patient was monitored by weekly reports which were carefully reviewed by the HF team. If the treating cardiologist detected a trend of increasing PAPs, the patient was contacted and asked to come to the clinic for a visit, or her medication was directly adjusted via telephone (e.g. by increasing the dose of diuretics or making a change in any other HF treatment). In some cases, management included simple dietary advice and salt restriction following dietary indiscretions. Indeed, we perceived a significant

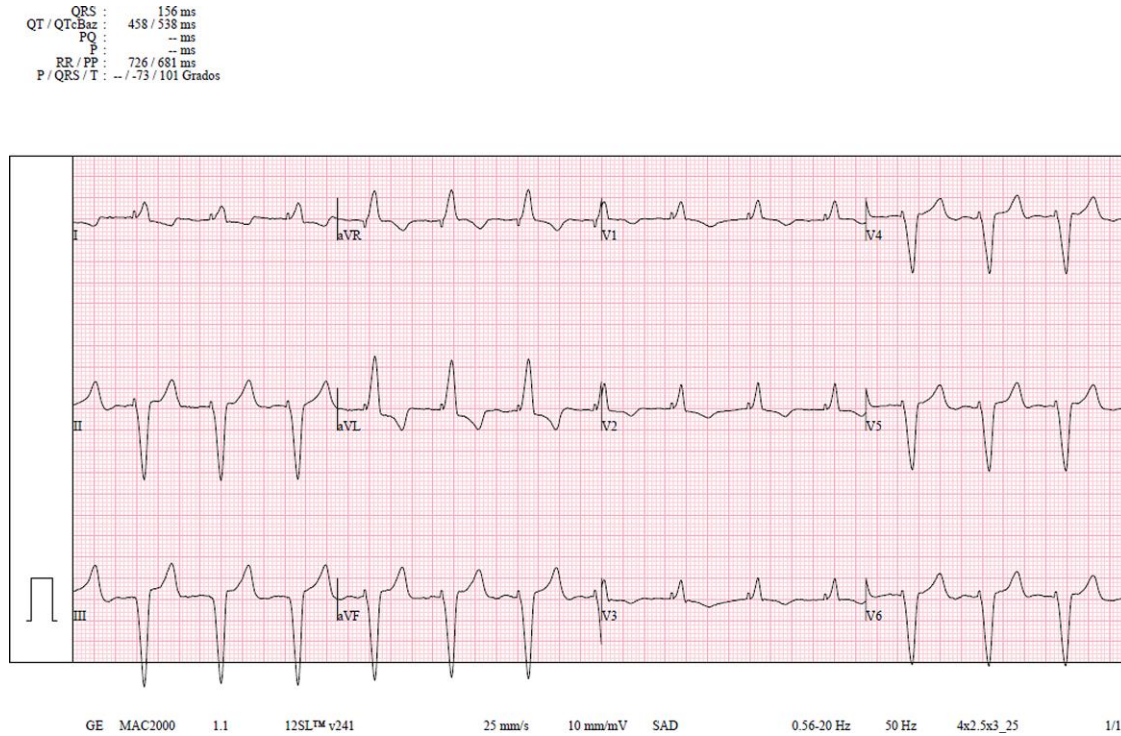


Figure 1 Electrocardiogram in atrial fibrillation with ventricular pacing by pacemaker.

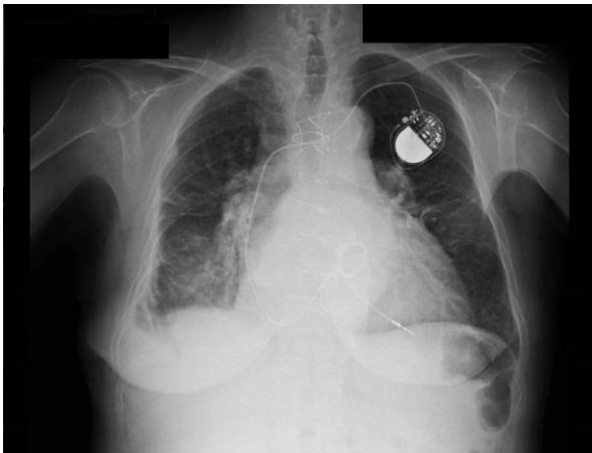


Figure 2 Posteroanterior chest X-ray showing the three prostheses and the CardioMEMS device.

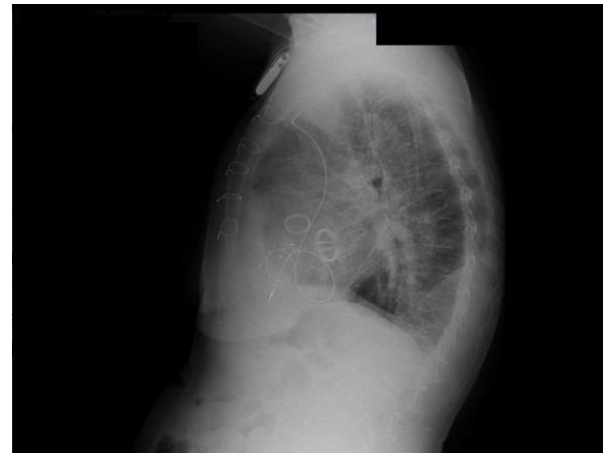


Figure 3 Lateral chest X-ray showing the three prostheses and the CardioMEMS device.

improvement in compliance with lifestyle modification and prescribed medication changes in this patient, as a result of her awareness of being closely monitored (Figure 4).

Discussion

Despite many recent advances in HF therapies, there remains an unmet need in patients with HFpEF for appropriate treatment and follow-up, with the potential to reduce associated mortality and morbidity. The

decrease in patient survival after each hospital admission for decompensation is also well known, along with a large impact on morbidity and quality of life.^{1,2} Increased intracardiac and intrapulmonary pressures have been shown to precede the onset of symptoms of decompensated HF by several days or even weeks,³ so there have been several attempts to influence the prognosis of HF by monitoring it through various methods. One of these is ambulatory pulmonary pressure monitoring to guide treatment and anticipate HF decompensation.

The TELE-HF trial and the TIM-HF trial showed no significant difference between the telemonitoring group and the control group in terms of

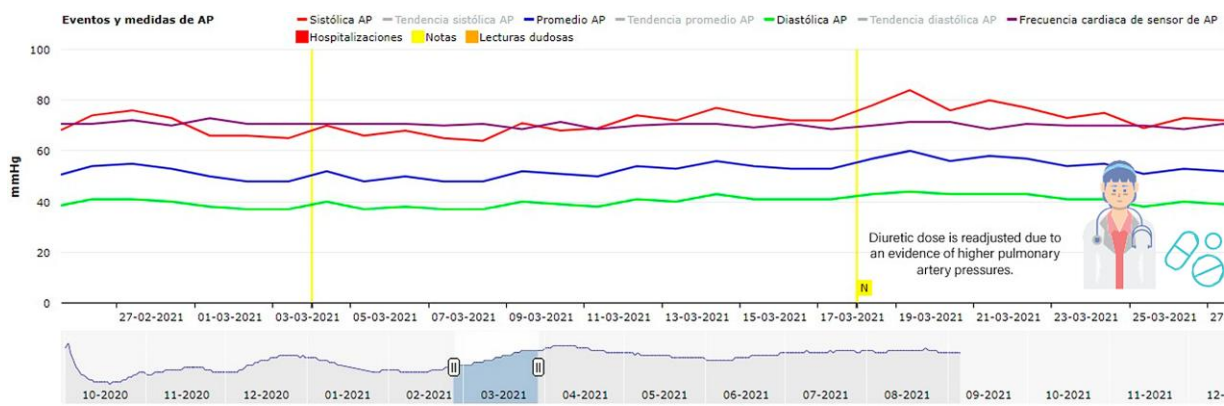


Figure 4 Chart recording the pulmonary pressures measured by the patient and the treatment adjustments reported by the cardiologist.

rehospitalization and death rates.^{4,5} The CHAMPION trial showed a significant reduction in HF hospitalizations, shorter length of stay, and improved quality of life in NYHA Class III patients with a prior HF hospitalization in the preceding 12 months who were undergoing ambulatory PAP monitoring with a CardioMEMS® device.⁶ These results have been confirmed in subsequent studies.^{7,8} More recently, in GUIDE-HF trial, investigators aimed to demonstrate that the CardioMEMS device could be used in a broader group of HF patients than in previous trials: in those with NYHA Class II or IV HF, or in patients with elevated natriuretic peptides but no prior hospitalization.⁹ The trial missed its primary endpoint, but an analysis showed that COVID-19 had a statistically significant effect on the results. We need more clinical trials in this regard in the future, but these previous studies show that there is room for tailored therapy, not to mention the ability that this information about how HF medication affects pressures may contribute to empowering both, doctors and patients, in understanding doses strategies and the course of their disease, respectively.

We present the first experience with CardioMEMS® in a patient HFpEF as an example of how ambulatory PAP monitoring can influence readmissions for decompensated HF, being a safe and effective option with a significantly positive impact on HF readmissions, which can be extrapolated to other patients with HFpEF or HF with reduced ejection fraction.

Lead author biography



Dr María Angullo-Gómez acquired her medical degree at 'University of Cordoba, Spain', and Actually she works as Resident Doctir in Cardiology in Hospital Virgen de la Victoria, Malaga, Spain.

Supplementary material

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

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

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.

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