

Is the lateral tethering angle associated with the severity of tricuspid valve regurgitation in hypoplastic left heart syndrome? A 3D echo and MRI study

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Objectives: The degree of tricuspid valve regurgitation (TR) is a significant prognostic factor for patients with hypoplastic left heart syndrome (HLHS) undergoing single-ventricle palliation. The lateral tethering angle (LTA) of the anterior papillary muscle (APM) of the tricuspid valve (TV) is the angle between the TV annulus and the APM and has been previously correlated with the severity of TR. However these studies have depended on subjective echo assessment of TR and RV function. We present data in respect of the relationship between LTA, MRI derived RV ejection fraction (RVEF), TR regurgitant fraction (TRRF) and indexed RV end-diastolic volume (iRVEDV).

Subjects and Methods: Patients with HLHS at different stages of single ventricle palliation. Echocardiography: LTA was measured using Tomtec Echoview software on transthoracic 3D datasets obtained using the Philips iE33 ultrasound system. Indexed RVEDV, TRRF and RVEF were recorded from MRI. MRI imaging was performed within 4 weeks of the echo in 26/31 cases. 31 paired MRI/echo studies from 27 patients (aged 35 days to 13 years) were analysed. 18 studies were prior to Hemifontan, 12 prior to Fontan, 1 post Fontan. Based on data from our own institution the patients were separated into groups depending on the surgical stage, TRRF (trivial/mild: RF<20%, moderate/severe: RF≥20%), RVEF (good ≥ 50%, impaired <50%), iRVEDV (pre Hemifontan normal ≤ 133.6ml/m², pre Fontan normal ≤109.6ml/m²).

Results: The LTA for the different groups was: 1) Pre Hemifontan (n=18): 93.5° ± 10.1°, pre Fontan (n=12): 93.7° ± 8.96° (p=0.949). 2) TRRF<20% (n=21): 93.8° ± 9.6°, TRRF≥20% (n=10): 91.2° ± 10.8° (p=0.502). 3) RVEF ≥ 50% (n=25): 93.5° ± 10.7°, RVEF <50% (n=6): 90.9° ± 5.3° (p=0.572). 4) Normal iRVEDV (n=26): 93.7° ± 9.9°, enlarged iRVEDV (n=5): 89.4° ± 9.9° (p=0.378).

Conclusions: Our study did not show any statistically significant difference in the LTA for different surgical stages, severity of TR, MRI-derived RVEF or iRVEDV. It can be used as part of the assessment of the TV but should be interpreted in the context of the whole echocardiographic and MRI findings. Further studies and larger number of patients are required to define this technique further.