

Transplant & Mechanical Support: How To Do It

Postmyocardial Infarction Ventricular Septal Defect Repair With Perioperative Impella 5.5 Support



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Ventricular septal defect (VSD) is a mechanical complication of myocardial infarction that can lead to rapid multiorgan system failure. Mechanical circulatory support is an invaluable tool to stabilize these patients before definitive surgical repair. The Impella 5.5 has been successfully used to maximize end-organ perfusion and as a bridge to delayed surgical repair. Preserving this device intraoperatively at the time of VSD repair is of great importance as mishandling can lead to device damage, thrombosis, and various postoperative complications. In this paper, we discuss tips on how to preserve this device during VSD repair.

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Postacute myocardial infarction ventricular septal defect (VSD) is an acute life-threatening complication that leads to cardiogenic shock and rapid multiorgan system failure.¹ Surgical correction is a class 1a recommendation per American Heart Association guidelines.² There is unanimity of studies that preoperative optimization with pharmacotherapy and mechanical circulatory support (MCS) along with delayed repair results in better outcomes.^{3,4} Use of the Impella (Abiomed) device is on the rise as a bridge to surgical repair of VSD, with reports demonstrating its success.^{5,6} Preservation of this device during surgery is of great importance to maintain postoperative MCS and to allow the stunned myocardium to recover by offloading the left ventricle (LV). In this paper, we describe surgical VSD patch repair while maintaining perioperative MCS using Impella 5.5, and we go over tips and pitfalls a surgeon may encounter during the operation.

TECHNIQUE

Before surgical incision, we recommend placing an arterial line in the upper extremity that is contralateral to the Impella 5.5 to avoid inaccurate misreading

of the blood pressure during the case. Transesophageal echocardiography (TEE) is performed to check the device's initial position, depth through the aortic valve (AV), and orientation in relation to the mitral valve.

We describe this technique through a median sternotomy. Cardiopulmonary bypass (CPB) is initiated by aortic and bicaval cannulation. Impella 5.5 should be turned off after the initiation of CPB. After full flow is achieved on CPB, the aorta is cross-clamped with a padded clamp, with care taken not to crush the Impella catheter, and the heart is arrested with use of both antegrade and retrograde cardioplegia as there might be a degree of aortic insufficiency secondary to the Impella device's crossing through the AV, subsequently making antegrade cardioplegia alone insufficient.

TIPS FOR RIGHT VENTRICULOTOMY APPROACH. A vertical ventriculotomy is made parallel with the left anterior descending artery approximately 1.5 cm in the right ventricle. The defect is identified. The Impella 5.5 device will likely be seen through the defect in the LV at this point (Figure), as opposed to other MCS devices like venoarterial extracorporeal membrane oxygenation or

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TandemHeart (Cardiac Assist Inc), which will be encountered in the right ventricle.

We recommend minimal or no manipulation of the device to avoid any damage to the motor housing part and the subsequent need to replace the device. Clots and debris on the device are removed manually if present. If there is irreparable damage to the device at this point, explantation of the preexisting device is advised with insertion of a new one at the conclusion of the VSD repair.

Wide débridement of all necrotic infarcted muscle is performed, with care taken not to seed the Impella 5.5 that resides in the LV. A wet sponge can be placed through the VSD into the LV to catch the necrotic debris at the time of septal débridement. The defect is measured, and a Dacron patch is tailored to achieve a 3-cm overlap with the defect margin. The extended sandwich patch technique is adopted for VSD repair⁷ (Video). The patches are inspected and confirmed to be adequate. Two strips of Teflon felt are used to close the right ventriculotomy in 2 layers. At the completion of the closure of the right ventriculotomy, it is inspected to confirm closure adequacy.

TIPS FOR LEFT VENTRICULOTOMY APPROACH. VSDs in the lowermost part of the septum may be visualized better through a small vertical incision in the LV near the apex. When performing the ventriculotomy, the surgeon must be cognizant that the Impella 5.5 device typically resides in the LV and might be damaged with the sharp blade. On LV entry, the device can be retracted from the field by a silk tie placed around any part of the device, except the motor housing. Once repair is completed, the device is irrigated to make sure no debris has contaminated the motor housing.

If a posterior approach is warranted, a left ventriculotomy is made parallel to the posterior descending artery. This approach is likely to require lifting and extensive manipulation of the heart to achieve a decent repair. For this reason, we recommend withdrawing the Impella 5.5 at least 3 cm back into the proximal LV outflow tract to prevent injury to the LV and the septum while maintaining its position in the LV. We do not recommend device retraction proximal to the AV as device reinsertion into the LV can be challenging without the introducing wire. Once VSD repair is accomplished, the device should be advanced 5 cm past the AV into the LV under TEE guidance.

The heart is reperfused once the repair is thought to be satisfactory. The patient is placed in head-down position, and the aortic cross-clamp is removed with an aortic root vent in place for deairing. The Impella is then restarted and put back on at low flow. This should help

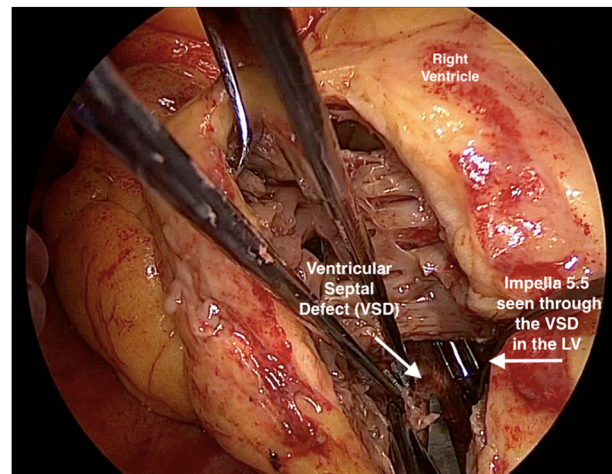


FIGURE Impella 5.5 as seen through right ventriculotomy. (LV, left ventricle; VSD, ventricular septal defect.)

to decompress the LV as the patient is weaned from CPB. After successful CPB weaning, TEE is used to confirm proper Impella 5.5 positioning and orientation. Impella 5.5 flows are adjusted as necessary. The device is typically left in place for at least 3 days after the procedure, with daily assessment of the hemodynamics and the potential for decannulation.

COMMENT

Impella 5.5 use is on the rise in various cardiac operations and has been successfully described in the literature in temporizing patients with postacute myocardial infarction VSD.^{5,6} In addition to preoperative optimization, Impella 5.5 provides ideal hemodynamic support to allow the stunned myocardium to heal postoperatively. Failure to preserve this device intraoperatively can lead to device damage requiring device exchange or the need for an additional form of MCS, adding more time and cost to the operation. Maintaining the Impella 5.5 device intraoperatively should not interfere with complete infarctectomy and subsequent VSD repair.

We recommend cleaning all the debris and clots from around the device during surgery as inadequate evacuation of residual debris coming from the infarcted tissue at the time of surgical repair can result in systemic showering emboli once the device pump is restarted after weaning from CPB.⁸ There are concerns in the literature about theoretical aspiration of debris in the motor housing of the Impella device³; however, there is no solid supporting evidence to suggest so.

We believe that this device should not damage the fresh synthetic interventricular patch if it is placed in the correct orientation with reference to the mitral valve. Depth of the device should not exceed 5 cm from the AV. If the device is placed too deep in the LV, it might rub against the patch and cause wear and tear or patch malalignment.

The Video can be viewed in the online version of this article [<https://doi.org/10.1016/j.atsr.2023.05.006>] on <http://www.annalsthoracicsurgery.org>.

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