

**Research Article**

Appropriate Use of Echocardiograms in a Brazilian Neonatal Unit. The More, the Better?

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Introduction

The echocardiogram (Echo) is an essential tool in the clinical management of neonatal patients, and its use is increasing in daily basis, leading to escalating costs for health systems worldwide. In this context, understanding the actual clinical impact of these Echo's is crucial to ensure their appropriate use [1]. The American College of Cardiology has already published a paper on the appropriate use criteria of Echo's for pediatric outpatients by classifying the indication as appropriate, possibly appropriate, or inappropriate [2]. In neonates, Echo's are used both to exclude congenital heart disease and to evaluate hemodynamic status in critically ill patients, particularly in preterm new-borns, where a higher incidence of congenital heart disease is observed [3]. Despite its clinical and financial importance, few studies on the theme, mostly in hospitalized neonates, led us to conduct this study. Our main objectives were to identify those indications that significantly influenced patients' clinical management and to establish educational approaches for neonatologists to reduce unnecessary costs. This study's findings hold the promise of improving neonatal care and reducing healthcare costs.

Methods

Data collection

This was a retrospective study. Data was collected from medical records in Hospital Israelita Albert Einstein from January 2011 to August 2018, including age, gender, gestational age, weight and length at birth, indication for the Echo, and clinical impact after the exam. We divided the indications for Echo into five categories: murmur, hypoxia, hemodynamic instability, fetal diagnosis of congenital heart disease, and prematurity. In our neonatal unit, the exams may be performed in the nursery, semi-intensive, and intensive care units. The clinical impact was considered positive whenever there was an introduction, change, or suspension of clinical management, including invasive procedures such as surgeries. Our local Ethics Committee approved this study (no. 3634-18).

Statistical analysis

The sample was characterized using a range of descriptive statistics: mean, standard deviation, minimum and maximum

values, median, interquartile range for quantitative variables, and absolute and relative frequencies for categorical variables [4].

Based on the presence or absence of clinical impact, group comparisons were performed using the Mann-Whitney U test for quantitative variables due to the non-parametric nature of their distributions and the Chi-square test for categorical variables. Data normality was evaluated using the Shapiro-Wilk test and visual assessments via boxplots, histograms, and quantile-quantile plots [4].

A multiple logistic regression model was developed to analyse changes in Clinical management. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 26.0, with a significance threshold set at 5%.

Results

A total of 1,271 hospitalized new-borns were assessed, and 2,079 Echo's were performed. The median age was two days (1-71), and the median gestational age (GA) was 38 weeks (20-43). According to GA, we found 36.27% preterm (below 37 weeks of GA), 62.23% term (37-41 weeks of GA), and only 1.49% post-term (>42 weeks of GA). The median weight was 2,939g (505-6,647g), and the median length was 45cm (26.5-63). Most exams happened in the neonatal intensive care unit (55.9%). The most common indication for the Echo's performance was prematurity (42.9%), followed by murmur (39.6%), fetal diagnosis of congenital heart disease (9.7%), hemodynamic instability (3.7%), and hypoxia (3%).

Clinical impact after the echocardiogram

Clinical impact occurred in 44.5% (n=926) of the patients, mainly in male gender (54.9%), preterm new-borns (68%), and in those with less than 2,500g (46.2%). The most typical indication that caused a change in clinical management was prematurity (51.3%), followed by murmur (27.5%), fetal congenital heart disease diagnosis (10.4%), hemodynamics instability (5.2%) and perinatal hypoxia (4.4%). Among the most common changes in clinical conduction were the indication or cancellation of additional methods (51.6%), cancellation of invasive procedures (34.3%), and introduction or change in prescribed drugs (11%).

We also used multiple logistic regression analyses to identify factors more likely to change clinical management. Among demographic characteristics, we found male gender presented a 36.2% increase in management change (odds ratio (OR) 1.362, p=0.001), and low birth weight (<2.5kg) had a 47.1% increase (OR 1.471, p=0.002). Among the indications, considering heart murmur as the reference, we found perinatal hypoxia was most likely to change clinical conduction (OR 2.550, p=0.002), followed by hemodynamics instability (OR 1.975 p=0.01), fetal heart disease diagnosis (OR 1.676 p=0.002) and prematurity (OR 1.566, p=0.001).

Discussion

To date, we studied the highest number of Echos recorded (2,072) to address the appropriate indication of this exam in the neonatal period, which is directly related to the cost/effectiveness of this tool in the health system. In our population, appropriateness measured by the change in clinical management occurred in 44.5%. This contrasts with Moss et al. [5], which studied a smaller number of Echos (157), indicating a change in 78% of them. Indeed, that might be related to differences in methodology once they considered clinical management change as immediate cardiology intervention, medical treatment without cardiologist assistance, and cardiologist follow-up, and this latter was the most common change (45%). In our cohort, we considered only immediate intervention after the exam. Thus, future clinical follow-up after discharge was not addressed.

Interestingly, the high number of exams and changes in clinical management (926) in our study made it possible to use a complete multivariate analysis to determine the conditions under which we could reach a more cost-effective equation for the exams: male gender, low birth weight, hypoxia, hemodynamic instability, and prematurity. This finding allowed us to reinforce the adequate indications of the exams with neonatologists to reduce financial costs with unnecessary exams.

It's important to acknowledge the limitations of our study. Firstly, it was retrospective in nature, which may have introduced some bias. Secondly, our definition of clinical impact as a change in clinical treatment did not take into consideration the opinions of the neonatologist or pediatric cardiologist. However, this did not interfere with the identification of the group of patients where Echo would be most beneficial. These limitations should be considered when interpreting our findings.

Conclusion

Although the Echo is a valuable tool for guiding neonatologists in the clinical management of patients, careful use must be considered to identify patients who could benefit from the exam. Including regular educational material for the neonatologists and the appropriate indications in electronic medical prescription systems may help prevent unnecessary costs to the health system.

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