

My Approach to Managing Left Ventricular Diastolic Function of Children and in Congenital Heart Disease

Como eu Faço Avaliação de Função Diastólica do Ventrículo Esquerdo em Crianças e em Cardiopatias Congênicas

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Echocardiography is the primary diagnostic method for assessing ventricular function in children and patients with congenital heart disease; however, it traditionally focuses on systolic function. Despite the growing interest in echocardiographic parameters for assessing diastolic function in children, diastolic dysfunction has been less investigated and, therefore, is less understood.

Some factors have limited this assessment:^{1,3}

Although diastolic dysfunction is a component of pediatric heart disease, it remains rare in this population.

1. Doppler assessment parameters vary significantly with age, body surface area, and heart rate.
2. No single measurement adequately describes diastolic function like ejection fraction does for systolic function.
3. A gold standard parameter to diagnose diastolic dysfunction is lacking. Even measurements obtained during cardiac catheterization are inaccurate and provide partial information about ventricular diastole characteristics.
4. Considering these difficulties, available guidelines for assessing diastolic function apply to adults, not children.

The latest American Society of Echocardiography guidelines for echocardiographic studies in children were published 12 years ago and included diastolic function analysis parameters.⁴ The recommended echocardiographic parameters for assessing diastolic function in this document include (Figure 1):

1. Mitral flow pulsed-wave Doppler: E and A wave velocities, E/A ratio, and E wave deceleration time;
2. Pulmonary venous flow pulsed-wave Doppler: S, D, and reverse A (Ar) wave velocities and Ar wave duration;
3. Left ventricular inlet/outlet flow continuous-wave Doppler: Isovolumetric relaxation time (IVRT);
4. Tissue Doppler: e' and a' wave velocities, E/e' ratio, and IVRT; and
5. Left atrial volume obtained in the apical four- and two-chamber planes.

Keywords

Child; Congenital Heart Disease; Echocardiography.

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Obtaining normal values for the pediatric population is challenging. Cantinotti and Lopez³ critically analyzed 33 studies of parameter nomograms obtained by Doppler to assess diastolic function, aiming to establish an ideal diastolic function nomogram for children and review its limitations, especially in neonates, and highlight its strengths. However, the authors reported several methodological limitations, such as a lack of standardization for obtaining parameters, normalizing the data, and presenting normal Z scores, percentiles, or mean values. Most studies adjusted for age, but few adjusted for body surface area and heart rate. The authors also reported a wide range of normal values for similar age groups.

Could the guidelines on diastolic dysfunction in adults prepared by the American and European Societies^{5,6} (Figures 2 and 3) apply to children?

Dragulescu et al.² and Chang et al.⁷ evaluated this question. Dragulescu et al.² evaluated children with dilated, restrictive, and hypertrophic cardiomyopathies and reported that these criteria were inadequate for diagnosing diastolic dysfunction in the study group and misdiagnosed diastolic dysfunction in the control group. They also observed that the wide range of pediatric normal reference values limited the diagnosis of diastolic dysfunction to a small number of cases. Chang et al.⁷ evaluated children and adolescents with systemic lupus erythematosus and reported that all diastolic function parameters were changed in the study versus control group. However, none of the cases met the criteria for diastolic dysfunction found in the adult guidelines.

Considering this complexity, how should left ventricular diastolic function be assessed in children? We suggest the method proposed by Frommelt¹, which included a Doppler analysis of pulmonary and mitral venous flow in all children (Figure 4) followed by tissue Doppler assessment of the mitral annulus, atrial volume, and strain rate. Despite its challenges, diagnosing diastolic dysfunction in children, an echocardiographic evaluation is critical. However, new standardized studies should be conducted to determine normal parameters for different age groups.

Authors' contributions

Research conception and design: Mercer-Rosa L and Saady SM. Data collection: Mercer-Rosa and Samira Saady SM. Data analysis and interpretation: Mercer-Rosa L and Saady SM; Critical review of the manuscript for intellectual content: Mercer-Rosa L and Saady SM.

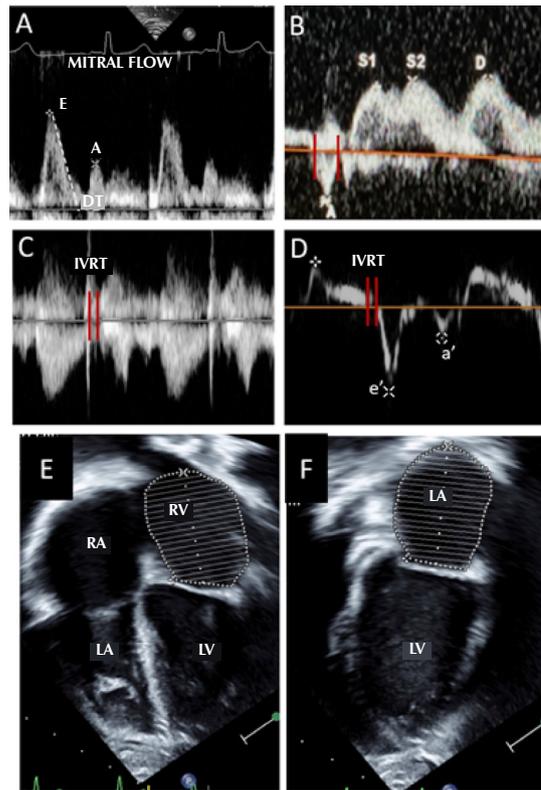
Conflict of interest

The author declares that he has no conflict of interest

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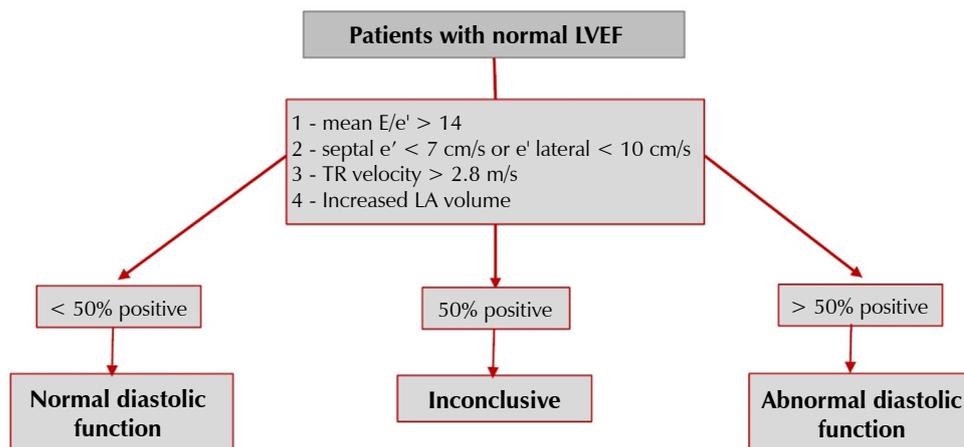


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TD: tempo de desaceleração; TRIV: tempo de relaxamento isovolumétrico; AE: átrio esquerdo; VE: ventrículo esquerdo; VD: ventrículo direito; AD: átrio direito.

Figure 1 – A: Mitral flow pulsed-wave Doppler: E and A wave velocities, E/A ratio, and deceleration time (DT). B: Pulmonary venous flow pulsed-wave Doppler: S, D, and reverse A wave velocities, and reverse A wave duration. C: Left ventricular inlet/outlet flow continuous-wave Doppler: isovolumetric relaxation time (IVRT). D: Tissue Doppler: e' and a' wave velocities, E/e' ratio, and isovolumetric relaxation time (IVRT). E: Left atrial (LA) volume obtained in the apical four- and F: two-chamber planes.



Source: Nagueh et al.⁶ LA, left atrium; TR, tricuspid regurgitation.

Figure 2 – Algorithm for diagnosing left ventricular diastolic dysfunction in adult patients with a normal left ventricular ejection fraction.

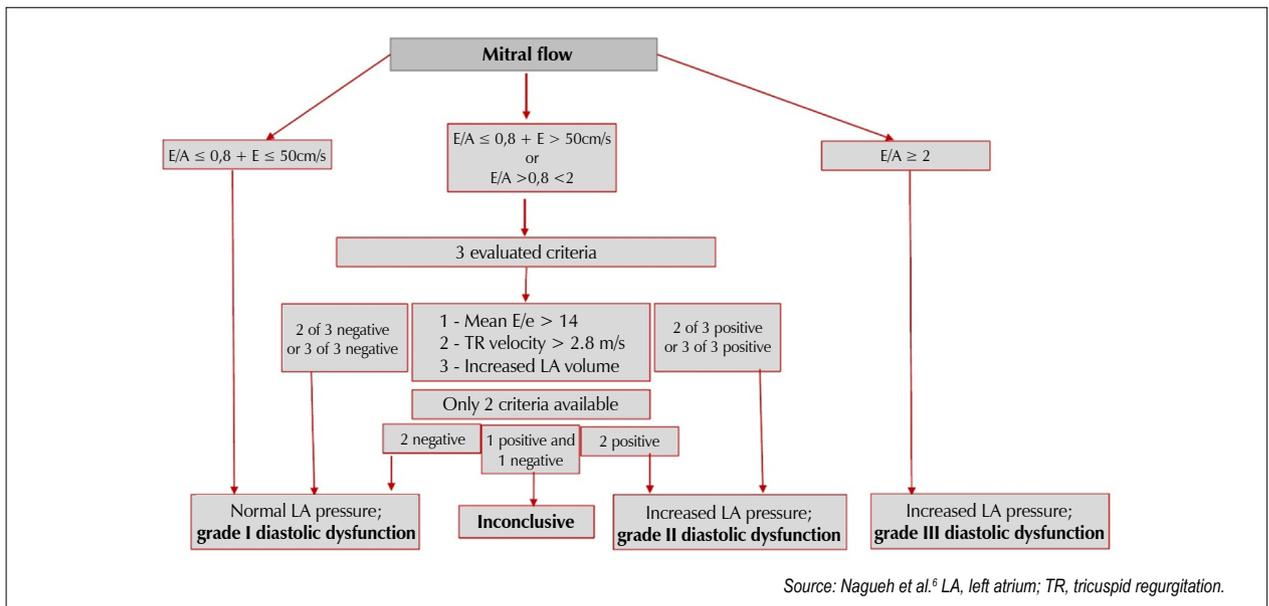


Figure 3 – Algorithm for left ventricular diastolic dysfunction graduation in adult patients with cardiomyopathies and a normal left ventricular ejection fraction.

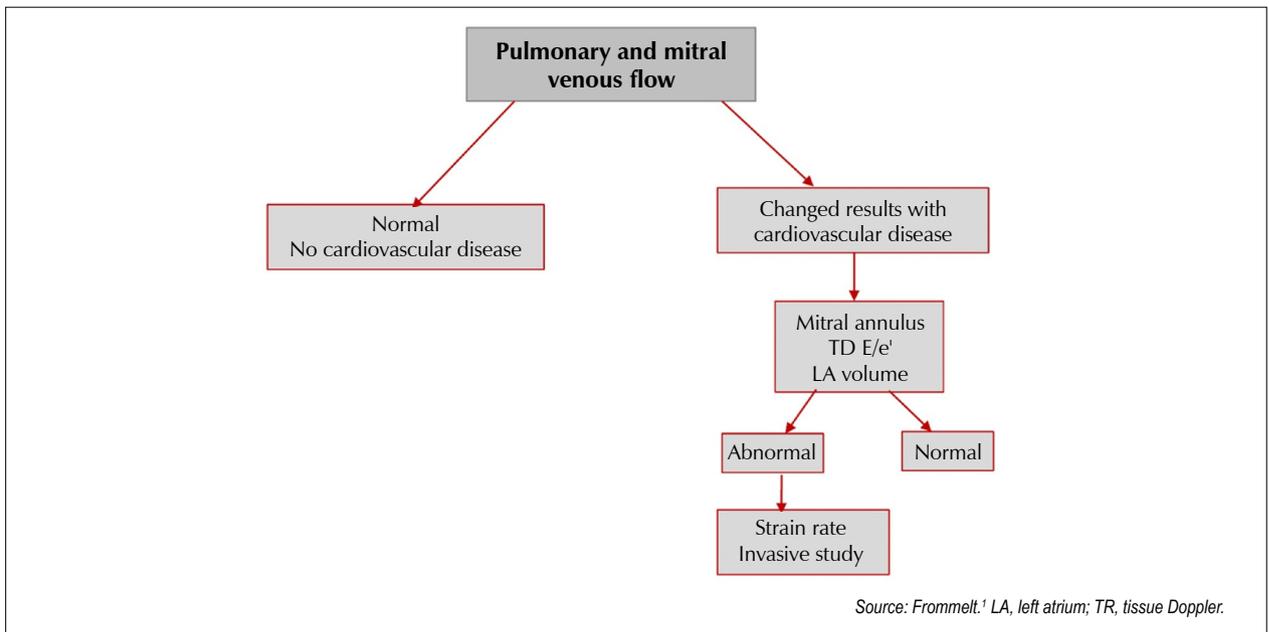


Figure 4 – Algorithm for assessing left ventricular diastolic function in children.

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