Right ventricular size determination with 2D echocardiography in children with an atrial septal defect: ready for clinical use?

Martin Koestenberger1, MD, Bert Nagel1, MD, William Ravekes2, MD, Ante Burnas1, MD, Alexander Avian3, PhD, Thomas Rehak1, MD, Gernot Grangl1, MD, Gerhard Cvirn4, PhD, Andreas Gamillscheg1, MD

1Division of Pediatric Cardiology, Department of Pediatrics, Medical University Graz, Austria; 2Division of Pediatric Cardiology, Johns Hopkins University School of Medicine, Baltimore, MD, USA; 3Institute for Medical Informatics, Statistics and Documentation, 4Institute of Physiological Chemistry, both Medical University Graz, Austria

Introduction:
Determination of right ventricular (RV) size and function has gained more interest during recent years in both adults and children, especially in patients with congenital heart disease. The following 2D echocardiographic measurements from the apical 4-chamber view were useful for the assessment of RV size: RV end-diastolic basal diameter (RVEDb-d), RV end-diastolic mid-cavity diameter (RVEDm-d), RV end-diastolic length (RVEDL), RV end-diastolic area (RVEDa), and RV end-systolic area (RVESA). These parameters were easy to determine, and therefore can be used as a non-invasive measurement to study RV size and performance in children. We investigated growth related changes of RV internal dimensions in a healthy pediatric cohort and the predictive value of RV parameters in identifying enlarged RVs in children with a moderate to large secundum type atrial septal defect (ASD) to investigate for a possible clinical use.

Methods:
A prospective study was conducted in a group of 576 healthy children (age: day 1 to 18 years) and 37 children (age range: 1.4 – 17.7 years) with a moderate-sized to large ASD. We determined the effects of age, body length (BL), body weight (BW), and body surface area (BSA) on the following RV parameters: end-diastolic basal-diameter (EDb-d), end-diastolic mid-cavity diameter (EDm-d), end-diastolic length (EDL), end-systolic length (ESL), end-diastolic area (EDA), and end-systolic area (ESA). The predictive value of normal values stratified for age, BW, BL, and BSA was tested in our children with a moderate-sized to large ASD.

Results:
The RV size parameters RVEDb-d, RVEDm-d, RVEDL, RVESL, RVEDa, and RVESA showed a positive correlation with age, BL, BSA, and BW in our healthy subjects. To investigate the ability of RV internal dimension upper normal reference ranges in detecting children with an ASD, we used as cutoff point a z-score of >2. In our pediatric ASD population RV z-scores showed a high specificity for detecting ASD patients with sensitivity up to 89%, especially in children below eight years of age.

Discussion:
We could identify enlarged RVs of our ASD patients with RV parameters z-scores, especially in ASD children below eight years of age. With increasing age, BSA, BW, and BL z-scores of our ASD patients draw near to normal values, but are still higher compared to healthy patients. Having normal RV dimensions with age, BSA, BW, or BL adjusted z-scores allows for plotting of an individual patient z-score over time. This may be useful to guide decision making in ASD patients for timing interventional or surgical closure. Being able to identify and quantify the amount of RV dilation from a quick apical 4-chamber view may also be very helpful in patients where detailed examination of the atrial septum from subxiphoid imaging is not possible secondary to poor echocardiographic windows or patient movement. Although we did not study other forms of CHD in this study, the easy and rapid ability to get an apical 4-chamber view to assess and serially follow the RV z-score in other lesions that affect the RV volume such as tetralogy of Fallot.

Conclusion:
With our study respective z-scores of each of these RV parameters are now available for possible use in ASD children and in children with congenital heart defects that influence RV size. In our population RV z-scores showed a high specificity for detecting ASD patients with sensitivity up to 89% and might therefore be important predictors in identifying pediatric ASD patients with a significant RV dilation and the possible need for an intervention, especially in children below eight years of age.

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