# Body Piercing with a Metallic Tongue Ring Resulting in Ineffective ICD Shocks: "Heart to Mouth"

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**Abstract**

Left ventricular assist devices (LVADs) provide circulatory support to patients with severe left ventricular systolic dysfunction. Many such patients have a pre-existing implantable cardioverter defibrillator at the time of their LVAD surgery. LVAD implantation can alter ICD lead parameters including R wave sensing, RV capture threshold, and impedance. These changes can in turn affect the ability of the ICD to successfully treat malignant ventricular arrythmias. In most patients who present with ineffective ICD shocks, the failed shock is assumed to be secondary to the patient's severe cardiomyopathy. Especially the role of physical examination in such patients is often minimized. In our patient a thorough history and history guided physical examination, led us to the root cause of his failed ICD shocks. Our patient was noted to have a metal tongue ring, which was the likely cause of his ineffective ICD shocks. Our case highlights the importance of a comprehensive history and physical examination.

## Introduction

The introduction of left ventricular assist devices (LVADs) into clinical practice over the past decade has improved the care of patients with end-stage heart failure.[1-3] Many patients have an existing implantable cardioverter defibrillator (ICD) at the time of LVAD implantation. LVAD Implantation can alter ICD lead parameters including RV capture threshold, RV lead impedance and R wave sensing .[4,5,6] Reduced R wave sensing can result in under sensing of malignant ventricular arrythmias (VAs), and hence withhold appropriate therapy including anti-tachycardia pacing and shocks. On the other hand, oversensing of noise generated by the LVAD, can result in inappropriate ICD shocks. Furthermore, the impact of LVAD implantation on defibrillation thresholds has not been clearly established. To our knowledge, no study has systematically looked at DFTs both pre and post LVAD implantation.

Recently, there have been reports of LVAD patients presenting with multiple ineffective ICD shocks.[7] Whether shock failure is the result of LVAD implantation or the patient's severe cardiomyopathy is unknown. The workup of post LVAD patients with preexisting ICDs presenting with ineffective ICD shocks is limited. Especially the importance of an exhaustive history and physical examination in such patients is considered to be low yield. We present a case of failed ICD shocks in an LVAD patient due to the presence of a metal tongue ring. Our case highlights the importance of a dedicated history and thorough physical examination.

## Case Description

50-year-old male with past medical history of severe non-ischemic cardiomyopathy necessitating HeartMate 3 LVAD implantation, who presented with multiple ineffective shocks by his Medtronic single chamber dual coil ICD. On thorough history, he described his ICD shocks as "brick hit my face". The patient had no history of

ICD shocks in the past and this was his first presentation for ICD shocks after LVAD implantation surgery. He was not on any antiarrhythmic drugs at the time of presentation. On physical examination, the patient was awake and conversant with a mean arterial blood pressure (MAP) of 79 mm of Hg, oxygen saturation of 97% on room air, and heart rate of 92 beats per minute (bpm). He was noted to be wearing a large metal ring on his tongue. (Figure A) His lungs were clear to auscultation and he had a normal LVAD hum over the precordium. His HM3 interrogation displayed a flow rate of 4.2 liters/minute, using 4 watts of power at a speed of 5400 revolutions per minute. Initial electrocardiogram (ECG) demonstrated normal sinus rhythm with premature ventricular contractions (PVCs). ICD interrogation demonstrated an episode of sustained VT at a rate of around 240 bpm, lasting approximately 43 second. The patient received anti tachycardia pacing (ATP) followed by two failed ICD shocks without termination of the VT. He then, spontaneously converted to normal sinus rhythm just prior to delivery of the third shock (35.9 J with impedance of 58 ohms). Initial laboratory work was significant for serum creatinine of 1.5 mg/dL from a baseline of 0.9-1.0 mg/dL, potassium level of 4.3 mmol/L and magnesium level of 2.2 mg/dL. Cardiac electrophysiology (EP) team was consulted, and patient was admitted to the cardiac intermediate care unit.

Given the unusual description of his ICD shock, i.e., "brick hitting his face", and presence of a sizable metal tongue ring, raised the possibility that his metal tongue ring might have affected the shock effectiveness by changing the vector. Hence, we decided to perform noninvasive programmed stimulation and test the effectiveness of his ICD shocks after removal of the metal tongue ring. The patient was brough to the EP lab, his metal tongue ring was removed, and his ICD was programmed to shock at 25 J, which was 10 J lower than his previously programmed shock output. Next, sustained VT was induced with a T wave shock. The patients ICD appropriately detected VT and delivered a 25 J shock, which successfully terminated the rhythm. Additionally, the shock impedance after removal of the tongue ring was noted to be 73 ohms, which was higher when compared to 58, 66 and 67 ohms from his initial shocks. (Table 1.)

**Discussion**

The incidence of ventricular arrythmias (VAs) in LVAD patients is high, ranging between 19% and 34% even after only 8 to 12 months post LVAD implantation.[8] Risk factors for VAs in such patients include electrolyte abnormalities, acidosis, hypoxemia, cardiac ischemia, etiology of the underlying cardiomyopathy, and VAs prior to LVAD implantation.[9,10,11] Interestingly, despite providing adequate hemodynamic support and offloading the left ventricle, LVADs do not reverse the underlying arrhythmogenicity.

Majority of LVAD patients have ICDs implanted for primary or secondary prevention of sudden cardiac death prior to the LVAD surgery. Recently, in a large retrospective observational study of 122 LVAD patients, Galand et al[13] reported that 15% of the patients exhibited a greater than 50% decrease in right ventricular (RV) sensing, 42% had >100 Ω increase/decrease in RV pacing impedance, and 20% experienced >50% increase in RV pacing threshold after LVAD implantation. Similar results have been reported by Foo et al[4], Thomas et al[6] and Boudghene-Stambouli et al.[12] These changes can result impact the ability of the ICD to detect and treat VAs. On one end under sensing VA may lead to no therapy being delivered by the ICD, on the other end, the device may inappropriately deliver therapy when not indicated. Furthermore, recently there have been increasing reports of LVAD patients presenting with multiple ineffective ICD shocks. Since routine DFT testing is not performed at the time of initial ICD implantation and pre and/or post LVAD placement, it is not known whether elevated DFTs in such patients is due to LVAD placement per se or simply reflect the severity of the patient's cardiomyopathy. If LVAD placement does increase DFT's, the mechanism(s) could be multifactorial including: 1. Vector shifts caused by the introduction of intrathoracic metal from the LVAD i.e., the LVAD itself may act as a current sink and shunt current away from the heart. 2. Dislodgement of the RV lead.[4] 3. Change in orientation of the heart after LVAD implantation and 4. Use of antiarrhythmic drugs that raise DFTs.[5]

When an LVAD patient presents with ineffective ICD discharges, the ICD should be immediately disarmed, and the patient should be externally defibrillated.[15] The subsequent evaluation of such patients should include: 1. A detailed history to search for any factors that could provoke malignant ventricular arrythmias (heart failure exacerbation, ischemia, unusual physical/mental stress etc.). Special attention should be paid

to exclude recent initiation of any drugs that could raise DFTs, 2. Meticulous, physical examination 3. Laboratory evaluation including serum electrolytes, 4. Chest X- ray to look for appropriate placement of ICD lead, and exclude lead fracture, and 5. Comprehensive interrogation of the patients ICD.

In our patient, thorough history and history guided physical examination lead us to investigate any role that the metal tongue ring may have played to result in ineffective ICD shocks. We decided to perform defibrillation testing after removal of the metal tongue ring. Lo and behold, after the ring was removed, the ICD was successfully able to defibrillate the patient by delivering a shock 10 J lower than the previously programmed shock output. The latter proved that the metal tongue ring was indeed responsible for the failed ICD shocks in our patient. We hypothesize that a portion of the electric charge was shunted away from the myocardium towards the patients face due to the presence of a large metallic ring. The latter was further supported by an increase in the shock impedance upon removal of the tongue ring. (Table 1).

Our case also brings into question the safety of wearing metallic body piercings in patients with ICDs. The reduced efficacy of the ICD shocks observed in our LVAD patient, could likely also be true for patients without LVADs. Further, whether the location of the metal body piercing is relevant also remains to be determined. Larger studies investigating patients with ICDs and body piercings are indicated.**Conclusion**

Clinicians should be aware of the potential for ineffective ICD shocks in LVAD patients. Thorough history and history guided physical examination are critical in determining the cause of failed ICD shocks in such patients. Additionally, metal piercings may result in failed ICD shocks, but this needs to be investigated in larger studies.

**References**


1. Slaughter MS, Rogers JG, Milano CA, et al. Advanced heart failure treated with continuous flow left ventricular assist device. N Engle J Med 2009;361:2241e2251.
2. Miller LW, Pagani FD, Russell SD, et al.: Use of a continuous-flow device in patients awaiting heart trans-plantation. N Engl J Med 2007;357:885–896.
3. Aaronson KD, Slaughter MS, Miller LW, et al.: Use of an intrapericardial, continuous-flow, centrifugal pump in patients awaiting heart transplantation. Circulation 2012;125:3191–3200.
4. Foo D, Walker BD, Kuchar DL, et al.: Left ventricular mechanical assist devices and cardiac device interactions: An observational case series. Pacing Clin Electrophysiol 2009.32: 879887.
5. Ambardekar AV, Lowery CM, Allen LA, et al.: Effect of left ventricular assist device placement on preexisting implantable cardioverter-defibrillator leads. J Card Fail 2010.16: 327331.
6. Thomas IC,Cork DP,Levy A,et al.ICDleadparameters,performance, and adverse events following continuous-flow LVAD implantation.*Pacing Clin Electrophysiol* . 2014;37:464-472.
7. Malik Shehadeh, Vijaywant Brar, John Costello, Cyrus Hadadi, Susan O'Donoghue, Seth Worley, Ineffective implantable cardioverter-defibrillator shocks among patients on continuous left ventricular assist device support: Clinical characteristics and management, Heart Rhythm O2, Volume 1, Issue 5, 2020,Pages 336-340
8. Galand V, Flécher E, Auffret V, Boulé S, Vincentelli A, Dambrin C, Mondoly P, Sacher F, Nubret K, Kindo M, Cardi T, Gaudard P, Rouvière P, Michel M, Gourraud JB, Defaye P, Chavanon O, Verdonk C, Ghodbane W, Pelcé E, Gariboldi V, Pozzi M, Obadia JF, Litzler PY, Anselme F, Babatasi G, Belin A, Garnier F, Bielefeld M, Hamon D, Radu C, Pierre B, Bourguignon T, Eschalier R, D'Ostrevy N, Bories MC, Marijon E, Vanhuyse F, Blangy H, Verhoye JP, Leclercq C, Martins RP; ASSIST-ICD Investigators. Predictors and Clinical Impact of Late Ventricular Arrhythmias in Patients With Continuous-Flow Left Ventricular Assist Devices. JACC Clin Electrophysiol. 2018 Sep;4(9):1166-1175. doi: 10.1016/j.jacep.2018.05.006. Epub 2018 Jul 25. PMID: 30236390.
9. Prinzing A, Herold U, Berkefeld A, Krane M, Lange R, Voss B. Left ventricular assist devices-current state and perspectives. J Thorac Dis. 2016 Aug;8(8):E660-6. doi: 10.21037/jtd.2016.07.13. PMID: 27621895; PMCID: PMC4999658.
10. Kilic A, Acker MA, Atluri P. Dealing with surgical left ventricular assist device complications. J Thorac Dis. 2015 Dec;7(12):2158-64. doi: 10.3978/j.issn.2072-1439.2015.10.64. PMID: 26793336; PMCID:

PMC4703654.

11. Yap et al. "Ventricular Arrhythmias in Patients With a Continuous-Flow Left Ventricular Assist Device" JACC (Journal of the American College of Cardiology), 2016-07-19, Volume 68, Issue 3, Pages 323-325, Copyright © 2016 American College of Cardiology Foundation
12. Boudghene-Stambouli F, Boule S, Goeminne C, et al. Clinical impli- cations of left ventricular assist device implantation in patients with an implantable cardioverter-defibrillator. *J Interv Card Electrophysiol* . 2014;39:177-184.
13. Galand V, Leclercq C, Bourenane H, Boulé S, Vincentelli A, Maury P, Mondoly P, Picard F, Welté N, Kindo M, Cardi T, Pasquié JL, Gaudard P, Gourraud JB, Probst V, Defaye P, Boignard A, Para M, Algalarrondo V, Pelcé E, Gariboldi V, Pozzi M, Obadia JF, Anselme F, Litzler PY, Blanchart K, Babatasi G, Garnier F, Bielefeld M, Hamon D, Lellouche N, Bourguignon T, Pierre B, Eschalier R, D'Ostrevy N, Varlet E, Marijon E, Blangy H, Sadoul N, Flécher E, Martins RP. Implantable cardiac defibrillator leads dysfunction after LVAD implantation. Pacing Clin Electrophysiol. 2020 Nov;43(11):1309-1317. doi: 10.1111/pace.14004. Epub 2020 Jul 24. PMID: 32627211.
14. Gopinathannair R, Cornwell WK, Dukes JW, Ellis CR, Hickey KT, Joglar JA, Pagani FD, Roukoz H, Slaughter MS, Patton KK. Device Therapy and Arrhythmia Management in Left Ventricular Assist Device Recipients: A Scientific Statement From the American Heart Association. Circulation. 2019 May 14;139(20):e967-e989. doi: 10.1161/CIR.0000000000000673. PMID: 30943783.
15. Gehi AK, Mehta D, Gomes JA. Evaluation and management of patients after implantable cardioverter-defibrillator shock. JAMA. 2006 Dec 20;296(23):2839-47. doi: 10.1001/jama.296.23.2839. PMID: 17179461.

Figure legend:

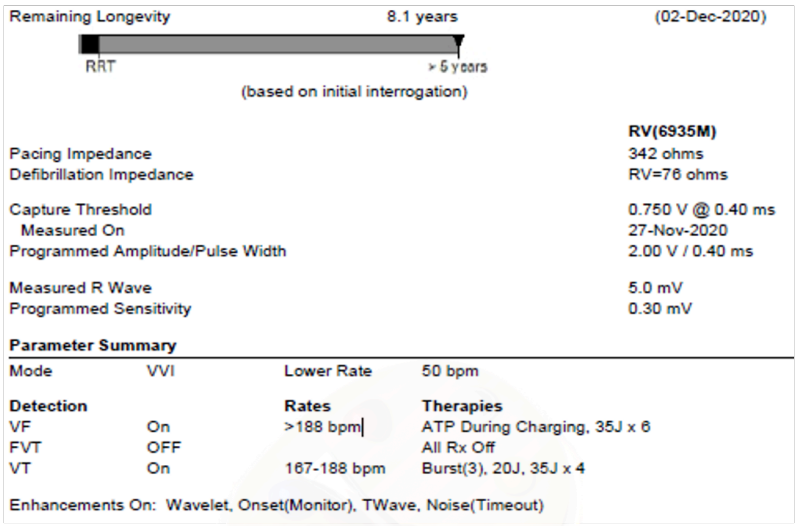
**Figure 1.** Metal tongue ring similar to the patient's ring.

**Figure 2.** Patient's ICD settings and lead parameters.

**Figure 3.** The electrocardiograms obtained from device interrogation demonstrating an episode of sustained VT at a rate of around 240 bpm, lasting approximately 43 second. Patient received anti tachycardia pacing (marked in red) followed by two failed ICD shocks. Later he spontaneously converted to normal sinus rhythm just prior to third shock. The shocks are marked by red boxes.

Table legend:

**Table 1.** Ineffective shocks received by the patient.



| | | |
|---|---|---|
| Remaining Longevity | 8.1 years | (02-Dec-2020) |

RRT > 5 years

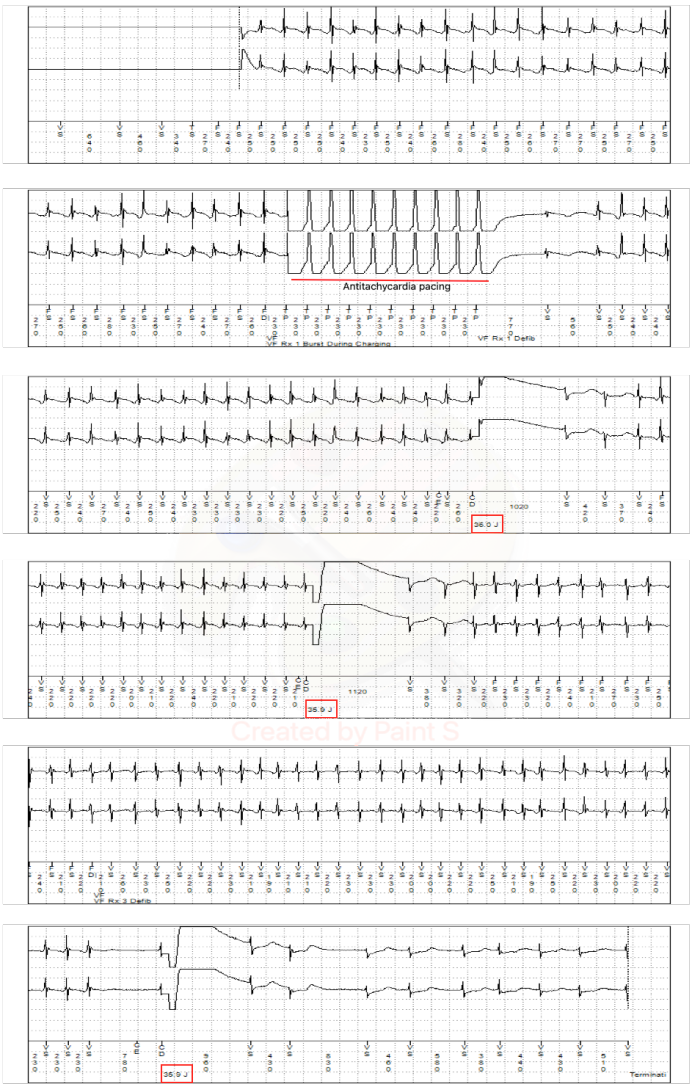
(based on initial interrogation)

| | RV(6935M) |
|---|---|
| Pacing Impedance | 342 ohms |
| Defibrillation Impedance | RV=76 ohms |
| Capture Threshold | 0.750 V @ 0.40 ms |
| Measured On | 27-Nov-2020 |
| Programmed Amplitude/Pulse Width | 2.00 V / 0.40 ms |
| Measured R Wave | 5.0 mV |
| Programmed Sensitivity | 0.30 mV |

**Parameter Summary**

| | | | |
|---|---|---|---|
| Mode | VVI | Lower Rate | 50 bpm |
| **Detection** | | **Rates** | **Therapies** |
| VF | On | >188 bpm | ATP During Charging, 35J x 6 |
| FVT | OFF | | All Rx Off |
| VT | On | 167-188 bpm | Burst(3), 20J, 35J x 4 |

Enhancements On: Wavelet, Onset(Monitor), TWave, Noise(Timeout)

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`Table 1.docx` available at https://authorea.com/users/367322/articles/709366-body-piercing-with-a-metallic-tongue-ring-resulting-in-ineffective-icd-shocks-heart-to-mouth