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Case Report

First implantation of the pulsatile left ventricular assist device iVAC2L in a heart failure patient infected with influenza type A

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In the last decade, novel percutaneous mechanical assist-devices have emerged, closing the gap between the minimum support delivered by the intra-aortic balloon pump (IABP) and the maximum support provided by the extracorporeal membrane oxygenation (ECMO) devices (1). Percutaneous mechanical circulatory support is intended to reduce work-load imposed to a deteriorating ventricle by reducing left ventricular pressures and volumes and potentially also increasing coronary blood flow (2) (see Table 1).

Clinical human experience with such devices is limited to high-risk percutaneous coronary interventions, however they might present a feasible option for the management of patients with cardiogenic shock (3-5). Here we present the first implantation of a pulsatile left ventricular assist device (Pulse Cath iVAC2L) in a patient with mixed cardiogenic and septic shock.

A 46-years-old female was admitted to our department due to worsening of a chronic heart failure with a reduced left ventricle ejection fraction (LVEF≈20%) owed to a post-partum cardiomyopathy. The patient was stable under optimal medical therapy for many years and had already undergone an automatic cardioverter defibrillator implantation. Right heart catheterization revealed a low cardiac output (CO) (2,57 l/min), increased left ventricular filling pressures and fluid congestion. Subsequently high diuretic doses were prescribed in order to decongest the patient.

Unlikely, during the hospital stay the patient developed fever and was diagnosed with Influenza type A. The infection led to hemodynamical instability, so that inotropes and vasopressors were gradually obligatory to maintain adequate circulation. Due to an electrical storm the patient was resuscitated, intubated and transported to the cardiac intensive care unit for further treatment. In that critical situation, the cardiac output was estimated as inadequate for the increased needs of the patient, so that the decision to implant a mechanical support device was met.

After obtaining percutaneously femoral access, the 18Fr special sheath was inserted over a super stiff wire. Then the iVAC2L device was inserted and correctly positioned using a contralaterally inserted pigtail catheter placed on the aortic cusps und thus marking the aortic valve position. This technique raised awareness, that in large ventricles the device could eventually fully dive into the left ventricle and consequently not work properly (Fig. 1A and B).

The cardiac output and cardiac index (CI) continuously monitored through a Swan-Ganz catheter, increased from 2.5 L/min and 1.2 L/min/m^2 respectively to 5.2 L/min and 2.5 L/min/m^2 (Fig. 1C). The device remained in use and effectively supported the patient for more than 48h. However, the patient gradually deteriorated and died in a septic condition, where the systemic vascular resistances continually declined.

Summarizing, the PulseCath iVAC2L is a transaortic left ventricular assist device (6, 7) that uses a pneumatic driving system to produce pulsatile forward flow able to generate an additional CO up to 2 L/min (8) in order to support patients undergoing high-risk percutaneous coronary interventions (9, 10). While precursor models of the device have been used in order to win patients out of

Abbreviations: IABP, Intra-Aortic Balloon Pump; ECMO, Extracorporeal Membrane Oxygenation; LVEF, Left Ventricular Ejection Fraction; CO, Cardiac Output; CI, Cardiac Index; HR, Heart Rate; MAP, Mean Arterial Pressure; MPAP, Mean Pulmonary Arterial Pressure; PCWP, Pulmonary Capillary Wedge Pressure.

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Table 1
Learning points.

Learning Points
• Exacerbation of chronic heart failure caused by type A influenza can lead to hemodynamic instability requiring circulatory support.
• The combination of inotropic agents and iVAC2L pulsatile ventricular assist device can provide up to 2.5 L additional cardiac output during an exacerbation of chronic heart failure due to influenza type A and may be useful to maintain an adequate circulation during hemodynamic critical situations.
• The iVAC2L system might be successfully operated even beyond the 24h labeled by the manufacturer
• Intraprocedural placement of a pigtail catheter on the aortic valve cusps facilitates proper iVAC2L placement

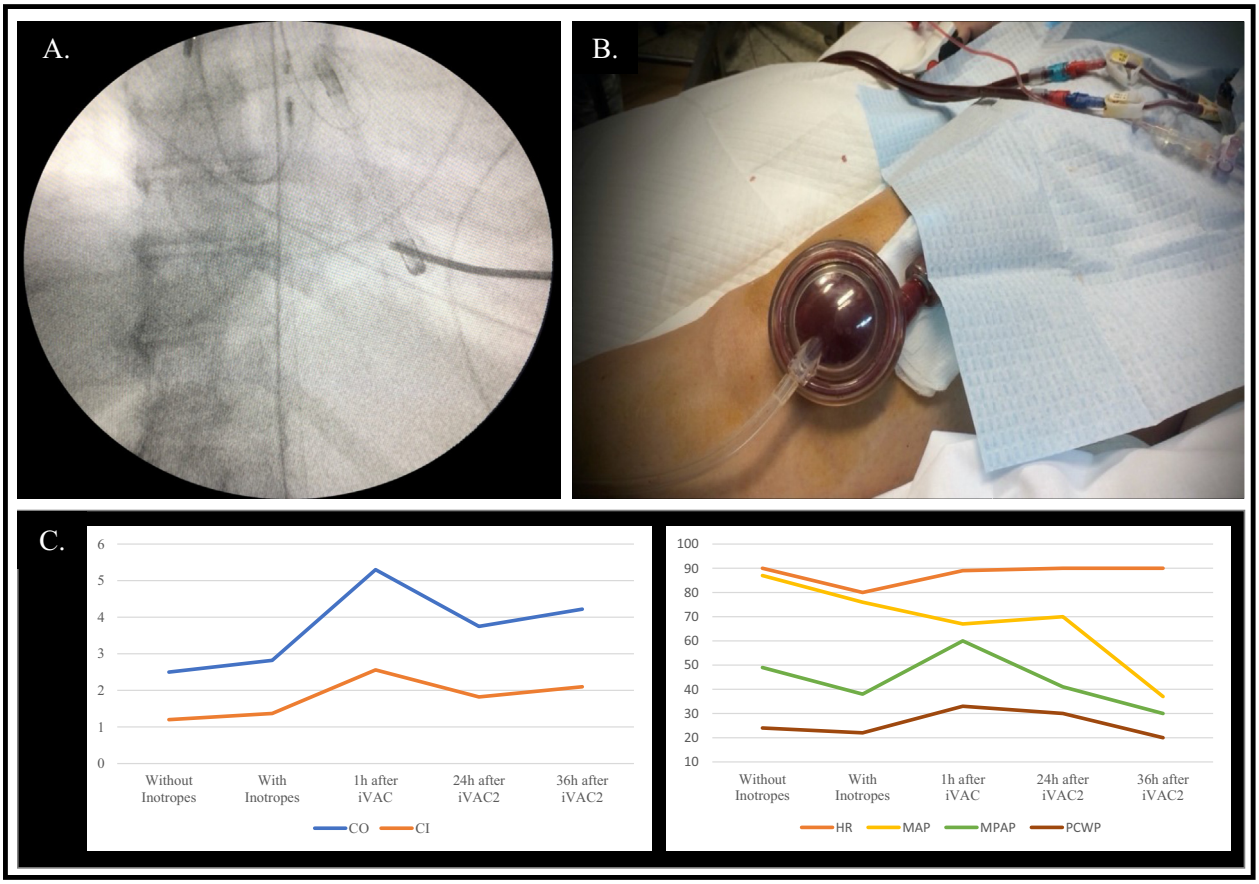

Fig. 1. **(A)** The iVAC2L device in its final position after the removal of the stiff wire, **(B)** The PulseCath catheter is connected with an IABP console, **(C)** The cardiac output, cardiac index and pressure measurements pre- and post-implantation. CO: cardiac output; CI: cardiac index; HR: heart rate; MAP: mean arterial pressure; MPAP: mean pulmonary arterial pressure; PCWP: pulmonary capillary wedge pressure.

ECMO (11), no large studies using the iVAC2L device have been published so far.

Here we demonstrate the first iVAC2L implantation in a patient with a mixed cardiogenic and septic shock, operated off label over the 24h limit described by the manufacturer. Percutaneous mechanical assistance of the heart, in cases with uncontrolled infection might is not an ideal indication. However, the concept of bridge-to-recovery, may give the necessary time for the patient to overcome a potentially reversible condition.

Consent

Written consent has been obtained from the patient.

Conflict of interest

Nothing to declare.

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