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An opportunity to begin again

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EDITORIAL

An opportunity to begin again

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On June 3, 2021, Medtronic Inc. (Minneapolis, MN) announced that it was terminating the manufacturing and distribution of the HVAD system, simultaneously instructing medical centers to cease further HVAD implants. [1] The news was followed by a tidal wave of emotions within the international mechanical circulatory support (MCS) community, reminiscent of the feelings engendered by the retirement of the HeartMate XVE (Thoratec, Pleasanton, CA) in 2011 and the rapidly fading use of the HeartMate II (Abbott, Inc., Abbott Park, IL) in the past 5 years. As we reflect on the contributions of the HVAD system to MCS innovation, we also need to cogitate about the present and future of the advanced heart failure field, including what is needed to foster the continued evolution of durable MCS and how to ensure our profession becomes more pertinent to referring cardiologist and payors.

The HVAD in Perspective

The HVAD was groundbreaking, miniaturized continuous flow technology. In contrast to the axial flow HeartMate II, which had blood inflow and outflow paths oriented parallel to the axis of rotation, the HVAD pump relied on centrifugal flow technology that propelled blood tangentially via spinning discs suspended by hydrodynamic levitation. [2] The centrifugal engineering of the HVAD imparted greater flow sensitivity in relation to preload and afterload (described via the device head-pressure curve) which translated within the human human vasculature as pulsations of blood flow.[2] While the impact on pulse pressure was highly variable between patients, the attempt of the HVAD system to mimic physiologic pulsatility as a means of improving hemocompatibility was met with zeal within the MCS community. With over 18,000 implants worldwide, the HVAD system prolonged survival and quality of life for many patients with advanced refractory heart failure.[1,3-5] Notably, the miniaturized technology opened the gateway of durable MCS to heart failure patients with small body surface areas, including women and children, for whom paracorporeal temporary support was previously their only option.[6] Additionally, the small size of the HVAD was welcomed by many surgeons as it facilitated the implant procedure and allowed for the development of sternal-sparing, minimally invasive implant techniques.[7] Moreover, for patients with biventricular failure, the HVAD offered the innovative possibility of dischargeable, durable biventricular assist device support via off-label use.[8] The experience gleaned from the HVAD encouraged industry to focus on areas for improvements in device engineering to reduce adverse events and to improve patient lifestyle through more compact peripherals. Though achieved at a high empirical cost, the accrued HVAD clinical trial data highlighted the importance of blood pressure control for optimization of device flow and to mitigate neurologic events.[9,10]

The decision by Medtronic to retire the HVAD was attributed to the "... growing body of observational clinical comparisons indicating a higher frequency of neurological adverse events, including stroke and mortality with the HVAD ™ System as compared to other circulatory support devices available to patients. [1]" Such evidence included comparative outcomes analyses of patients enrolled into Intermacs, demonstrating 87% vs 80% 1-year survivals in propensity matched patients supported with third generation HeartMate 3 (Abbott, Inc) centrifugal flow technology vs. HVAD, respectively, [11-13] as well as comparative data from HeartMate 3 patients enrolled into the MOMENTUM 3 clinical trial[14]. Additionally, Medtronic acknowledged concerns over failure of HVAD pumps to restart after controller exchange or other instances of power loss and pump stoppage.[1] However, when one examines MCS trends in the field prior to this decision, the yearly frequency of durable MCS implants had already plateaued or had started to decline in many countries, including the United States (U.S.)[15], and the bulk of the market had started to shift toward third generation technology.[15] In the field of MCS where technologic evolution is mandatory for therapeutic

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extension into more patients with advancing heart failure, the HVAD system should not be remembered as an incidental technological failure but rather, as a sound and substantiative option that underscored the purported benefits of continuous over pulsatile flow, packaged into a small, widely applicable and easy-to-implant pump.

The present and future of the field of advanced heart failure

The sure-footedness of our field, especially within the U.S., is being challenged in several ways. An unprecedented pandemic turned off the spigot of our economy and affected lives and livelihoods in way unimaginable prior to 2020. The COVID-19 pandemic exposed deep-rooted health care inequities and deficiencies in the preparedness of our global health care systems, indubitably impacting the ability of advanced heart failure patients to seek care and our capacity to provide it. During 2020 and 2021, our field's mission to advance heart failure management felt trivial compared with the battle to save humanity from COVID-19. As such, MCS volumes fell and global heart failure outcomes transiently suffered.[15-17]

Antecedent to this, an attempt to reduce heart transplant waitlist mortality and geographic disparities led the United Network of Organ Sharing (UNOS) to amend organ allocation in the U.S. This policy change in late 2018[18] had a monumental - yet unsurprising - impact on advanced heart failure in the U.S. with reverberations felt globally due to the large market share that the U.S. has on MCS. The new UNOS policy favored the direct-to-transplant route over bridging with durable MCS, thereby effectively changing the phenotype and intent of durable MCS patients in the U.S.[18] Within our own community, some practitioners began to lose enthusiasm for durable MCS, [19] favoring direct transplantation despite the laudable 84% 2-year survival on third generation technology (mirroring the 82% survivals attained with cardiac transplantation)[20] and the dramatic reduction in the burden of hemocompatibility-related adverse events.[14] These negative sentiments and trends in MCS utilization should trigger considerable concern. Failure of advanced heart failure practitioners to embrace what the field has achieved with modern MCS support could result in future patient disenfranchisement and impede our ability to recruit promising young faculty into the profession. Importantly, while transplantation carries a meaningful impact for the fortunate few recipients, it remains epidemiologically trivial, even as efforts to expand the donor pool with use of Hepatitis C [21] and DCD hearts [22] are being embraced. If governments, payors, and investors interpret the MCS market as stagnant, failing, or antiquated, the desire to expand MCS support or support new technologies and innovation will wane.

Outside of the heart failure community, widespread acceptance of durable MCS as a management strategy for advanced heart failure is lacking and patient care is increasingly siloed. To most cardiologists and cardiac surgeons, our offerings remain foreign or unfamiliar, and their general knowledge of contemporary survival and quality of life with durable MCS and transplant remains woefully insufficient. Yet, implementation of temporary circulatory support for cardiogenic shock management has soared despite high upfront care costs and even higher short- and longer-term mortalities[23]. In this patient population with so much to gain from durable MCS and transplant, the utilization of advanced heart failure therapies in cardiogenic shock remains perplexingly low. Similarly, the extension of percutaneous mitral valve interventions for management of functional mitral regurgitations in patients with lower ejection fraction is rapidly growing, yet one year mortality remains high.[24] With advanced heart failure care becoming increasingly attractive to other specialists (structural heart, electrophysiology), more and more care siloes have developed, increasing the potential for delayed or insufficient referrals despite years of data supporting the benefit of our therapies. Our specialty is at risk of becoming increasingly niche or overlooked.

Added to the above commingling forces is the unforeseen dissolution of the long existing durable MCS duopoly enacted by the retirement of the HVAD. This newfound monopoly has introduced a sense of disquiet among heart failure practitioners. These feelings are compounded by the reality that, because HVAD was the intended platform for Medtronic's device evolution, new technologies in the durable MCS pipeline from other manufacturers will likely not be available for approved clinical use for years. Competition in industry is important to make products better, to make products different, and to improve market awareness, efficiency, pricing and customer satisfaction. More than ever, the field of MCS needs competition.

A time for unity within the advanced heart failure community

At a time when the field of MCS is being challenged by a lack of imminent new technologies, a durable MCS market dominated by a single device, falling implant volumes, and competition from other cardiac specialists, it is time for the international field of advanced heart failure to unify its efforts and to celebrate the astounding victories achieved in a mere 2 decades of scientific endeavor. The challenges above cannot be met with pessimism or laissez faire indifference. While fortunate to have a third-generation technology with excellent early survival, we must continue our quest to devise technologies that can successfully compete with transplantation for long-term survival. Similar to pacemakers and cardiac resynchronization therapy, we need durable MCS devices to be "forgettable" to the patient, less onerous for practitioners to manage, with lower readmission and adverse event burdens.

Admittedly, our efforts to educate and emphasize the pertinence of our treatment options to the general cardiology community have lacked broad and coordinated messaging. Along these lines, we propose that the immediate aims for the Advanced Heart Failure field should include: (1) an expansion of advanced heart failure specialists and durable

MCS support within the general community; (2) a revision of society guideline documents to better reflect the benefits of MCS and transplant for many patients with end-stage heart failure (e.g., advanced heart failure evaluation for MCS and transplantation should be a Class I recommendation for patients with recalcitrant cardiogenic shock or inotrope dependence). This will require increased visibility of key opinion leaders at the more inclusive cardiology specialty academic meetings; (3) the addition of an advanced heart failure specialist evaluation for high-risk heart failure patients to payor or governmental quality metrics; and (4) the incorporation of a heart failure specialist within the interdisciplinary structural heart, critical care, and cardiogenic shock teams so optimal therapy can be provided for the patient with systolic heart failure.

Thus, as we celebrate the history of HVAD system, the success of third generation MCS technology, and the promise of extended cardiac donation, we need to join forces to promote our field with an aim to change the global impression that advanced heart failure care is a niche market. We need to tear down care silos within and between institutions so we can increase our offerings to those with refractory heart failure. Finally, our technology needs to continue to evolve to remain pertinent and less intimidating to patients and providers. Henry Ford, a man who revolutionized the automotive field, said "failure is simply the opportunity to *begin again*, and this time more intelligently." Our field, replete with brilliant minds, skilled surgeons, and life-saving medical technology, will reinvent itself again with the sole aim to allow our advanced heart failure patients the opportunity to *truly live and breathe again*. We cannot lose sight of these opportunities. Carpe diem.

Disclosures

Jennifer Cowger MD, MS- Advisory Board member and speaker for Abbott (HeartMate 3 and Tendyne); Advisory Board, speaker and National Co-pI for Medtronic (HVAD); Steering committee member for Procyrion (Aortix device) and Cordella (Endotronix device). Speaker for Zoll Medical (Zoll Lifevest). Henry Ford receives clinical trial funds from Abbott, Medtronic, Procyrion, and Cordella.

Danielle Goldstein, MD- Consultant (paid) and national Co-PI (unpaid) for Abbott and Abiomed technologies.

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