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EXTENDED ABSTRACT

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Reverse Remodelling of Right Ventricle in Children after Aortic Coarctation Repair – Z-Score Application

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Introduction

Coarctation of the aorta (CoA) is a congenital heart defect. It is characterized by diffuse arteriopathy which can persist to upward of the aortic isthmus, even after successful surgical correction. This arteriopathy can also occur in the pulmonary vasculature, leading to pulmonary hypertension (PH), a strong risk factor of poor prognosis in CoA population. The echocardiographic assessment has showed to be a relevant approach to define not only the location and extension of CoA, but also to explore cardiovascular alterations resulting by its condition along time. The purpose of this study was to characterize the right ventricle (RV) functional and structural reverse remodelling in a CoA paediatric population after surgical repair using z-score.

Methods

This cross-sectional study included only children submitted a successful surgical repair of the CoA in a tertiary centre [1996, 2009] up to the first year of age. Children with other cardiac structural lesions or recoarctation were excluded. Systemic arterial hypertension diagnosis was based in measures of arterial pressure by ambulatory 24 hours blood pressure monitoring [1]. It was defined as blood pressure in the 95th percentile or higher. PH was considered if the estimated pulmonary systolic arterial pressure (PSAP) was higher than 30mmHg. Pulse wave velocity, ambulatory 24 hours blood pressure monitoring, echocardiographic assessment of right ventricle (RV) and blood tests were performed 11 ± 4 years after surgical procedure. The functional RV evaluation included: 1) E and A waves of tricuspid flow, assessed by pulsed doppler; 2) S', E' and A' waves, isovolumetric relaxation and contraction times and ejection time measured by tissue doppler; 3) velocity of tricuspid regurgitation flow to calculate pulmonary artery systolic pressure (PSAP) and 4) tricuspid annular plane systolic excursion (TAPSE) measured by M-mode in RV free wall. Echocardiographic variables were normalized and evaluated by z-scores, because during childhood the unique normal range for each echocardiographic parameter can't be defined taking into account only gender, as established in adult range. Z-score is an important tool to echocardiographic assessment in paediatric cardiology, because it can correlate the parameter measured with value expected in cardiac anatomy and function evaluation according to child growth and/ or age. It is calculated through difference between value measured and expected, divided by standard deviation of the paediatric population. To interpret its values, positive z-score means that measurement is higher than population mean. However, the opposite meaning is verified if z-score value have the negative signal. In addition, this tool allowed us to use echocardiographic evaluation of all children included, not separating according range of age and without statistical power losing. Normality distribution inspection was assessed through visual analysis of histograms of the total sample, as well as by Shapiro-Wilk test application. Continuous variables were presented by means and standard deviation or by median, minimum and maximum, as adequate. If continuous variable followed normal distribution, the parametric tests were used. If not, the non-parametric tests were selected. Absolute values and relative frequencies were presented in categorical variables. One sample t test or sign test was used to estimate the deviation of measured/observed values from the normality/expected values (defined by z-score=0). It analysis was performed in IBM-SPSS-Statistics, version 23.0 (Windows_8.1). $P<0.05$ is considered significant. The study sample homogeneity were verified through principal component analysis, which was performed in R program version 3.4.0. The variables included in this study were

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converted in lesser number of compound variables through principal component analysis, obtaining a correlation and covariance matrix. It allowed highlighting potential trends/patterns by a compact representation, without loss of relevant information. No correlations were found between different parameter from the medical tests performed. The uniform distribution observed evidenced no reason for the multivariable analysis to remove the effect of potential confounding variables.

Results

We included 38 children with a mean age of 11 ± 4 years, 63% being male. Late arterial hypertension was diagnosed in 29% of the children and PH incidence was 68% with a mean PSAP of 37±5mmHg. The mean of A' wave (z-score: 0.34±0.93, p=0.030) and median of E/E' ratio (z-score: 0.46 [-1.32; 3.68], p=0.004) z-scores were increased comparing with expected normal values in paediatric population. Moreover, E' wave (z-score: -0.35±0.98, p=0.034) and RV index of myocardial performance (z-score: -0.20±0.41, p=0.006) were decreased. Regarding RV systolic function, TAPSE z-score was significantly increased (z-score: 2.06±2.33, p<0.001), being outside the z-score normal range.

Discussion and conclusion

Children submitted to CoA surgical repair before the first year of life showed already significant RV functional abnormalities when compared to the normal paediatric population, through z-score analysis. Z-score showed a major advantage to study slight RV modifications, providing a simulated comparison with normal paediatric population. These abnormalities can underlie pulmonary vascular remodelling after left ventricular pressure overload in CoA population that seems irreversible after pressure overload relief.

This study highlights the major changes present in right side of the heart, which could become a potential factor of long-term worse prognosis in CoA population. In addition, z-score seems to be a suitable tool to detect these abnormalities earlier and, consequently, may be used to support the most appropriate medical treatment selection.

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