Pulmonary artery pressure telemonitoring by CardioMEMS in a patient pre- and post-left ventricular assist device implantation

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Abstract

We present a case to demonstrate the feasibility of pulmonary artery monitoring with the CardioMEMS sensor for the preoperative optimization of patients with end-stage heart failure undergoing LVAD surgery. Additionally, we demonstrate the feasibility of combining two state-of-the-art techniques by integrating haemodynamic feedback from CardioMEMS and static pump settings of an LVAD. CardioMEMS aids in the remote monitoring of LVAD patients with the potential of identifying complications, pump dysfunction or filling status alterations.

Keywords: Heart failure · CardioMEMS · Telemonitoring · Left ventricular assist device · HeartMate3

INTRODUCTION

Currently, CardioMEMS is used for the remote monitoring of patients with chronic heart failure (HF) [1, 2], and has been applied, to a certain extent, in patients from the CHAMPION trial who required LVAD implantation or in patients post-LVAD implantation [3, 4]. However, we hypothesize that haemodynamic data from the CardioMEMS system can be used to optimize patient haemodynamics pre-LVAD implantation, in addition to echocardiographic and clinical parameters. We believe that lowering pulmonary artery pressure (PAP), ideally aiming for a mean PAP (mPAP) $< 25\text{mmHg}$, which is an indication of optimal decongestion of the right ventricle (RV), is the best way to proceed towards surgery.

Figure 1: (A) Daily PAPs, prior and post-LVAD implantation. (B) PAP reading shortly after CardioMEMS implantation, showing a clear notch, indicating severe mitral valve insufficiency. (C) PAPs, after optimization: PAPs are within the target range, and the notch has disappeared. (D) PAPs, after LVAD implantation, showing that the CardioMEMS provides a good quality signal after LVAD implantation. LVAD: left ventricular assist device; PA: pulmonary artery; PAP: pulmonary artery pressure.

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interference between the LVAD, hospital equipment and the CardioMEMS system was observed. PAP was elevated as a result of transfusions after implantation, and continued to rise as a sign of congestion. The PAPs were used to optimize HF therapy (up-titrating diuretics, mineralocorticoid receptor antagonists (MRA) and renin-angiotensin-system (RAS)-blockers), resulting in a normalization of the PAPs (Fig. 1D), and MI reduced to mild on echocardiography. The patient remained stable without complications and was discharged on LVAD support in good clinical condition.

DISCUSSION

The CardioMEMS device provides haemodynamic information on a daily basis, which can be used by the treating clinician for patient management. The use of this additional mode of haemodynamic feedback will change the way clinicians work. Weekly monitoring of the haemodynamic parameters allows for timely reaction on haemodynamic changes and medication to be adjusted accordingly, providing truly individualized therapy [2]. CardioMEMS is a very safe system, with only 1% of patients developing device-related complications, and the most common complication is bleeding at the puncture site after implantation, which is easily managed [1].

In pre-LVAD management, clinical signs, laboratory results and echocardiography are currently used to guide pre-LVAD optimization. However, data describing the accuracy of these techniques are lacking. Additional daily haemodynamic information is very important to achieving true pre-LVAD optimization, as has been shown in our case. Thus, unloading the RV and kidney could potentially reduce the preoperative risk for RV and kidney failure.

Currently, post-implantation monitoring is limited to pump-controller defined parameters, which display fixed number of rotations, calculated pump flow and pulse index. Adding haemodynamic changes measured with the CardioMEMS could lead to earlier detection of complications, such as major bleeding, tamponade, RV-failure, decompensation or arrhythmia. Earlier detection facilitates earlier treatment, potentially improving outcome.

Currently, this new technology is only used in clinical trials. However, the combination of CardioMEMS and LVAD could enable telemonitoring of patients who have undergone LVAD implantation.

Conflict of interest: none declared.

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