



Dizziness in the Heartmate III patient

Dizziness in the LVAD patient is often multifactorial. Titration of anti-hypertensive medications, fluid shifts associated with diuresis, and arrhythmias, particularly those originating in the ventricle, are factors often implicated as contributors to dizziness in these patients. Another possible explanation may lie in the enhanced HeartMate 3 mechanism that more accurately calculates low flows,¹ which can lead to greater frequency of PI events, and subsequently may result in dizziness. Unfortunately, there are no reports in the literature about the frequency of dizziness as a symptom in this patient population which may in part be due to its relatively recent approval in 2018 by the FDA for all patients who are candidates for the device. Anecdotally, clinicians both in the United States and internationally have implicated dizziness as a symptom that is noted by a subset of patients with the HeartMate 3 device. Further studies to better delineate the actual frequency of this occurrence are needed.

LVAD patients can become dependent on their device to sustain adequate cardiac output. Power oscillations from the LVAD reflect the interplay between pump flow and the native cardiac cycle. When the change between the aortic pressure and left ventricular pressure is smaller which occurs in systole, more blood can travel through the LVAD resulting in an increase in LVAD power. The pulsatility index (PI) on the HeartMate devices measures the change in power compared to the average power.² Because power changes reflect flow changes, PI may also be viewed as a surrogate for native heart function.

Flow through the LVAD and power demands vary during the cardiac cycle with increased variability seen in aortic regurgitation, atrial fibrillation, hypertension, and even ventricular volume changes each cycle. When the per-second PI and the PI averaged over 15 s vary by more than 45%, a PI event is triggered resulting in the speed dropping to the low speed setting of the HeartMate device and subsequent ramping back up to the fixed speed.¹ For HeartMate II devices, ramping occurs at 100 RPMs per second and for HeartMate 3 devices, ramping occurs at 50 RPMs.¹

HeartMate II is less accurate in calculating very low flows and instead a “—” can be seen in place of a numerical flow values where low flow alarms are triggered when flows less than 2.5 LPM are sustained.¹ The HeartMate 3 is capable of accurately calculating and displaying very low flows in numerical format instead of “—” with the capability of differentiating between flows of 2.4 and 0.4 LPM. For this reason, greater changes in low flows are better appreciated by the HeartMate 3 whereas all low flows on the HeartMate II would be only be able to be displayed as “—” with no differentiation between how low the flow actually may be in a given scenario.¹ This ability to more accurately detect flow changes at the lower range each cycle can lead to increased frequency of PI events in the HeartMate 3 patient.

This has clinical significance for patients with frequent PI events. If a patient has a low speed setting of 400 RPM less than the fixed speed for a HeartMate 3 device and has PI events more frequently than every 8 s, the device will never fully ramp up to the fixed speed before the next speed drop; thus, the patient is maintained in cycle of inadequate support at a lower speed than might be expected given the fixed speed.

When a HeartMate 3 patient is dizzy at our center with frequent PI events, we consider narrowing the difference between the fixed speed and the low speed settings to 200 or 100 RPM to limit large shifts in left ventricular offloading, maintain a speed closer to the actual fixed speed, and reduce the potentially symptomatic period of time while the patient's LVAD is ramping up from the low speed to the fixed speed. We have found this to be helpful in ameliorating some of the low flow alarms that previously affected patients. Certainly treatment of underlying causes contributing to HeartMate 3 low flow variations including addressing atrial fibrillation or hypertension is initiated which may also serve to reduce stroke risk,³ but if PI events are triggered by beat to beat LV volume variation in the context of heart failure independent of a clear correctable factor, adjustments to the low speed setting could be considered to improve dizziness in the HeartMate 3 patient with dizziness and frequent PI events.

Disclosures

None

Conflict of interest

All authors report no conflict of interest relevant to this manuscript.

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