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**Peer-reviewed Case Report**

# Treatment of Refractory Ventricular Tachycardia with Radiofrequency Ablation and Temporary Mechanical Circulatory Support

**Som Singh,[1] Alejandro Vidal Margenat,[1] David Boone,[1] Ellen Condoure,[2] Ramesh Hariharan[1]***

[1]The University of Texas Health Science Center at Houston, Houston, TX
[2]Abbott, Houston, TX

*Corresponding author: *Ramesh.Hariharan@uth.tmc.edu*

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## Abstract

Catheter-based radiofrequency ablation has long been recognized as an effective treatment for refractory ventricular tachycardia (VT). A 57-year-old male with severe coronary artery disease underwent percutaneous mechanical circulatory support because of worsening cardiogenic shock after failed revascularization attempts. Despite aggressive medical management, the patient experienced refractory VT episodes, leading to the decision to proceed with radiofrequency catheter ablation. Notably, the Impella 5.5 device (Abiomed) provided critical left ventricular support during the ablation procedure. This case underscores the potential benefits of Impella support during radiofrequency ablation of complex ventricular arrhythmias.

**Keywords:** percutaneous mechanical circulatory support device, ventricular tachycardia, Impella 5.5, ablation, advanced heart failure

## Introduction

Catheter-based radiofrequency ablation is a well-established treatment for refractory ventricular tachycardia (VT).[1] This procedure effectively reduces the occurrence of implanted cardioverter defibrillator shocks and decreases overall hospitalizations related to cardiovascular diseases. For this patient population, temporary mechanical circulatory support (MCS) during ventricular ablation is a valid option.[2] However, it is worth noting that the emerging body of evidence supporting the advantages of using MCS devices during radiofrequency ablation procedures is limited, and early literature on this subject has reported conflicting findings.[3] We present a case of effectively treating refractory VT using radiofrequency ablation in a patient who experienced cardiogenic shock and received MCS.

## Case Report

A 57-year-old male presented to an outside hospital with an anterolateral ST-segment elevation myocardial infarction (STEMI). Coronary angiography revealed multivessel coronary artery disease, including proximal left anterior descending artery (LAD) occlusion, for which revascularization attempts were unsuccessful. An Impella CP (Abiomed) was subsequently placed via the femoral route, and the patient was transferred to our center for a higher level of care. Upon his arrival, the MCS was upgraded to an Impella 5.5 device (Abiomed) via the right axillary artery because of worsening cardiogenic shock. After returning from the operating room, the patient developed a complete heart block and underwent emergent placement of an externalized dual chamber transvenous pacemaker. In addition, a percutaneous coronary intervention of the distal LAD was completed with the placement of a 2.75 x 24 mm Synergy XD drug-eluting stent (Boston Scientific). He continued to experience repeated VT episodes requiring cardioversion and remained refractory to multiple antiarrhythmic drugs, including amiodarone, mexiletine, and procainamide. Attempts to wean the patient from the Impella 5.5 support proved unsuccessful.

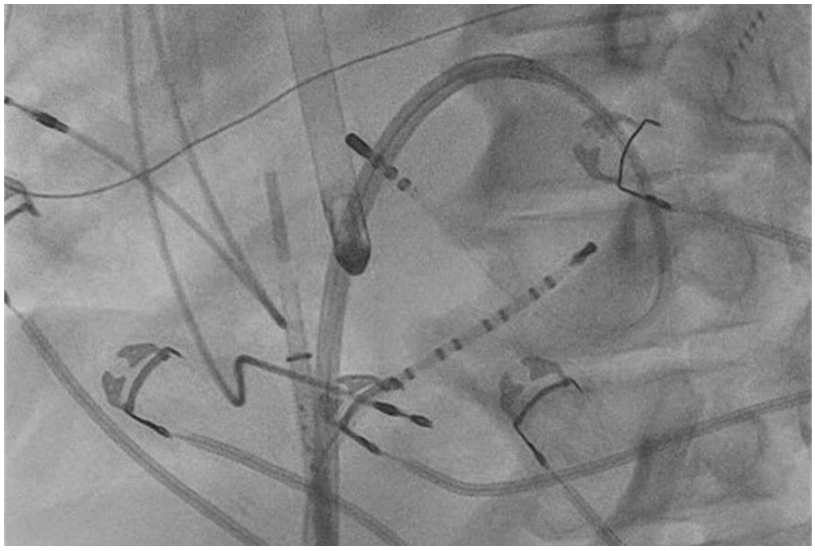

***Figure 1.*** *X-ray image showing the temporary mechanical support device (Impella 5.5, [Abiomed]) and the ablation catheter where the first ventricular tachycardia was terminated.*

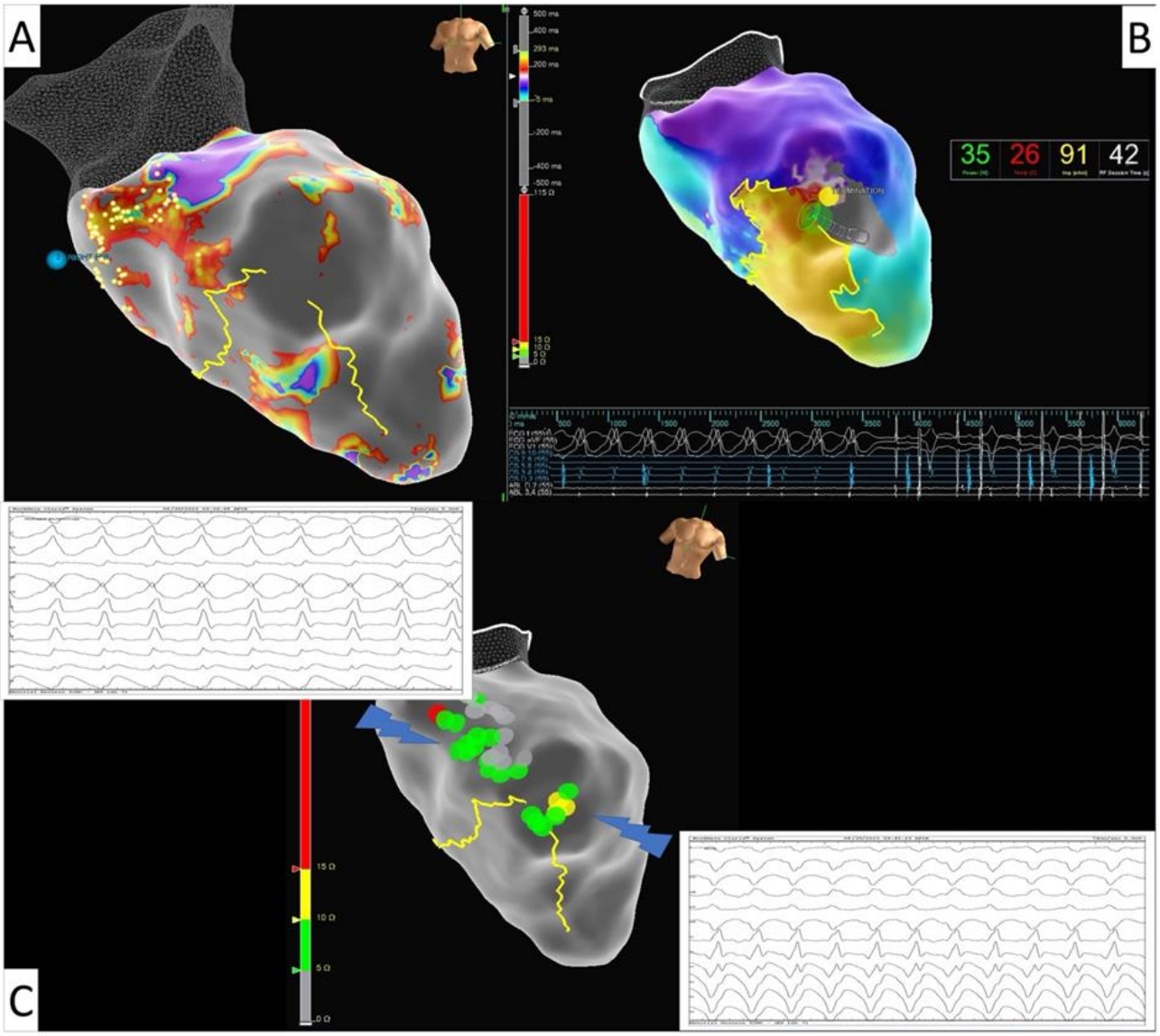


***Figure 2****. A) Anterior view of a three-dimensional left ventricle map showing extensive scarring with transition zones indicated by voltage mapping. B) Activation map during tachycardia, highlighting the slow conduction isthmus. Radiofrequency ablation at this precise location resulted in the termination of the tachycardia with the first lesion. C) 12-lead electrocardiograms corresponding to the two different ventricular tachycardias observed and appear to be correlated with the ablation lesion set and their respective zones where successful termination was achieved.*

We proceeded with VT ablation using a trans-septal approach for VT mapping and ablation because of the presence of the MCS device. We created a three-dimensional electroanatomic activation map of the left ventricle using the EnSite™ X EP System (Abbott), EnSite™

Omnipolar Technology (Abbott), and isochronal late activation mapping (ILAM). The voltage map of the left ventricle revealed scarring in the anterior, apical, and antero-septal walls. The ILAM map also showed several areas of slow conduction in the border zone of this scar in the anteroseptum. Given the patient's pacemaker-dependent status, mapping was performed with right ventricular pacing.

During catheter manipulation, episodes of spontaneous VT occurred; they were identical to the repeated clinical episodes. The VT presented a right bundle branch block morphology, was negative in inferior leads (I and augmented Vector Left [aVL]) and showed a transition at V2 with a cycle length of 280-300 ms, which was dissociated from the atrial signal. This VT was localized to the anteroseptal wall, remarkably correlating with the areas of slow conduction at the base of the left ventricle observed in the baseline ILAM map with right ventricular pacing (Figure 2).

We applied radiofrequency energy with a TactiFlex Irrigated Ablation Catheter (Abbott)[4] at 40 watts with half normal saline as the irrigant to the region of interest. This resulted in the immediate termination of the VT with the first burn. For the second VT and similar ablation, we targeted the areas of fractionated and late potentials. At the end of the procedure, there were no inducible arrhythmias.

## Discussion

The advantageous hemodynamic profile of the Impella 5.5 enables left ventricular unloading and myocardial oxygen consumption.[5] However, there is limited data regarding the advantages or outcomes of catheter ablation to treat VT in patients with a left ventricular assist device (LVAD).[6-9]

Current clinical evidence for the routine use of mechanical support in this context is still emerging. Nevertheless, it shows promise as the rates of induced VT are higher in patients with severe heart failure that require treatment with an LVAD. Early literature on flow support of up to 5 L/minute demonstrates limited clinical success in improving outcomes. VT ablation in such settings often relies on substrate mapping, as these patients do not generally tolerate VT of any duration. Typically, these approaches involve ablation of larger areas of the myocardium, leading to more prolonged procedures that patients may endure poorly.

Attempting and initiating urgent mechanical cardiac support in response to such deterioration has been associated with worse outcomes. Therefore, our preference is to plan and install mechanical cardiac support before proceeding with VT ablation. This approach offers the advantage of not only substrate mapping but also activation mapping of VT, enabling more discrete ablation rather than targeting extensive areas of the myocardium.[7,10,11]

In this case, the patient underwent percutaneous MCS because of severe left ventricular dysfunction after percutaneous coronary intervention. This was subsequently complicated by recurrent VT refractory to medication, requiring multiple cardioversions. This ultimately led to the decision to perform radiofrequency catheter ablation. However, it is well established that

there is the potential for a high mortality rate in patients with electrical storm, despite mechanical cardiac support.

A review of recent literature has not shown improved 30-day mortality in the setting of flow support by the Impella 5.0 (Abiomed) or higher variants of flow support. However, the case we present here prompts a renewed discussion about the device's true utility. The Impella 5.5, with higher flow rates because of its larger diameter, allowed for successful and uncomplicated VT mapping and ablation, while maintaining hemodynamic stability.[7] Furthermore, unlike older Impella devices, no electromechanical interference was noted, such as noise and catheter distortion on the mapping system or the ablation catheter.

The improved hemodynamic profile provided by the Impella 5.5, coupled with its non-interference with the mapping system, enabled the creation of an excellent map of the left ventricular anatomy, voltage, and activation properties, even in regions adjacent to the device. Such a high-quality map is not easily achievable with other Impella devices. It is important to identify and target the critical isthmus responsible for the VT. Identifying such critical tissue substrates in these patients is difficult without mapping in sustained arrhythmias because of the rapid hemodynamic instability that occurs within seconds to minutes after the onset of sustained VT.

## Conclusion

This case serves as a notable example of effectively treating refractory VT using radiofrequency ablation in a patient experiencing cardiogenic shock with mechanical support. Remarkably, this is a rare occurrence in which the Impella 5.5 device successfully provided temporary circulatory support in the context of left ventricular dysfunction during the VT ablation procedure. This unique case underscores the need for additional clinical research to gain deeper insights into the potential of Impella 5.5 support when combined with radiofrequency ablation to address ventricular arrhythmias. Further exploration of this avenue could provide valuable insights for optimizing treatment strategies in similar complex clinical scenarios.

## References

1. Electrophysiology. CAa. Ventricular tachycardia ablation in severe heart failure. Accessed September 10, 2023. https://www.ahajournals.org/doi/10.1161/CIRCEP.116.004494
2. Napp LC, Basir MB. Outcomes of mechanical circulatory support for ventricular tachycardia ablation in severe systolic heart failure. *J Interv Card Electrophysiol*. 2021;61(2):431-433. doi:10.1007/s10840-021-00997-x
3. O'Donnell D, Nadurata V. Radiofrequency ablation for post infarction ventricular tachycardia. *Indian Pacing Electrophysiol J*. 2004;4(2):63-72.
4. Abbott. Tactiflex ablation catheter, sensor enabled. Accessed September 10, 2023. https://www.cardiovascular.abbott/int/en/hcp/products/electrophysiology/ablation-technology/tactiflex-se-ablation-catheter/about.html

5. Kennel PJ, Lumish H, Kaku Y, et al. A case series analysis on the clinical experience of Impella 5.5(R) at a large tertiary care centre. *ESC Heart Fail*. Oct 2021;8(5):3720-3725. doi:10.1002/ehf2.13512
6. Kaki A, Subahi A, Shokr M, et al. Impella-Induced Incessant Ventricular Tachycardia. *Ochsner J*. 2019;19(3):248-251. doi:10.31486/toj.18.0018
7. Sroubek J, Vajapey R, Sipko JJ, et al. First-in-Human Experience With Impella 5.0/5.5 for High-Risk Patients With Advanced Heart Failure Undergoing VT Ablation. *J Am Coll Cardiol*. 2023;82(5):469-471. doi:10.1016/j.jacc.2023.05.012
8. Bhardwaj A SDAI, Al Rameni D, et al. Use of Impella 5.5 in patients with cardiogenic shock as a bridge to decision, recovery, or destination therapy. *IHJ Cardiovasc Case Rep CVCR*. 2023;7(2):61-64. doi:doi:10.1016/j.ihjccr.2023.06.002
9. Volgmann C, Barten MJ, Al Assar Y, et al. Unloading, ablation, bridging and transplant: different indications and treatments using the Impella 5.5 as longer-term circulatory support in one patient-an interdisciplinary case report. *Eur Heart J Case Rep*. 2023;7(7):ytad293. doi:10.1093/ehjcr/ytad293
10. Miller MA, Dukkipati SR, Chinitz JS, et al. Percutaneous hemodynamic support with Impella 2.5 during scar-related ventricular tachycardia ablation (PERMIT 1). *Circ Arrhythm Electrophysiol*. 2013;6(1):151-9. doi:10.1161/CIRCEP.112.975888
11. Turagam MK, Vuddanda V, Atkins D, et al. Hemodynamic Support in Ventricular Tachycardia Ablation: An International VT Ablation Center Collaborative Group Study. *JACC Clin Electrophysiol*. 2017;3(13):1534-1543. doi:10.1016/j.jacep.2017.07.005