P3440

Can pre-operative echocardiography predict RV failure post-LVAD implantation in children?

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Background: One of the most frequent complications of left ventricular assist device (LVAD) implantation is the development of right ventricular (RV) failure, which occurs in 10%-40% of patients. It is, therefore, essential to identify which LVAD candidates are at risk for RV failure and will require additional RV mechanical support with a biventricular assist device (BiVAD). However, the echocardiographic assessment of the RV is challenging due to its complex geometry and marked load dependence of its function indices. To our knowledge, there is no published evidence regarding which specific RV echocardiographic parameters should inform this decision in the paediatric population.

Aims: We sought to determine which pre-operative RV echocardiographic parameters best correlate with the need for a BiVAD, as opposed to LVAD alone, in a paediatric population undergoing VAD insertion at a tertiary care institution.

Methods: Retrospective review of the pre-operative echocardiograms of children (<18 years) with dilated cardiomyopathy undergoing elective VAD implantation at our institution, from November 2007 to December 2018. Preoperative quantitative and qualitative RV echocardiographic parameters described in the literature to be associated with RV failure after LVAD implantation in adults were collected. Moreover, qualitative RV function was independently assessed by three echocardiographers, blinded to the outcome of the patients.

Results: 89 patients were included, 39 (43.8%) males, median age = 1.7 years (IQR = 6.9), median weight = 11.6 kg (IQR = 13.8). 49 (55.1%) patients had an LVAD implanted, whereas 40 (44.9%) were deemed to need biventricular support. 45 (50.6%) patients received an EXCOR Berlin Heart, 16 (18%) a HeartWare HVAD and 28 (31.4%) a Levitronix Centrimag device. Requirement of BiVAD support was significantly more common in patients with moderate to severe RV impairment, as per expert assessment (OR = 2.864; 95% CI: 1.188–6.903, p=0.018), and tricuspid regurgitation > grade III (OR = 3.154; 95% CI: 1.124–8.850, p=0.025). All the other parameters collected – tricuspid annular plane systolic excursion (TAPSE), tricuspid regurgitant jet velocity, tricuspid regurgitation duration corrected for heart rate, RV tissue Doppler indices, RV fractional area change, and RV/LV diameter ratio– were not significantly different among groups.

Conclusions: In our paediatric population, expert assessment of RV function and degree of tricuspid regurgitation were strong predictors of RV failure among patients undergoing LVAD implantation, allowing for preemptive RVAD implantation and improving patient outcomes.