

Joint reference values for cardiac MR imaging derived ventricular size and function for children aged 0-18 years

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Introduction:

Cardiac magnetic resonance imaging (CMR) is an important tool in the assessment of congenital heart disease (CHD). Although widely used in the management of CHD, available normative data is considered suboptimal, considering the relatively small sample sizes. We sought to create more comprehensive reference values for ventricular size and ejection fraction.

Methods:

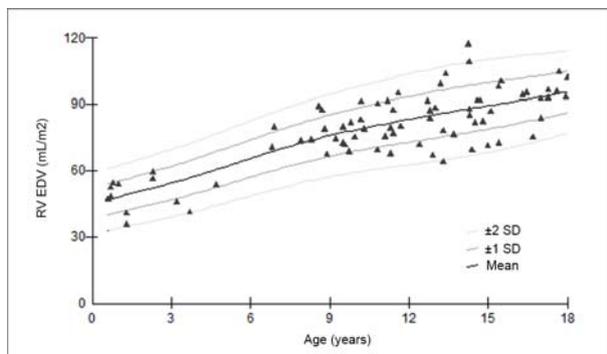
We combined data of 141 healthy children (68 male), aged 0 to 18 years, from previously published Caucasian cohorts from 3 european centers. CMR images were obtained using a standard cine-SSFP sequence. Pre-analysis consensus was obtained for the contouring method. All CMR images were manually contoured in the short-axis orientation under supervision of one experienced expert according to the established guidelines. Biventricular volumes and myocardial masses were derived. Reference curves of volumes and masses, indexed for BSA, in relation to age, ranging from 0 to 18 years, were constructed using the LMS method.

Results:

We report normative values stratified per gender and age group representing developmental stages. Age-related reference curves showed non-linear growth patterns. As an example, normal right ventricular end-diastolic volume (RVEDV) in boys was approximately 55 ± 9 mL/m² at age 3, increasing to 75 ± 10 at age 9 and 95 ± 10 at age 18. The reference curve is shown in fig 1. In this curve, a rapid growth is initially observed and growth decelerates past age 9 years.

During puberty, a significant difference between girls and boys in biventricular volumes and mass develops (e.g. RVEDV 76 ± 11 in girls vs 89 ± 12 mL/m² in boys >12 years, $p < 0.01$). No differences between genders could be observed in children under 6 years.

Our data was generally in concordance with previously published normative data. Interobserver agreement (coefficient of variation (CoV) -9 to 11% for right ventricular parameters) and intraobserver variability (CoV -6 to 0% for right ventricular parameters) were comparable to previous studies.



Conclusions:

This study provides normal reference ranges for biventricular volumes and masses in a large group of healthy children. These data can be used as reference for the interpretation of CMR studies in patients with CHD.