DOCTORAL SCHOOL OF MEDICINE AND PHARMACY

PHD THESIS ABSTRACT - **NOVEL ECHOCARDIOGRAPHIC TEHNIQUES FOR THE HEMODYNAMIC ASSESSMENT OF THE NEWBORN**

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Introduction

The evaluation of biventricular size and function is a critical aspect of cardiac clinical assessment, particularly in neonates. The neonatal heart differs significantly from that of other age groups due to distinct hemodynamic conditions, contractile properties, and electrophysiological characteristics. During the neonatal period, the left ventricle undergoes a transitional phase, characterized by preload and afterload changes, as well as architectural adaptations. Conventional echocardiographic parameters often fail to adequately capture these unique neonatal alterations. In contrast, a detailed analysis of longitudinal strain parameters may provide valuable insights into neonatal cardiac function, particularly in the context of specific pathologies that require therapeutic intervention and ongoing monitoring. Understanding the clinical applicability of myocardial strain, as measured by speckle-tracking echocardiography, necessitates a thorough knowledge of the normal reference values for this age group.

Objectives

The primary objectives of this study were: (1) to assess myocardial strain in neonates using cardiac echocardiography, with an emphasis on its clinical utility; (2) to establish reference values for global longitudinal strain in healthy full-term and late preterm infants; (3) to quantify myocardial strain values for healthy neonates, preterm infants, and those with various congenital heart anomalies; and (4) to evaluate the reproducibility of these reference values and their correlation with patient age and associated pathologies.

Study 1

In this study, we researched the quantification of neonatal cardiac function through the speckle-tracking method, aiming to identify more reliable assessment parameters compared to traditional echocardiographic measures. A total of 127 neonates were enrolled, of whom 103 met the inclusion criteria. Longitudinal strain was analyzed, with the following parameters determined: global ventricular strain for the left ventricle (LV), global longitudinal strain (LVGLS), right ventricular free wall strain (RVFWS), and four-chamber right ventricular strain (RV4CS).

Additionally, longitudinal strain was measured for each ventricular segment, including the interventricular septum. The reference values obtained for left ventricular global strain (LVGLS) ranged from -24.65 to -14.62, while values for right ventricular free wall strain (RVFWS) ranged from -28.69 to -10.68, and those for four-chamber right ventricular strain (RV4CS) ranged from -22.30 to -11.37. Given the reproducibility of these results, these parameters can be considered reliable for clinical use.

Study 2

A prospective study was conducted with the objective of establishing baseline values for global longitudinal strain (GLS) specifically in late preterm newborns, in order to evaluate the impact of preterm birth on myocardial function. The study included a control group of 64 healthy term newborns and a cohort of 21 late preterm newborns, with a corrected gestational age at the time of assessment between 34 weeks and 36 weeks plus 6 days. The significance of this study lies in the establishment of reference values for global and segmental longitudinal strain in both ventricles of late preterm infants. The results demonstrate that late preterm infants exhibit a more pronounced response in right ventricular longitudinal strain compared to term newborns, a key finding that underscores the clinical importance of accurate reference values in the assessment of ventricular function in preterm infants with associated pathologies.

Study 3

This methodology for assessing cardiac function was also applied to neonates and infants with congenital heart malformations. The first investigation focused on a cohort of neonates with simple transposition of the great arteries (TGA), which was compared to a group of healthy term newborns. Myocardial function in both groups was evaluated using speckle-tracking echocardiography. The primary aim was to identify a strain parameter with high discriminatory ability to detect subclinical myocardial dysfunction in neonates with TGA. The study concluded that the global longitudinal strain of the left ventricle (LVGLS) was significantly reduced in neonates with TGA compared to healthy controls, independent of body mass index, ejection fraction, or left ventricular mass.

Study 4

A subsequent study on congenital heart malformations focused on neonates with severe or critical pulmonary valve stenosis, who required percutaneous pulmonary valvuloplasty. The study aimed to compare longitudinal strain parameters between this group of patients and a control group of healthy neonates and infants. The findings identified the right ventricular four-chamber longitudinal strain (RV4CSL) parameter as a sensitive and reliable marker for evaluating right ventricular longitudinal strain in neonates with pulmonary stenosis.

Conclusions

The assessment of longitudinal, segmental, and global biventricular myocardial strain using speckle-tracking echocardiography demonstrates considerable potential as an alternative method for clinical cardiac evaluation. Due to its simplicity, ease of measurement, and reproducibility, this technique may be particularly useful in the cardiac assessment of healthy newborns, preterm infants, and neonates with congenital heart malformations.