Single-center experience of intraoperative ventricular tachycardia ablation at time of ventricular assist device placement

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Introduction

Left ventricular assist devices (LVADs) are a therapy for patients with advanced heart failure (HF). Ventricular arrhythmias (VA) occur in up to 50% of patients following LVAD implantation.[1] They are multifactorial in origin, including arrhythmogenic substrate from the underlying cardiomyopathy, LVAD-induced apical scarring around the inflow cannula, suction events, mechanical trauma, and immediate postoperative changes. VA in the post-LVAD setting is associated with increased morbidity and mortality.[2]

Limited data supports catheter ablation in this population.[3] VA ablation is often limited owing to technical challenges including catheter entrapment, maneuvering, and mapping interference.[2] Nevertheless, data suggest potential benefits in post-LVAD survival and freedom from significant ventricular tachycardia (VT).[4]

Most catheter-based VA ablations occur either before or after LVAD implantation; what remains less investigated is intraoperative VA ablation. Endocardial and/or epicardial access *during* LVAD implantation may avoid the technical difficulties of a standard LVAD VT ablation and prevent subsequent higher-risk open/hybrid epicardial VA ablations.[5]

KEY TEACHING POINTS

- Concomitant surgical ventricular tachycardia (VT) ablation at the time of left ventricular assist device (LVAD) implantation is an area lacking in data, but still may be reasonable and feasible given the challenges of catheter ablation and the potential for future high-risk procedures.
- Intraoperative mapping in the open chest and with the LVAD can be challenging: this sample did not undergo intraoperative mapping. Surgical ablation sites were based on 12-lead VT morphology and available echo, magnetic resonance imaging, and/or prior intracardiac mapping/ablation. Recommendations on ablation sites from the Electrophysiology team were then weighed intraoperatively based on anatomic considerations.
- The upcoming PIVATAL trial (NCT05034432) will hopefully shed more light on this particular population as well as further detail the risk/benefit profile of the procedure in a randomized controlled trial.

Case report

We describe our single-center experience with intraoperative VT ablation at the time of LVAD implantation. We retrospectively reviewed all implanted LVADs from 2012 to 2022 (n = 725) and identified 6 patients.

Appropriate institutional review board approval was obtained and patients were screened for inclusion by querying the advanced HF database (Ascension St. Vincent Heart Center, Indianapolis, IN). CPT codes for LVAD placement (33979) and intraoperative VA ablation (93654) were cross-referenced to increase accuracy.

Results

Of 6 patients, 2 were implanted with a HeartMate II device, 1 with an HM 3, and 3 with Medtronic HeartWare ventricular assist devices. All patients underwent endocardial

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Table 1 Baseline patient characteristics

Total number of patients	6
Male	83%
Ischemic cardiomyopathy	50%
NICM	50%
Heart transplant recipients	50%
Mean age	60 ± 10
Mean BMI	32 ± 11
Mean room time (minutes)	376 ± 186
Mean bypass time (minutes)	96 ± 24
Mean length of stay (index hospitalization)	28 ± 25 days
1-year survival rate post LVAD implant	83%

BMI = body mass index; LVAD = left ventricular assist device; NICM = nonischemic cardiomyopathy.

cryoablation in the left ventricle, with 1 undergoing epicardial ablation. Additional patient characteristics are detailed in Table 1. All patients were on appropriate warfarin therapy per standard protocol after LVAD implantation. Worsening VA was the driver for urgent LVAD implant in all patients.

Survival

One patient died within 24 hours of ablation owing to pulmonary hemorrhage unrelated to the ablation procedure. Two patients died within 3 years of LVAD implantation: 1 died from complications owing to abdominal aortic aneurysm endoleak 2 years after LVAD; the other eventually declined further therapies and died at home.

The remaining 3 patients underwent transplant within 1 year of LVAD implant and remain alive today.

Recurrent ventricular arrhythmia

Post LVAD, 3 patients remained VA free and 3 patients had VA recurrence (1–91 days). Four out of 6 patients were on amiodarone preprocedurally, with 5 out of 6 on amiodarone postoperatively. The only patient who did not receive amiodarone at any point died within 24 hours of implantation.

Destination therapy LVAD patients remained on amiodarone indefinitely. Of the patients who received LVADs and went on to receive heart transplants, 2 continued a short course of amiodarone after LVAD implantation, which was discontinued prior to transplantation (3–6 months). One required amiodarone for 1 year after LVAD implantation and then 1 month after orthotopic heart transplant.

The first patient developed VT storm during their index hospitalization on postoperative day 1, requiring a stellate ganglion block. That patient remained on antiarrhythmics and had recurrent VA requiring hospitalization 1 year after surgery. The patient died owing to complications from abdominal aortic aneurysm endoleak 2 years after LVAD implant.

The second patient was hospitalized for HF 2 months after surgery, requiring intravenous inotropy, which precipitated VA and an appropriate implantable cardioverter-defibrillator (ICD) shock. That patient received heart transplant 11 months after LVAD implant and had no further VA events.

The last patient was successfully managed as an outpatient for an appropriate ICD shock 91 days after LVAD implantation. That patient died under unrelated circumstances 2 years after LVAD implant without any further VA events.

Postoperative course

Apart from the acute VT storm and respiratory failure patients, the other patients had standard LVAD postoperative courses. One patient had a hospitalization for gastrointestinal bleeding 33 days after implantation and there was 1 HF admission 2 months after implant. Two patients had no further hospitalizations until their transplants.

Conclusion

Analysis is limited by small sample size, but half of our patients receiving LVAD and concomitant VA ablation had no VA on follow-up. Operation time, length of stay, and other outcome measures do not appear different from standard values.

Overall arrhythmia burden was low. One patient had refractory arrhythmias for years after LVAD but ultimately did not die from VA. Overall, 4 out of 6 patients did not have significant VA burden (singular ICD shock either managed successfully outpatient; or inotrope-instigated event that did not recur).

Concomitant VA ablation may carry additional risk and there have been observations of LVAD thrombosis and postoperative bleeding after ablation.[6,7] To further assess risks, benefits, and outcomes, this intervention should be investigated in a randomized controlled trial: we applaud the efforts of the PIVATAL investigators (NCT05034432).[8] We suspect intraoperative VA ablation has the potential to prolong VA-free survival and decrease subsequent hospitalization in this patient population without adversely affecting postoperative care.

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