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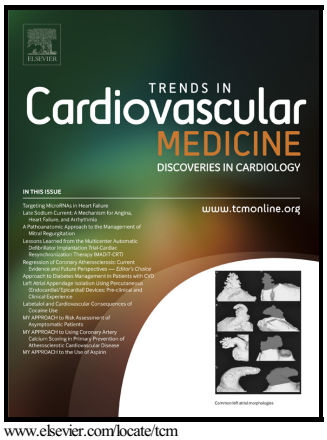

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Arrhythmias in Patients with Left Ventricular Assist Devices: Pump Fixed; Rhythm… Not So Much

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Left ventricular assist devices (LVADs) provide great benefit to patients with advanced systolic heart failure, including those awaiting heart transplantation. As there is a limited supply of donor hearts, increasing numbers of patients are supported by LVAD therapy for prolonged periods of time. As with most advances, LVADs carry with them both benefits and challenges.

In this issue of *Trends in Cardiovascular Medicine*, Kadado *et al.* review the problem of cardiac arrhythmia following LVAD implantation.[1] Their article will be a valuable resource for anyone who cares for these patients, as both atrial and ventricular arrhythmias are common among the heart failure (HF) population. The authors summarize for us the epidemiology, prevention, and management of these arrhythmias.

Atrial Arrhythmias

As Kadado *et al.* explain, HF often coexists with atrial fibrillation (AF), and the synergistic detrimental impact of the combined conditions is more than additive.[2,3] While AF's hemodynamic effects are largely mitigated by the LVAD's support of the left heart's output, still AF may

impact negatively on right heart function. In addition, AF carries with it a significant risk of thrombosis and thromboembolism (TE). The presence of an LVAD may raise an AF patient's thromboembolic risk, while also paradoxically exacerbating the bleeding risk associated with anticoagulation (AC) for TE prophylaxis.

The treatment of atrial arrhythmias in LVAD patients shares some similarities with treatment in those without LVADs, but some differences exist as well. Control of the ventricular rate is a cornerstone of therapy for AF in the LVAD patient, as rhythm control often produces no change in the assisted heart's output. LVAD patients already require AC, but AC therapy often must be intensified in the presence of AF. Kadado *et al.* include an important section regarding the elevated bleeding risk associated with LVAD patients' acquired von Willebrand Syndrome and their propensity toward arteriovenous malformations. The resultant increased bleeding risk is important for many aspects of care, including decision making regarding implantation of pacemakers or implantable cardioverter-defibrillators (ICDs; see below).

Ventricular Arrhythmias

Because LVADs can effectively replace cardiac output with little or even no contribution from the native heart, oftentimes even prolonged periods of otherwise deadly ventricular arrhythmias (VAs) can be well tolerated.[4] However, VAs may also have ill consequences, ranging from harmless palpitations to dangerous effects such as progressive right heart failure. In addition, embolic injury has been described, presumably due to thrombus formation related to tachyarrhythmic myocardial standstill.[5]

VAs in the LVAD population can have similar or different mechanisms as those in HF patients without LVADs. Patients with or without LVADs may have VAs related to scar-mediated reentry, ischemia, or electrolyte abnormalities, which may be further exacerbated by the infusion of inotropes and pressor medication. Kadado *et al*. list for us some additional factors that are specific to those with LVADs: mechanical "suck-down" events, postoperative inflammation, and electrical reentry around the LV apical cannula itself. In addition, the presence of an LVAD may complicate attempts at management via catheter ablation (though

ablative therapy has been described as successful, in small series also cited in the Kadado paper).

Kadado *et al*. offer practical recommendations for the evaluation of VT in LVAD patients. These include searching for underlying reversible causes of VT, weaning pressors and maximizing beta blockade, as well as volume repletion and/or pump speed reduction in the case of suck-down events (which often are evident via echocardiography).

Another cornerstone of VA therapy is ICD implantation. The benefit of ICDs in the LVAD population is incompletely understood at the present time. While patients are unlikely to die *suddenly* in the presence of a functioning LVAD, sustained arrhythmias may cause progressive right heart failure or other problems that lead to more gradual decompensation and death. The most recent societal guidelines and expert consensus statements support the use of ICDs in patients awaiting transplant or in those with LVADs either as "destination" therapy or as a "bridge to transplant."[6,7] However, as Kadado *et al*. discuss in their article, several retrospective analyses of ICD therapy in patients with LVADs have been published, and these studies come to

varying conclusions about ICDs' value in this population. Clearly, a randomized controlled trial is needed to answer this question.

Of course, there can be downsides to ICD implantation, including the high associated cost. The added risks of ICD implant in LVAD patients, including bleeding and infection, must also be considered. Another complication related to ICDs is the possibility of inappropriate shocks, which can be damaging not only to the patient's psychological health but also to myocardial function. Kadado *et al.* support MADIT-RIT-like programming designed to minimize inappropriate shocks. The authors also offer other guidance such as programming for aggressive/prolonged antitachycardia pacing, thereby targeting painless termination of the monomorphic ventricular tachycardias that are characteristic of patients with LVADs.

Conclusion

In their excellent review, Kadado *et al*. summarize for the clinician the incidence, prevention, and treatment of arrhythmias in the LVAD population. The insight gained from reading this work will assist with caring for, and improving outcomes for, this deserving group of patients.

References:

1. Kadado AJ, Akar JG, Hummel JP. Arrhythmias After Left Ventricular Assist Device Implantation: Incidence and Management. *Trends Cardiovasc Med*. 2017. (in press; this issue)
2. Thihalolipavan S, Morin DP. Atrial Fibrillation and Heart Failure : Update 2015. *Prog Cardiovasc Dis*. 2015;58(2):126-135.
3. Morin DP, Bernard ML, Madias C, Rogers PA, Thihalolipavan S, Estes NAM. The State of the Art: Atrial Fibrillation Epidemiology, Prevention, and Treatment. *Mayo Clin Proc*. 2016;91(12):1778-1810.
4. Sims DB, Rosner G, Uriel N, González-Costello J, Ehlert FA Jorde UP. Twelve Hours of Sustained Ventricular Fibrillation Supported by a Continuous-Flow Left Ventricular Assist Device. *Pacing Clin Electrophysiol*. 2012;35(5):e144-e148.
5. Oz MC, Rose EA, Slater J, Kuiper JJ, Catanese KA, Levin HR. Malignant ventricular arrhythmias are well tolerated in patients receiving long-term left ventricular assist devices. *J Am Coll Cardiol*. 1994;24(7):1688-1691.
6. Tracy CM, Epstein AE, Darbar D, DiMarco JP, Dunbar SB, Estes NAM, et al. 2012 ACCF/AHA/HRS Focused Update of the 2008 Guidelines for Device-Based Therapy of Cardiac Rhythm Abnormalities: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm S. *Circulation*. 2012;126(14):1784-1800.
7. Kusumoto FM, Calkins H, Boehmer J, Buxton AE, Chung MK, Gold MR, et al. HRS/ACC/AHA expert consensus statement on the use of implantable cardioverter-defibrillator therapy in patients who are not included or not well represented in clinical trials. *Heart Rhythm*. 2014;11(7):1271-1303.