What's New in MCS

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Reviews:

"April showers bring May flowers" – or in the MCS field, a plethora of articles ranging from the Heartmate 3 hemocompatibility score, the problems with novel oral anticoagulants (NOAC), prediction of survival in the ROADMAP trial, and a look toward the future in making a smart LVAD with physiologic flow adjustments.

The vexing problem of hematologic complications

Despite providing improved survival and quality of life, the current LVAD technology is not "hemocompatible". In other words, patients with LVAD are often plagued with thrombotic and bleeding events. Uriel and colleagues of the MOMENTUM 3 trial presented at this year's ISHLT a novel hemocompatibility score derived from the 6-month cohort. The manuscript was published in Circulation.1 The hemocompatibility score consists of thrombosis (stroke, pump thrombus) and bleeding (gastrointestinal or other) events. The higher the score, the less "hemocompatible" the LVAD. Freedom from any pump thrombus was the main reason behind the Heartmate 3's more favorable hemocompatibility score compared to the Heartmate 2. However, debilitating stroke and major bleeding rates remain unchanged, suggesting that we are still years away from the ideal LVAD that can balance bleeding and clotting problems.

The tools to combat thrombosis are antiplatelet and anticoagulant therapies. Vitamin K antagonists (VKA, e.g. phenprocoumon, warfarin) are the anticoagulants of choice for LVAD patients. Much to the chagrin of providers everywhere, medication titration to keep patients within target international normalized ratio (INR) goal is challenging and labor-intensive. The novel oral anticoagulant (NOAC) dabigatran was therefore tested in a randomized, pilot, single center study against phenprocoumon in addition to aspirin for long-term anticoagulation.2 The trial was stopped early due to increased thrombotic events (pump thrombus and transient ischemic attack) in the dabigatran arm. It is worth noting, however, that patients in the dabigatran arm received the lower dose of 75 mg BID due to renal dysfunction, so they might have been undertreated. Alternatively, VKA might be better at global inhibition of the coagulation cascade. Just as NOACs are contra-indicated in mechanical heart valves based on the RE-ALIGN trial3, they should be avoided in LVAD patients until further data are obtained.

How early is too early? Survival prediction to determine timing of LVAD implant

Due to more favorable outcomes in patients with higher INTERMACS profiles, there is increasing interest in implanting LVAD when patient is not yet inotrope-dependent. How does one predict who may progress to end-stage HF faster than others, and therefore may benefit from early LVAD implant? The ROADMAP (Risk Assessment and Comparative Effectiveness of Left Ventricular Assist Device and Medical Management in Ambulatory Heart Failure Patients) investigators attempted to answer this

question using the Seattle Heart Failure Model (SHFM).4 They found that SHFM overestimates LVAD-free survival in advanced heart failure patients managed with optimal medical therapy. They also applied the Heartmate II Risk Score (HMRS) to the LVAD arm of ROADMAP and showed that HMRS underestimates post-VAD survival as well. This is not too surprising given that the SHFM was not developed in this patient cohort, and the HMRS was derived primarily from inotrope-dependent patients. This study underscores a need for further research in developing better risk-prediction models in a contemporary cohort.

The future is here: making a smart LVAD

Despite recent advances including the Heartmate III's magnetically levitated rotor and artificial "pulse", current LVAD technology with a constant pump speed remains crude in response to physiologic needs. A few studies have shown that incremental pump speed increases may contribute to better peak VO2 on cardiopulmonary exercise stress test5, though intracardiac filling pressures do not change during supine bicycle exercise6. No one knows how much or how often speed change is adequate according to patient's daily activities, unless pump flow and intracardiac volumes are directly measured. Tchantchaleishvili and colleagues reviewed the current challenges and promising technologies of flow sensor technology, such as the wireless pressure sensor Titan (ISS Inc., Ypsilanti, MI) that monitors left atrial pressure and can be inserted at the time of LVAD implantation.7

Other interesting articles:

Couperus LE, Delgado V, Khidir MJH, et al. Pump Speed Optimization in Stable Patients with a Left Ventricular Assist Device. Asaio j 2017;63:266-72.

This is a study in a small (n=17) cohort of ambulatory LVAD patients who undergo ramp speed optimization using echocardiographic parameters. The authors concluded that ramp speed optimization was associated with improved right ventricular function at 3 months post-implant. RV function was measured by fractional area change and speckle-tracking peak systolic strain. However, it is unclear if those who did not undergo speed change could not do so due to RV sensitivity to septal shift, and those with improved RV function just had better RV adaptation regardless of speed change. This study inspires further questions regarding longitudinal RV changes in the presence of LVAD.

Segan LA, Nanayakkara SS, Leet AS, Vizi D, Kaye DM. Exercise Hemodynamics as a Predictor of Myocardial Recovery in LVAD Patients. Asaio j 2017;63:342-5.

This is a small (n=21) study from Australia demonstrating better hemodynamics during supine bicycle exercise in 4 patients with successful LVAD explant due to myocardial recovery. Despite similarly depressed LV EF, compared to the non-explant group, the explant group generated higher cardiac output with smaller increase in wedge pressure indexed to the amount of work. It is unclear how the ultimate decision of explant was made, which remains an area that requires further research.

References:

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2. Andreas M, Moayedifar R, Wieselthaler G, et al. Increased Thromboembolic Events With Dabigatran Compared With Vitamin K Antagonism in Left Ventricular Assist Device Patients: A Randomized Controlled Pilot Trial. Circ Heart Fail 2017;10.
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6. Muthiah K, Robson D, Prichard R, et al. Effect of exercise and pump speed modulation on invasive hemodynamics in patients with centrifugal continuous-flow left ventricular assist devices. J Heart Lung Transplant 2015;34:522-9.
7. Tchantchaleishvili V, Luc JGY, Cohan CM, et al. Clinical Implications of Physiologic Flow Adjustment in Continuous-Flow Left Ventricular Assist Devices. Asaio j 2017;63:241-50