Right ventricular volumetry in healthy children and young adults by RT3DE – New axis, new quantification tool, promising results

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Background: Right ventricular (RV) volume quantification by 3D-echocardiography (RT3DE) is challenging because of difficult ultrasound windows to get an entire RV dataset and scarce high quality quanitification software. In children image quality is favourable at the expense of higher heart rates and less compliance. We tested the hypothesis if a modified acquisition axis in combination with a new RT3DE quantification software shows relevant deviations to the gold standard CMR.

Methods: We prospectively enrolled 20 healthy children, adolescents and adults (7 males, 6.0-40.3, median 16.5 years) for RT3DE with a IE 33 (Philips, X5-1 transducer) or Vivid E9 (GE, V4 transducer) machine. The 3D volumes were aquired from an apical view with the RV apex next to the transducer including entire inflow as well as outflow portion in the 2D planning view using 4 subvolumes in 90-110° under breathhold, Frame Rates 20-24/s. 2D echocardiographic imaging planes were selected from single RT3DE datasets. Anatomic landmark selection on the 2D images were performed with dedicated software (Ventripoint) to obtain end-diastolic and end-systolic volumes (EDV, ESV). 2 different RT3DE volumes of each person were calculated by one expert investigator. CMR was done in the same examination unit and quantified by standard semi-automative software based on the summation of disks method. Quantification of agreement between MRI and 3D echocardiography was done by Bland and Altman analysis, correlations by Pearson-Bravais.

Results: Data of 17 individuals could be included. There was mild underestimation of EDV by RT3DE (2.3±3.6%, r=0.996). ESV was calculated with 5.3±12% (r=0.972) higher volumes resulting in a slight underestimation of SV (6.7±10.4%, r=0.971) and EF (4.2±8.2%, r=0.981)

by RT3DE. Interstudy variability of RT3DE was low (EDV 1.9±7%, r=0.989, ESV 1.4±10%, r=0.98, SV 2.2±10.8%, r=0.977, EF 0.3±6.3%, r=0.988).

Conclusions: This studies provides excellent accuracy and reproducibility of RT3DE for RV volumetry in children and young adults compared to the gold standard CMR. Both the new quantification software based on a reliable 2D approach by the same manufacturer as well as an optimized image acquisition technique are good preconditions for studies in pathological cases.