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CASE REPORT

ADVANCED

CLINICAL CASE

# Report of Accidental Anchoring of an Impella Device to a Perceval Bioprosthesis in a Patient

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## ABSTRACT

We herein report a case in which we encountered complications when placing an Impella CP ventricular assist device (catheter-based ventricular assist device) in a patient with a Perceval bioprosthetic valve (sutureless valve). Specifically, the catheter-based ventricular assist device became anchored to the sutureless valve and needed to be removed under cardiopulmonary bypass. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:101674)


## HISTORY OF PRESENTATION

We herein report a case involving a 75-year-old woman who presented with cardiac arrest because of acute myocardial infarction and underwent an emergent percutaneous coronary intervention to her left main trunk and left anterior descending artery under venoarterial extracorporeal membrane oxygenation. Immediately after the percutaneous coronary intervention, transthoracic echocardiography (TTE) revealed severe aortic stenosis, and 3 weeks later, spinal cord injury occurred. Therefore, she remained hospitalized for rehabilitation. As she recovered, she began to report shortness of breath.

### LEARNING OBJECTIVES

- To recognize that the insertion and placement of a catheter-based ventricular assist device through a sutureless valve requires careful attention.
- To be aware that it is difficult to remove a catheter-based ventricular assist device that has become anchored to a sutureless valve without CPB.

## PAST MEDICAL HISTORY

The patient's past medical history was notable for hypertension.

## INVESTIGATIONS

The patient was considered New York Heart Association functional class II. TTE showed mild diffuse hypokinesis and an ejection fraction of 49%. Her aortic valve area was 0.61 $cm^2$, peak velocity was 4.8 m/s, and mean pressure gradient was 49.8 mm Hg. The laboratory findings were as follows: hemoglobin, 10.8 g/dL;

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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**ABBREVIATIONS AND ACRONYMS**

**CPB** = cardiopulmonary bypass

**TEE** = transesophageal echocardiography

**TTE** = transthoracic echocardiography

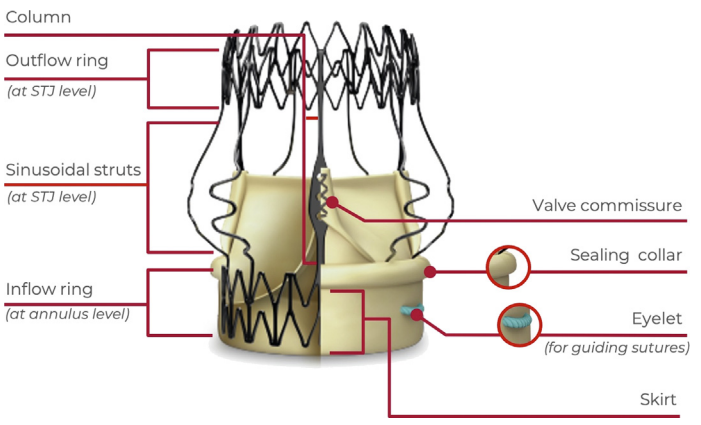
creatinine, 0.48 mg/dL; and brain natriuretic peptide, 944 pg/mL. Coronary computed tomography showed no significant coronary stenosis.

## MANAGEMENT

After a discussion regarding the option of either transcatheter or surgical aortic valve replacement, the patient elected to undergo surgical aortic valve replacement. The operation was performed via a right third intercostal anterior minithoracotomy. Cardiopulmonary bypass (CPB) was established via the ascending aorta and right femoral vein. The ascending aorta was cross-clamped, and cold blood cardioplegia was delivered in antegrade fashion. A Perceval bioprosthesis (M-size, Corcym) (**Figure 1**) was implanted after complete removal of the leaflets and annular calcification. After declamping the aorta, the state of shock was prolonged (>1 hour), and weaning from CPB was difficult because of poor recovery of the patient's left ventricular function. This poor recovery was thought to be the result of inadequate delivery of antegrade selective cardioplegia because of poor intraoperative visualization and prolonged aortic cross-clamping. In addition, the fluid and inotrope management was inadequate. We avoided the use of an intra-aortic balloon pump for mechanical circulatory support because this device could increase the risk of spinal cord ischemia. Additionally, because the original left ventricular dysfunction had been caused by acute myocardial infarction, it was necessary to unload the left ventricle. Left ventricular unloading is a specific advantage of the Impella CP catheter-based miniaturized ventricular assist device (Abiomed); therefore, we chose this device for treatment of our patient. The tip of the catheter-based ventricular assist device was inserted into the left ventricle via the left common femoral artery and through the sutureless valve. The position of the device was confirmed by fluoroscopy, transesophageal echocardiography (TEE), and the aortic waveform displayed on the automated Impella controller.

The patient showed stable vital signs and sufficient urine production at the P-2 setting of the catheter-based ventricular assist device; therefore, decannulation was attempted on the second postoperative day. However, resistance was encountered, and the catheter-based ventricular assist device could not be decannulated. On detailed evaluation by TEE, the catheter-based ventricular assist device cannula appeared to have passed through the sinusoidal struts of the sutureless valve and into the left ventricle (**Figures 2A and 2B,** Videos 1 to 3). Because of artifacts and a hypertrophic sigmoidal septum, we could neither determine whether the catheter-based ventricular assist device had been placed incorrectly nor ascertain the location of the inlet area. Therefore, we performed a fluoroscopic examination. Although the anteroposterior fluoroscopic view did not appear to show incorrect positioning of the sutureless valve (**Figure 3A**), a right anterior oblique view showed that the catheter-based ventricular assist device had crossed the struts of the valve (**Figure 3B**). Mindful that percutaneous decannulation of the catheter-based ventricular assist device might cause migration or dysfunction of the bioprosthetic valve, we elected to remove the device directly under cardiac arrest during CPB using the same approach. During this procedure, we found that the catheter-based ventricular assist device had passed through the sinusoidal struts of the valve and that the outlet of the catheter-based ventricular assist device had become anchored to its outflow ring (**Figure 4**). The trapped catheter-based ventricular assist device was released manually and removed, and the surgeon confirmed that there was no damage to the leaflets or migration of the sutureless valve. After declamping the aorta, there was no evidence of valve dysfunction on TEE and the patient was hemodynamically stable; therefore, we decided that there was no need to replace the valve.

**FIGURE 1 Structure of the Sutureless Valve**

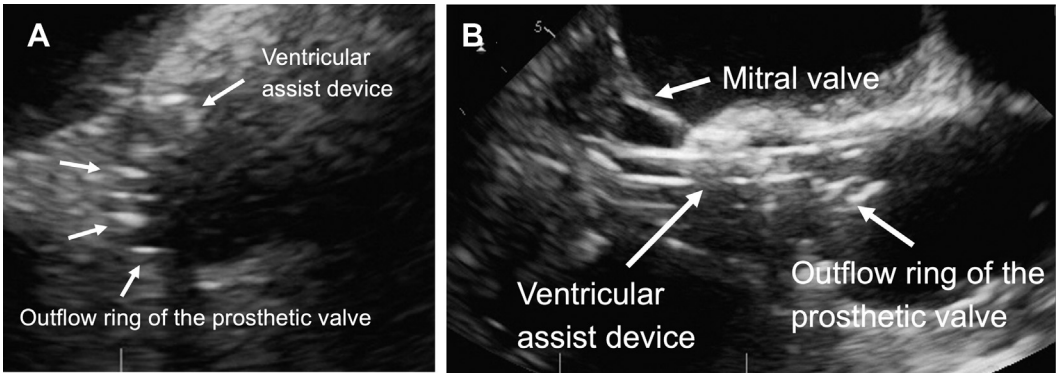



Adapted with permission from the product information sheet supplied by Corcym (https://corcym.com/devices/aortic/US/perceval). STJ = sinotubular junction.

## DISCUSSION

Several reports have described valvular complications following catheter-based ventricular assist device

**FIGURE 2 Transesophageal Echocardiographic Images of the Catheter-Based Ventricular Assist Device and Sutureless Valve Obtained Intraoperatively**

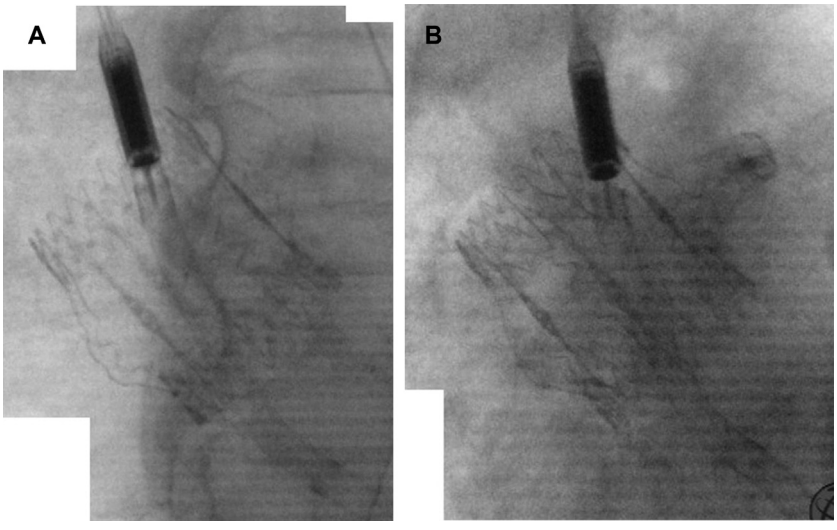



**(A)** Short-axis view of the ascending aorta. The catheter-based ventricular assist device is positioned outside the rings of the sutureless valve. **(B)** Long-axis view of the aortic valve. The catheter-based ventricular assist device is positioned outside the struts of the valve.

placement.[1,2] However, the anchoring of a catheter-based ventricular assist device to a prosthetic valve is an extremely rare event; only 1 previous report has described interference between a catheter-based ventricular assist device and a transcatheter aortic valve.[3] In that case, the catheter-based ventricular assist device outlet was in close proximity to the frame of an Evolut R (Medtronic), and the edge of the valve frame entered the outlet of the catheter-based ventricular assist device. In the present case, the catheter-based ventricular assist device passed through the sinusoidal struts of the sutureless valve, causing device-device interference.

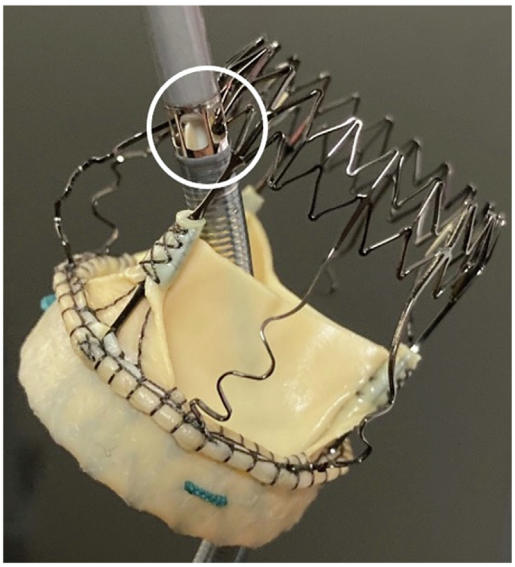
The present case provides 2 important lessons regarding the avoidance of this serious complication.

**FIGURE 3 Fluoroscopic Images of the Catheter-Based Ventricular Assist Device and Sutureless Valve**



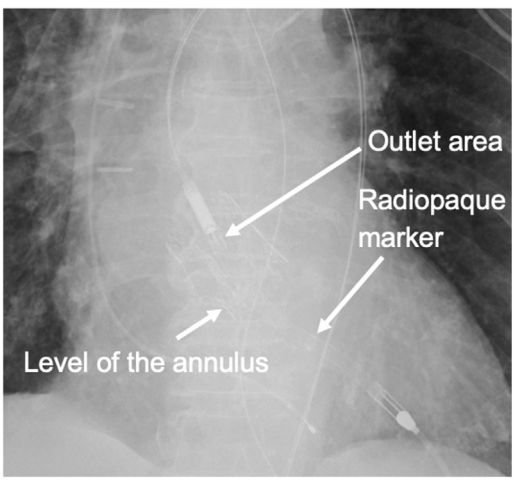

**(A)** Anteroposterior view. **(B)** Right anterior oblique view.

**FIGURE 4 Interference Between the Catheter-Based Ventricular Assist Device Outlet and the Outflow Ring of the Sutureless Valve**



The interference between the catheter-based ventricular assist device outlet and the outflow ring of the sutureless valve is shown in the **white circle**. Reproduced with permission from product information supplied by Abiomed, Inc (https://www.abiomed.com/products-and-services/impella) and Corcym (https://corcym.com/devices/aortic/US/perceval).

**FIGURE 5 Chest Radiograph Obtained Immediately After the Initial Surgery**



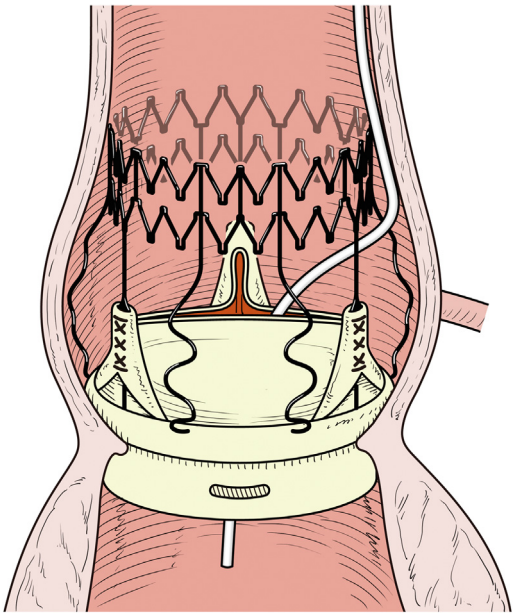

The catheter-based ventricular assist device is positioned too deeply, and the outlet of the catheter-based ventricular assist device is overlapping the struts of the sutureless valve.

First, 2 or more fluoroscopic views may be useful when inserting the guidewire into the left ventricle through valves with struts or a frame. In the present case, insertion of the guidewire using the anteroposterior view alone led to incorrect positioning of the catheter-based ventricular assist device and its accidental anchoring to the sutureless valve. Second, the position of the outlet area of the catheter-based ventricular assist device must be noted. Although the position of the catheter-based ventricular assist device can be confirmed using TEE or TTE, it is not always clearly visible. In such instances, care should be taken not to insert the catheter-based ventricular assist device too deeply. In the present case, postoperative chest radiography showed that the outlet of the device was located at the level of the outflow ring of the sutureless valve (**Figure 5**). Consequently, the proximity of the outlet of the catheter-based ventricular assist device to the outflow ring of the valve permitted the devices to interfere with each other.

Notably, the guidewire should not be advanced ahead of the diagnostic catheter at the level of the outflow ring of the sutureless valve (at the sinotubular junction level). In the present case, only the guidewire was passed through the sutureless valve, after which the diagnostic catheter was inserted. Consequently, the guidewire entered the space between the sutureless valve and the aortic wall at the level of the sinusoidal junction. Clinicians should be aware that a gap exists between the outflow ring of the sutureless valve and the aortic wall. For example, an M-size sutureless valve (which has an outflow ring diameter of 25.5 mm) is suitable for a sinotubular junction diameter of 27.3 to 29.9 mm (**Figure 6**).

Several case reports have described the insertion of a catheter-based ventricular assist device after transcatheter aortic valve replacement without major complications.[4-6] However, the risk of device-device interference may be relatively high for the CoreValve and Evolut series of devices (Medtronic) because of their height. Konami et al[7] reported the successful use of a catheter-based ventricular assist device after implanting a CoreValve transcatheter aortic valve and emphasized the importance of the positioning of the catheter-based ventricular assist device outlet. Given the likelihood that the placement of a catheter-based ventricular assist device in a patient with a sutureless valve will become more common in future, it is important to recognize the potential for such a complication to occur and to use multiple imaging modalities for investigation where appropriate.

**FIGURE 6** **Incorrect Passing of the Catheter Between the Aortic Wall and the Outflow Ring**



Gap between the outflow ring of the sutureless valve and the aortic wall at the sinusoidal junction level, through which the catheter-based ventricular assist device can accidentally be passed.

## FOLLOW-UP

The patient's postoperative course was uneventful. She was clinically well 6 months following the surgery, and echocardiography suggested no problems with the function of the prosthetic valve.

## CONCLUSIONS

The insertion of a catheter-based ventricular assist device through a sutureless valve requires careful attention. The characteristics of the catheter-based ventricular assist device and its potential to become anchored to the struts of a sutureless valve should be recognized. This complication can be avoided by using more than one modality.

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## REFERENCES

**1.** Chandola R, Cusimano R, Osten M, Horlick E. Severe aortic insufficiency secondary to 5L Impella device placement. *J Card Surg*. 2012;27:400-402.

**2.** Sef D, Kabir T, Lees NJ, Stock U. Valvular complications following the Impella device implantation. *J Card Surg*. 2021;36:1062-1066.

**3.** Sharma A, Bertog S, Mbai M. Impella placement across transcatheter aortic valves: a potential for device-device interaction. *J Am Coll Cardiol Intv*. 2020;13:2574-2575.

**4.** Arora S, Bahekar AA. Staged high-risk percutaneous coronary intervention with Impella support after on-pump transcatheter aortic valve replacement. *Tex Heart Inst J*. 2016;43:423-427.

**5.** Lazkani M, Kishi P, Murarka S, Fang K, Pershad A. Efficacy of Impella implantation during coronary occlusion following valve-in-valve transcatheter aortic valve replacement. *IHJ Cardiovasc Case Rep (CVCR)*. 2017;1:7-9.

**6.** Dallan LAP, Young A, Bansal E, et al. Predicted coronary occlusion and Impella salvage during valve-in-valve transcatheter aortic valve replacement. *Cardiovasc Revasc Med*. 2020;21:28-32.

**7.** Konami Y, Sakamoto T, Suzuyama H, Unoki T. Successful emergent transcatheter aortic valve implantation and left ventricular unloading by Impella in a patient with severe aortic stenosis who experienced cardiogenic shock after primary percutaneous coronary intervention for ST-elevation myocardial. *Eur Heart J Case Rep*. Published online February 18, 2021. https://doi.org/10.1093/ehjcr/ytab033

**KEY WORDS** catheter-based ventricular assist device, Impella device, Perceval bioprosthetic valve, sutureless valve

**APPENDIX** For supplemental videos, please see the online version of this paper.