Save the Leg: Utilization of Distal Perfusion Catheter With Impella CP® May Prevent Morbidity of Limb

Lydia McDermott 1, Gary Cook 1, Joshua Park 1, Qiong Yang 1, Hitoshi Hirose 1

1. Surgery, Virtua Health, Camden, USA

Abstract

Leg ischemia is a potential complication of percutaneous left ventricular assist device (Impella CP®, Abiomed, Danvers, Massachusetts, United States) placement. To avoid leg ischemia in at-risk patients, a distal perfusion catheter (DPC) should be placed. In utilizing a passive distal perfusion system from the contralateral femoral artery, we optimized blood flow to the distal limb mitigating leg ischemia. A 65-year-old female with dilated cardiomyopathy complicated by hemodynamic instability was placed on an Impella CP via the right femoral artery. A DPC was placed to the right distal femoral artery and connected to the wire re-access port of the Impella CP. Despite this, the leg became ischemic shortly after admission to the ICU. A contralateral femoral arterial line was placed in standard fashion, and it was connected to the DPC while the wire re-access port was capped. Shortly after placement of the new DPC system, the right lower extremity distal pulses returned, and distal leg ischemia was resolved. Another patient, a 67-year-old male with acute myocardial infarction, was placed on an Impella CP via the left femoral artery for cardiogenic shock. His hemodynamics continued to deteriorate, requiring initiation of veno-arterial extracorporeal membrane oxygenation (VA ECMO) via the right femoral artery and vein with associated DPC placement. Shortly after the initiation of VA ECMO, the Impella CP-related extremity (left leg) became ischemic. A left femoral DPC was placed and connected to the side port of the right femoral arterial cannula. After initiation of the additional DPC system, the left leg ischemia resolved. Distal leg ischemia with Impella CP is not a rare event. Utilization of a DPC to Impella CP may decrease the morbidity of limb malperfusion.

Technical Report

Case 1 (Impella CP and DPC)

A 65-year-old female with dilated cardiomyopathy developed refractory ventricular tachycardia and cardiogenic shock requiring high doses of vasopressors. She was taken to the catheterization laboratory where she was noted to have elevated left ventricular end-diastolic pressure (36 mmHg) and a poor cardiac index despite normal coronary anatomy. An Impella CP was placed via the right femoral artery to stabilize her hemodynamics. A DPC was placed to the right distal femoral artery using a 5 Fr sheath under ultrasound guidance, although the femoral artery appeared small by angiogram (Figure 1).
Femoral angiography shows a small common femoral artery; placement of Impella CP to such small arteries most likely causes distal limb ischemia.

The DPC was connected to the wire re-access port of the Impella CP. The leg was perfused by the DPC via the re-access port in the catheterization laboratory; however, despite initial good flow and appropriate anticoagulation, the leg became ischemic shortly after admission to the ICU. There appeared to be malperfusion of the leg (distal pulses were not detected and the right leg became cold), which was further confirmed by a drop in the tissue oxygen saturations and loss of distal pulses. The DPC was flushed and patency was confirmed. Upon flushing of the re-access port, there was only sluggish flow likely not enough to perfuse the entire leg. An additional contralateral femoral arterial line was placed using a 5 Fr sheath and connected to the DPC while the Impella re-access port was capped (Figure 2, Figure 3).
FIGURE 2: DPC for Impella CP®: Distal perfusion catheter placement on leg affected by Impella side

DPC: distal perfusion catheter placement

Shortly after placement of the new DPC system, the distal right pulse returned to baseline and the right thigh and calf oxygenations improved to the level found on the contralateral side. Limb ischemia did not reoccur while on Impella CP support with this DPC configuration in place.
Case 2 (Impella CP, ECMO, and DPC)

A 67-year-old male was admitted to the hospital with acute anterior ST-elevation myocardial infarction. He was intubated in the emergency room due to acute pulmonary edema and sent to the catheterization laboratory. Due to ongoing hemodynamic instability, an Impella CP was placed through the left femoral artery. Coronary angiography revealed a proximal left anterior descending artery (LAD) occlusion, which was successfully revascularized with coronary stents. Despite this intervention, his hemodynamics continued to deteriorate requiring initiation of veno-arterial extracorporeal membrane oxygenation (VA ECMO) via the right femoral artery and vein with subsequent DPC placement. Shortly after the initiation of VA ECMO, the Impella CP-related limb became ischemic with the development of a cold leg and loss of distal pulses. An additional DPC was placed in the left distal femoral artery under ultrasound guidance and connected to the VA ECMO DPC system (Figure 4, Figure 5).
The left distal pulse was restored and there were no further episodes of leg ischemia during VA ECMO/Impella CP support. The patient remained on VA ECMO/Impella CP support for five days until he developed a fatal intracranial hemorrhage.
Discussion

Impella CP has been used for cardiogenic shock patients to improve cardiac output and promote cardiac recovery. Impella CP is a catheter-based, mechanical circulatory assist device (MCS) that is placed percutaneously via the femoral artery. The catheter tip lies in the left ventricle and suctions blood from the left ventricle and disperses it into the ascending aorta. Impella CP support provides left ventricular unloading, increases systemic perfusion, and increases coronary blood flow [2]. Among the variety of Impella catheters, Impella CP is most often used in the catheterization laboratory since it allows for percutaneous insertion and provides a maximum of 3.7 L/min of flow, which is appropriate in most cases of cardiogenic shock. The catheter size is 9 Fr and can be often placed without distal leg compromise; however, patients with a small femoral artery can suffer from distal leg ischemia. Furthermore, patients in cardiogenic shock often require high doses of vasopressors, which constrict arteries, further compromising distal leg perfusion [3]. The reported incidence of distal leg ischemia with Impella CP is 4-17% and is more common in females, due to small caliber femoral arteries, or in older patients, likely as a result of the presence of baseline
Distal leg ischemia can occur in patients with small vasculature and vasospasm due to vasopressor use in the setting of femoral Impella CP use. DPC placement with appropriate inflow can prevent progression of distal leg ischemia even with concomitant VA ECMO use.

Conclusions

Distal leg ischemia can occur in patients with small vasculature and vasospasm due to vasopressor use in the setting of femoral Impella CP use. DPC placement with appropriate inflow can prevent progression of distal leg ischemia even with concomitant VA ECMO use.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Virtua Health, United States issued approval 21-005. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

Data, methods, and study materials are available upon request.

References

1. McDermott L, Cook G, Yang Q, Hirose H: Save leg: using contralateral femoral inflow for distal perfusion catheter placed for Impella CP [Peter Abstract]. ASAIO J. 2022, 68:121. 10.1097/01.mat.00000841416.84804.4a
2. Papolos AJ, Barnett CF, Tuli A, Vavilin I, Kenigsberg BB: Impella management for the cardiac intensivist. ASAIO J. 2022, 68:752-8. 10.1097/MAT.0000000000001680
3. Pahuja M, Ranka S, Chehab O, et al.: Incidence and clinical outcomes of bleeding complications and acute limb ischemia in STEMI and cardiogenic shock. Catheter Cardiovasc Inter. 2021, 97:1129-38. 10.1002/ccd.29005
4. Abaunza M, Kabhani LS, Nypaver T, et al.: Incidence and prognosis of vascular complications after percutaneous placement of left ventricular assist device. J Vasc Surg. 2015, 62:417-23. 10.1016/j.jvs.2015.05.040
5. Flottmann C, Braun M, Köster M, Rudolph V: Treatment of acute limb ischemia in an Impella CP patient. Int J Artif Organs. 2019, 42:525-7. 10.1177/0391398819847679
6. Geyer M, Vosseler M, Gori T: Interventional femoral ‘crossover’ bypass for peripheral ischaemia under cardiocirculatory support with the Impella CP heart pump. EuroIntervention. 2020, 15:1286-7. 10.4244/EIJ-D-18-00797
7. Wong JK, Smith TN, Pitcher HT, Hirose H, Cavarossi NC: Cerebral and lower limb near-infrared spectroscopy in adults on extracorporeal membrane oxygenation. Artif Organs. 2012, 36:659-67.
8. Ohira S, Kawamura M, Ahern K, Cavarocchi N, Hirose H: Aggressive placement of distal limb perfusion catheter in venoarterial extracorporeal membrane oxygenation. Int J Artif Organs. 2020, 43:796-802. 10.1177/0391398820917160

9. Patel SM, Liptinski J, Al-Kindi SG, et al.: Simultaneous venoarterial extracorporeal membrane oxygenation and percutaneous left ventricular decompression therapy with impella is associated with improved outcomes in refractory cardiogenic shock. ASAIO J. 2019, 65:21-8. 10.1097/MAT.0000000000000767

10. Kizner L, Flottmann C, Horstkotte D, Gummert J: Bilateral antegrade perfusion of the superficial femoral artery to prevent limb ischaemia during combined use of Impella CP left ventricular assist device and extracorporeal life support. Interact Cardiovasc Thorac Surg. 2016, 23:335-7. 10.1093/icvts/ivw115