

The Impact of Acute Preload Changes on Left Ventricular Cardiac Mechanics in Children who Underwent Percutaneous Closure of Patent Ductus Arteriosus

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Introduction: Patent ductus arteriosus (PDA) is one of the most common congenital heart defects, representing 5% to 10% of all congenital heart cases. Usually PDA spontaneously resolve but those that lead to clinical instability require invasive management; among closure technique, the transcatheter percutaneous one is safe and effective. However, PDA closure is always associated with abrupt hemodynamic changes. For this reason, the evaluation of children undergoing percutaneous PDA closure could be a unique clinical model to assess the impact of acute preload changes on cardiac mechanics.

Aim of our study was to evaluate the left ventricular mechanics before and within 24 hours after transcatheter percutaneous PDA closure.

Methods: twenty-one children (age 57.4 ± 55.1 months, age range 1-186 months) diagnosed with hemodynamically significant PDA underwent percutaneous PDA closure.

Complete echocardiographic evaluation, including standard and advanced speckle-tracking echocardiography (STE) with acquisition of left ventricular ejection fraction (LVEF), left ventricular global longitudinal (LS), radial (RS) and circumferential strain (CS), was performed at pre-closure and within 24 hours post-closure.

Results: Mean PDA diameter was 2.1 ± 0.9 mm. At baseline evaluation, all patients presented normal LVEF (62.7 ± 4.0 %). The baseline strain values were: LV LS -22.1 ± 2.1 %; LV CS -25.3 ± 2.5 %; LV RS 39.1 ± 13.1 %. At the post-closure evaluation there was a significant reduction in LV volumes (baseline: LV end diastolic volume = 40.4 ± 24.4 ml vs. 34.5 ± 24.4 ml, $p = 0.001$), a significant drop in LV EF (57.1 ± 7 %, $p = 0.0016$) and also a significant reduction in LV LS (-18.00 ± 3.1 %, $p < 0.001$), LV CS (-17.7 ± 5 %, $p < 0.01$), and LV RS (28.85 ± 10.4 %, $p < 0.001$).

In 6 (28.6%) patients, LV EF dropped below 55% (49 ± 4 %, p vs baseline = 0.001) at the 24 hour assessment. These 6 patients were comparable with the remaining 15 patients for baseline age, LV end-diastolic volume, PDA size and LVEF ($p = 0.09$). Only LV LS was significantly ($p = 0.04$) reduced in the 6 patients who presented a LVEF < 55 % after percutaneous PDA closure.

Conclusions: Preload changes after transcatheter PDA closure cause a significant decrease in left ventricular systolic performance indexes. Of note, evaluation of pre-closure LS can help to identify the subgroup of patients who may experience an immediate drop in LVEF < 55 % after the procedure.