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Case Report

Impella Cardiac Power Device used in Patient with Cardiogenic Shock Due to Non-Ischemic Cardiomyopathy

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Abstract

The percutaneous Impella CP (Cardiac Power; Abiomed, Inc., Danvers, MA) was designed to provide a higher level of cardiac support than Impella 2.5 (Abiomed, Inc.). We present a case of a patient in which we used Impella CP in the setting of refractory cardiogenic shock due to non-ischemic cardiomyopathy. A 33-year-old male patient known to have idiopathic dilated non ischemic cardiomyopathy, presented to King Abdulaziz university Hospital with progressive dyspnea, orthopnea and lower limbs edema, BP was 97/50 with heart rate of 97 bpm, he was admitted initially to medical floor and Lasix infusion. His echocardiogram showed biventricular failure with left ventricular EF of 10%. Over the course of the subsequent three days, the patient's condition deteriorated and became hemodynamically unstable, where he was shifted to ICU and started on inotropes. In the ICU, he became critically ill with severe multiorgan failure. His conscious level started to deteriorate; thus, he was Intubated and mechanically ventilated. His hemodynamic profile shows severe cardiogenic shock, despite the fact that he was on maximum dose of levophid, dopamine and epinephrine, he was taken to cardiac catheterization laboratory, right heart catheterization using swan catheter shows right atrial pressure 28 mmHg, pulmonary capillary wedge pressure 30 mmHg, with cardiac index 1.6 L/min. Impella CP was inserted which can provide up to 3.5 L/min of cardiac output. Over the course of the next 72 hours, the patient showed significant improvement in his hemodynamics profile and cardiac function (LVEF 28% estimated by echocardiogram), with recovery of liver function. The Impella CP was removed with no complications. The Impella CP was shown to be safe and effective for prolonged use in critically ill patients with non-ischemic cardiomyopathy, and may significantly improve their outcome & prognosis.

Introduction

Left ventricular assist devices are commonly used in critically ill patients with cardiogenic shock to reduce the cardiac workload and provide sufficient circulation to the myocardium and vital organs. Prognosis is poor for patients with acutely decompensated advanced heart failure (HF) refractory to medical therapy [1]. Evaluating candidacy for durable mechanical circulatory support, orthotopic heart transplantation (OHTx), or palliative care is complex and may take a meaningful amount of time. This complexity is compounded by hemodynamic instability. In addition, outcomes are worse for patients who undergo durable left ventricular (LV) assist device (LVAD) implantation while in cardiogenic shock (Interagency Registry for Mechanically Assisted Circulatory Support [INTERMACS] Profile 1) compared with outcomes for hemodynamically stable patients [2] and rarely can these patients be listed for OHTx. Temporary circulatory support (TCS) devices may offer a bridge-to-decision (BTD) option in this population, providing hemodynamic stabilization and potentially slowing, stopping, or reversing the downward spiral of cardiogenic shock

until transition to durable therapy is appropriate [3].

The Impella CP (Cardiac Power) (Figure 1) is a 14F pump mounted on a 9F catheter and can provide peak blood flows of approximately 4 L/min using the same console platform as the Impella 2.5.

Figure 1: Impella CP.

Case presentations

33-year-old male was diagnosed with non-ischemic cardiomyopathy, presented to King Abdulaziz University Hospital with progressive dyspnoea, orthopnoea, PND and lower limb edema. On examination, BP 97/50, HR 97 bpm, afebrile, JVP was 10cm above the sternal angle. On cardiac exam, he had gallop rhythm, lungs exam reveals fine crepitation up to the upper zone of both lungs. He had ascites and bilateral lower limb edema up to the knees. He was admitted to medical floor on Lasix infusion. Later, he became hypotensive, requiring dopamine infusion 15 meg/min, thus, he was shifted to intensive care unit. His level of consciousness started to decline and he was intubated to secure airways. Over the course in the ICU, he required escalating the dose of introps and pressors; he was on maximum dose of epinephrine, dopamine, and levophid. He started to have multiorgan failure; he required haemodialysis due to acute tubular necrosis from profound hypotension. The decision was made to bridge him to decision, which would be LVAD or heart transplant, using Impella CP. IV Milrinone was added at dose 0.375 meg/kg/day. Echocardiogram showed biventricular failures, sever tricuspid regurgitation with PASP of 62 mmHg. He was taken to cardiac catheterization lab with PH 6.9 Lactate 16, on maximum dose of introps and pressors (Table 2), right heart hemodynamics before impella CP implantation shown in table 2. Impella CP was delivered through left femoral arterial approach. Appropriate position of Impella CP device in the left ventricular was confirmed by transthoracic echocardiogram before he was shifted back to ICU. Over the course of 72 hours; his hemodynamic had improved with successful weaning off introps and presser's. He was kept on IV milirnon for RV support (Table 2). On day 3, impella CP was removed due to profound haemolysis with coagulopathy requiring multiple blood transfusion as well as platelets transfusion. His echocardiogram showed EF 28%, mild reduced in RV function and moderate TR. He was extubated successfully on day 4. His kidney function did not recover, therefore decision was made that he is not candidate for LVAD. Transplant work up had been started. He was shifted to medical floor on IV milirnon. He remained stable in the medical floor for two months; however, he developed line sepsis leading to septic shock. He was transferred to ICU; he passed away after 4 days from development of septic shock.

Discussion

The use of durable LVADs is growing exponentially. During the past decade, LVAD implantation for INTERMACS 1 patients has declined as a result of a high risk of early death after LVAD surgery. Thus, more physicians are looking for alternative approaches such as TCS devices. However, these devices differ from LVADs in several important ways, and not all TCS devices are made the same. Possible advantages of the Impella over other TCS options, such as intra-aortic balloon pump (IABP) or venoarterial extracorporeal membrane oxygenation (ECMO), include the magnitude of LV unloading (contrasted to increased afterload on ECMO) and the marked increase in cardiac output (unlike IABP, which is a diastolic pressure augmentation device that requires native cardiac contractility for its function [4]. The axillary approach in carefully selected patients demonstrated profound device stability and allows more patient movement, even to the point of ambulation. Second, in contrast to durable LVADs, withdrawal of temporary support if a patient is identified as a poor candidate for OHTx or LVAD is often considered a successful outcome for use of the device. This ability to "buy time" to sort through the myriad other clinical issues that go into candidacy for durable support treatments (such as determination of adequate social support or investigation of other comorbidities) so that appropriate decisions can be made is a critical objective of the BTD strategy. TCS enables the care team to provide adequate hemodynamic support during a critical clinical situation and thus accomplish multiple tasks. The first goal is stabilization of patients in cardiogenic shock, and implantation is hopefully early enough to allow reversal of end-organ dysfunction. Our findings indicate that this type of TCS is a feasible option for BTD in patients with pre-existing advanced HF and acute decompensation being evaluated for advanced therapies, providing a means to allow stabilization and reversal of cardiogenic shock before a final decision on next therapy is made will ultimately improve these patients' chances of survival from the acute incident and the ability to successfully undergo a more durable solution via OHTx or LVAD.

In our patient, Initial support with the Impella CP allowed for the stabilization of the hemodynamics and delayed further degradation of the patient's status while providing a maximum flow of 3.6 L/min. The patient's hemodynamics and clinical status improved markedly with the incremental flow provided by the Impella CP, reflected in (Tables 1 and 2). Not only had hemodynamic parameters continuously improved from the time of insertion of the Impella CP to the time of removal of the device, but also we were able to wean Epinephrine and Dopamine and Levophid support (Table 2).

	Pre- Impella	Impella CP
Creatinine (mmol/l)	420	320
Lactate (mmol/l)	17	1.0
PH	6.9	7.38
Bicarbonate (Meq/L)	12	22
Total bilirubin (mg/dl)	57	32
AST (U/L)	976	221
ALT (U/L)	1065	251
INR	2.2	1.8
Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; INR, international normalized ratio. [a]on continuous venovenous hemodialysis (CVVHD).		

Table 1: Indicators of multiorgan failure with no Impella support and Impella CP.

	Pre impella	Impella CP
Pressors and introps		
Epinephrine (mcg/kg/min)	4mcg/min	1mcg/min
Milrinone (mcg/kg/min)	0.375 mcg/kg/min	0.375 mcg/min
Dopamine (mcg/kg/min)	20 mcg/kg/min	Weaned off
Levophid (mcg/kg/min)	4mcg/min	Weaned off
Hemodynamics		
MAP (mmHg)	52	80
RA (mmHg)	28	18
MPAP (mmhg)	48	29
PCWP (mmHg)	32	22
CO (L/min)	2.7	5.0
CI (L/min/m2)	1.4	2.8
Abbreviations: CI, cardiac index; CO, cardiac output; MAP, mean arterial pressure; PAP, pulmonary artery pressure; PCWP, pulmonary capillary wedge pressure; RAP right atrial pressure.		

Table 2: Doses of inotrops and pressors with corresponding hemodynamic parameters

There were two episodes of monomorphic ventricular tachycardia successfully terminated with pharmacological interventions. It is uncertain whether these episodes were related to epinephrine therapy, to the Impella device use, or were related to the acute cardiomyopathy itself independent of treatment interventions. There were no serious complications of the device use. The patient

experienced hemolysis while on Impella support and required a blood transfusion. The patient experienced no vascular complications related to the prolonged presence of the 9F sheath in the left femoral artery; the blood flow was not compromised. The potential complications related to the treatment with the device mentioned by the manufacturer include the occurrence of hemolysis, thrombocytopenia, bleeding, and risk of infection, as well as possible vascular complications related to both the insertion of the device as well as explanation. There is also the risk of injury to the aortic valve related to the prolonged use of the device. In this case, the patient experienced mainly hemolysis requiring multiple blood transfusions. No other complications related the devices were noted in this case.

We present a single case report of the usage of Impella CP in a patient with cardiogenic shock because of nonischemic cardiomyopathy. While no major conclusions can be drawn from this case, it is important to demonstrate, at least, the hemodynamic benefit provided by the Impella CP in the setting of refractory cardiogenic shock due to non-ischemic cardiomyopathy in the same patient. While this result was encouraging for our practice and may have saved our patient's life, prospective investigations will help establish whether the Impella CP device will become the recommended standard of care in the treatment of cardiogenic shock. In our opinion, insertion of Impella CP provided better end-organ perfusion and allowed to wean the patient from additional vasopressor support with prevention of arrhythmias related to inotropes. Although the patient passed away after two months due to septic shock, the cause of death was not due to cardiogenic shock.

Conclusions

In our case, Impella CP was demonstrated to be safe for use and to have added favorable outcome in the setting of prolonged use in our critically ill patient with cardiogenic shock.

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