Section: Miscellaneous

Original Research Article

COMPARISON OF 2D ECHOCARDIOGRAPHIC PARAMETERS BETWEEN PRETERM AND TERM INFANTS IN A TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT

Background: Echocardiography can facilitate early identification of cardiovascular compromise that can facilitate clinical management and improves the short term outcomes in neonates. The aim and objective is to compare the ventricular dimensions and valvular dimensions between preterm and term infants in a tertiary care teaching hospital.
Materials and Methods: An Analytical cross-sectional study was conducted in a hospital setting. The data collection was done for 2 month period between January and September2021 from adequate sample of study group including preterm and term infants in a tertiary care teaching hospital. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.
Results: Among the study population, 25 (50%) participants were term neonates and 25 (50%) were preterm neonates .Among the most important echocardiographic parameters ,The mean IVSd was 3.29 ± 0.53 in term neonates and it was 2.55 ± 0.4 in preterm neonates.The mean IVSs was 4 ± 0.76 in term neonates and it was 3.38 ± 0.45 in preterm neonates.The mean LVIDd was 19.35 ± 1.73 in term neonates and it was 13.54 ± 2.67 in preterm neonates.The mean LVIDs was 13.36 ± 3.32 in term neonates and it was 8.87 ± 1.71 in preterm neonates.. There is a significant difference in dimensions between study group. (P value <0.001).
Conclusion: This study found Echocardiographic parameters and values significantly less in preterm babies compared to the term babies with no significant difference in the physical parameters between the groups.
Keywords: Neonate, echocardiography, cardiac, systole, valve.

INTRODUCTION

Hemodynamic instability and inadequate cardiac performances are very common in critically ill children.[1] Echocardiography can be used to provide the hemodynamic information in order to support the bedside clinical decisions.[2,3] Two dimensional echocardiography is being used increasingly in neonatal units to determine the neonatal cardiac structure and function.[4]

Echocardiography can facilitate early identification of cardiovascular compromise that can facilitate clinical management and improves the short term outcomes in neonates.[5-7] There is a need to ensure the standardization of training and clinical practice guidelines with quality assurance systems in order to maintain a safety dissemination of echocardiography.[8]

MATERIALS AND METHODS

Study area: The study was conducted in a hospital setting.
Study Population: preterm and term infants in a tertiary care teaching hospital. The first study group included preterm infants with gestational age < 37 weeks. The other group consisted of fullterm infants. Infants with any suspected congenital anomalies of the airways, congenital heart disease (except hemodynamically insignificant ventricular or atrial

septal defects), intrauterine growth restriction (IUGR) or small for gestational age (SGA) were excluded from the study. Infants with qualitative right or left ventricular systolic dysfunction and/or echocardiographic signs of pulmonary hypertension (i.e. unusual degree of right ventricular hypertrophy, flat septum or elevated tricuspid regurgitation velocity) were also excluded from the reference values.

Sample size: The sample size was calculated assuming the expected mean and standard deviation of the Right ventricle end diastolic area in the preterm infants as ,σ_1(33,5) and in the term infants as , σ_0(26,4), as per the pervious study by Levy PT et al et al.11The other parameters considered for sample size calculation included were 95% power of study and 5% two sided alpha error. The required sample size was calculated using the following formula sproposed by Kirkwood BR et al.15 Formula used for sample size calculation:

$$N = (u+v)^2 (\sigma_1^2 + \sigma_0^2)/(\mu_1 - \mu_0)^2$$

group 1: preterm infants group 2: term infants

N = Sample size

μ_1, μ_0 =Difference between the means (μ_1=33 and μ_0=26) σ_1, σ_0 =Standard deviations (σ_1=5 and σ_0 =4)

u =two sided percentage point of the normal distribution corresponding to 100 % - the power = 95%, u =1.645

v =Percentage point of the normal distribution corresponding to the (two sided) significance level for significance level = 5%, v = 1.960

The required sample size as per the above-mentioned calculation was 11 in each group.To account for a non- participation rate/ loss to follow up rate of a about 10%, another 1 subjects will be added to the sample size. Hence, the minimum required sample size would be 12 subjects in each group. But we will study 25 subjects in each group, to facilitate subgroup analysis based on gender, birth weight category.

Study design: Analytical cross-sectional study

Study duration: The data collection was done for 2 month period between January and September2021.

Method of measurement of outcome of interest: Echocardiographic imaging

The GE Ultrasound CFM 800 (GE Ultrasound, Bedford, UK) will be used for all examinations. This incorporated a 5–10 MHz multifrequency imaging transducer, colour flow mapping, and pulsed wave and continuous wave Doppler. The images obtained during the examination was stored in an integrated digital archiving system (Echopac, version 5.3; GE Ultrasound). A complete two dimensional and Doppler examination was performed to exclude structural heart disease, and to assess the patency and flow characteristics through the ductus arteriosus. The right and left ventricle was imaged using an apical four chamber view with the septum as vertical as possible, the tricuspid valve as horizontal as possible, and the apex in view. A simultaneous electrocardiogram was recorded.[6]

Data Collection Methods: Healthy term infants were recruited from the postnatal wards. Premature infants were recruited from the neonatal unit if they had no cardiorespiratory distress. The convenience sampling technique was used to serially include the participants in the study. After obtaining the written informed consent from the parents, the Echocardiographic examinations were performed on each infant after 72 hours of delivery. All infants were examined during quiet respiration or while asleep.

Data Collection Forms: The data will be collected serially in a structured manner. The data will be collected about gestational age, sex, Birth weight, mode of delivery. The following clinical data will be recorded at the time of completion of study: heart rate, respiratory rate, oxygen saturation, blood pressure, capillary filling time. Over the study period, the following information will be collected whenever an echocardiogram was performed on the neonatal unit: Interventricular septum diastolic dimension (IVSd), Interventricular systolic dimension (IVSs), Left ventricle Posterior wall diastolic dimension (LVPWd), Left ventricle Posterior wall dimension systole (LVPWs), Left ventricle end diastolic dimension (LVIDd), Left ventricle end systolic dimension (LVIDs), aortic root dimension (AO), left atrium dimension (LA).

Statistical methods: Cardiac chamber dimensions were considered as primary outcome variable. cardiac flow velocities (RVEF), were considered as Secondary outcome variables. Study group (preterm Vs. term) was considered as primary explanatory variable.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram pie diagrams.

For normally distributed Quantitative parameters the mean values were compared between study groups using independent sample t-test (2 groups)/ ANOVA (>2 groups).

Categorical outcomes were compared between study groups using Chi square test.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.[16]

RESULTS

Among the study population, 25 (50%) participants were term neonates and 25 (50%) were preterm neonates. The mean gestational age was 35.04±1.02 in the study population [preterm], minimum and maximum was 32 and 36 respectively with 95% C.I (34.64 to 35.44). Among the study population, 4 (8%) weighted <2 kgs, 19 (38%) weighted 2 to 2.5 kgs and 27(54%) weighted >2.5 kgs.

Table 1: Comparison of mean of physical examination between study group(N=50)

Physical Examination	Study group (Mean± SD)		P-value
	Term Neonates (N=25)	Preterm Neonates (N=25)	
Heart rate	140.96 ± 18.6	131.8 ± 16.53	0.072
Respiratory rate	61.68 ± 13.55	58.64 ± 10.09	0.373
Spo2	95.64 ± 2.89	96.68 ± 2.59	0.186

The mean Heart rate was 140.96 ± 18.6 in term neonates and it was 131.8 ± 16.53 in preterm neonates. The mean Respiratory rate was 61.68 ± 13.55 in term neonates and it was 58.64 ± 10.09 in preterm neonates. The mean heart rate was 95.64 ± 2.89 in term neonates and it was 96.68 ± 2.59 in preterm neonates. There is no significant difference in physical examination between study group. (P value >0.05).

Table 2: Comparison of mean of parameters between study group(N=50)

Parameter	Study group (Mean± SD)		P value
	Term Neonates (N=25)	Preterm Neonates (N=25)	
IVSd	3.29 ± 0.53	2.55 ± 0.4	<0.001
IVSs	4 ± 0.76	3.38 ± 0.45	<0.001
LVIDd	19.35 ± 1.73	13.54 ± 2.67	<0.001
LVIDs	13.36 ± 3.32	8.87 ± 1.71	<0.001
LVPWd	3.85 ± 0.73	2.43 ± 0.59	<0.001
LVPWs	4.78 ± 0.87	3.4 ± 0.57	<0.001
Aorta size	9.04 ± 1.15	7.39 ± 0.51	<0.001
LA size	9.84 ± 1.24	7.7 ± 0.66	<0.001

The mean IVSd was 3.29 ± 0.53 in term neonates and it was 2.55 ± 0.4 in preterm neonates. The mean IVSs was 4 ± 0.76 in term neonates and it was 3.38 ± 0.45 in preterm neonates. The mean LVIDd was 19.35 ± 1.73 in term neonates and it was 13.54 ± 2.67 in preterm neonates. The mean LVIDs was 13.36 ± 3.32 in term neonates and it was 8.87 ± 1.71 in preterm neonates. The mean LVPWd was 3.85 ± 0.73 in term neonates and it was 2.43 ± 0.59 in preterm neonates. The mean LVPWs was 4.78 ± 0.87 in term neonates and it was 3.4 ± 0.57 in preterm neonates. The mean Aorta size was 9.04 ± 1.15 in term neonates and it was 7.39 ± 0.51 in preterm neonates. The mean LA size was 9.84 ± 1.24 in term neonates and it was 7.7 ± 0.66 in preterm neonates. There is a significant difference in dimensions between study group. (P value <0.001).

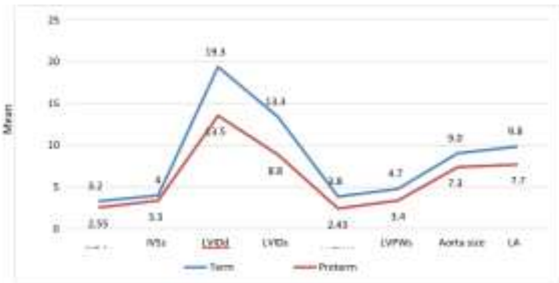

Figure 1: Line chart for Comparison of mean of parameters between study group(N=50)

Table 3: Comparison of dimensions with Birth weight category (N=50)

Parameter	Birth weight category (Mean ± SD)			P Value
	<2 (N=4)	2 to 2.5 (N=19)	>2.5 (N=27)	
IVSd	2.08 ± 0.10	2.55 ± 0.32	3.31 ± 0.48	<0.001
IVSs	2.92 ± 0.22	3.33 ± 0.41	4.05 ± 0.68	<0.001
LVIDd	11.40 ± 0.27	13.41 ± 1.85	19.33 ± 1.98	<0.001
LVIDs	6.75 ± 0.65	8.84 ± 1.19	13.37 ± 3.10	<0.001
LVPWd	2.13 ± 0.22	2.39 ± 0.42	3.81 ± 0.79	<0.001
LVPWs	2.92 ± 0.22	3.31 ± 0.32	4.82 ± 0.80	<0.001
Aorta size	7.08 ± 0.28	7.26 ± 0.32	9.06 ± 1.04	<0.001
LA size	7.20 ± 0.22	7.56 ± 0.30	9.86 ± 1.14	<0.001

The mean IVSd was 2.08 ± 0.10 in <2 kg birth weight, it was 2.55 ± 0.32 in 2 to 2.5 kg birth weight and it was 3.31 ± 0.48 in >2.5 kg birth weight. The mean IVSs was 2.92 ± 0.22 in <2 kg birth weight, it was 3.33 ± 0.41 in 2 to 2.5 kg birth weight and it was 4.05 ± 0.68 in >2.5 kg birth weight. The mean LVIDd was 11.40 ± 0.27 in <2 kg birth weight, it was 13.41 ± 1.85 in 2 to 2.5 kg birth weight and it was 19.33 ± 1.98 in >2.5 kg birth weight. The mean LVIDs was 6.75 ± 0.65 in
<2 kg birth weight, it was 8.84 ± 1.19 in 2 to 2.5 kg birth weight and it was 13.37 ± 3.10 in >2.5 kg. birth weight. The mean LVPWd was 2.13 ± 0.22 in <2 kg birth weight, it was 2.39 ± 0.42 in 2 to 2.5 kg birth weight and it was 3.81 ± 0.79 in >2.5 kg birth weight. The mean LVPWs was 2.92 ± 0.22 in <2 kg birth weight, it was 3.31 ± 0.32 in 2 to 2.5 kg birth weight and it was 4.82 ± 0.80 in >2.5 kg birth weight. The mean Aorta size was 7.08 ± 0.28 in <2 kg birth weight, it was 7.26 ± 0.32 in 2 to 2.5 kg birth weight and it was 9.06 ± 1.04 in >2.5 kg birth weight. The mean LA size was 7.20 ± 0.22 in <2 kg birth weight, it was 7.56 ± 0.30 in 2 to 2.5 kg birth weight and it was 9.86 ± 1.14 in >2.5 kg birth weight. There is a

significant difference in dimensions between birth weight category. (P value <0.001).

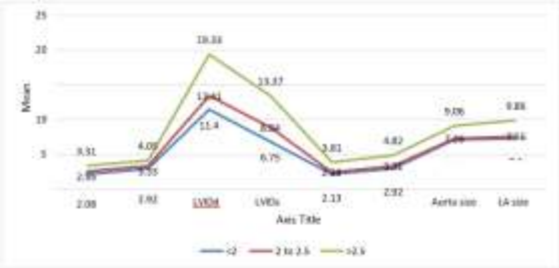

Figure 2: Line chart for Comparison of dimensions with Birth weight category (N=50)

DISCUSSION

The size and structure of the heart, as well as its functioning features, can be assessed non- invasively using echocardiography.[17] Because of these features, this evaluation has become essential for diagnosing, assessing the consequences, and monitoring newborns, children and adolescents with suspected or confirmed cardiac problems.[18,19] Echocardiography has been utilised in a number of studies to establish normality standards for cardiac measures in the general population.[20,21]

The values for heart dimensions in children and neonates that are currently used as a reference of normalcy come from research conducted in the 1970s and 1980s with a limited sample of infants, pre-school children, and adolescents.[19,22] The fact that the results may be impacted by the number of individuals and the characteristics of the population studied is well known as a key limitation of studies utilising population samples of children to achieve normality values. As a result, reference values must be established based on a larger number of children of various ages, as well as taking racial variables into account, as these factors can alter the values of cardiac measurements. The present study aimed to compare the ventricular and valvular dimensions between preterm and term newborns in a tertiary care teaching hospital.

A total of 50 neonates of which 25 where term neonates and 25 were preterm neonates were included. The preterm babies included in our study were healthy. Overall, majority of the babies weighed greater than 2.5kgs and very less (8%) weighed less than 2 kgs. Similarly, Abushaban, Let al,[23] prospectively studied 400 neonates of which 268 were preterm healthy babies with slight female predominance (M:F 1:1.13), the mean gestational age was 29.8 (± 2.38 SD) weeks, ranging between 24 and 35, and the mean body weight 1,479 (± 413 SD) grams, ranging between 588 and 3,380. In our study we found a greater mean gestational age greater (35.04±1.02 weeks) ranging between 32 and 36. We found a male predominance among the preterm neonates and a slight female predominance in term babies (P value 0.083).

Past studies by Lange et al,[24] studied the echocardiographic values in premature infant, where the former study with 105 infants weighing 500-4,000grms showed a linear relationship between LVED dimension and the later study found a gradual increase in the left ventricular dimensions as the birth weight increased. These studies correlated the values for the given birth weight but did not relate to gestational age.

There has never been a study that correlates measures with gestation. Later, during the first month of life, Zecca et al,[26] evaluated 35 preterm newborns with a gestational age of 25-29 weeks and a birth weight of 750-1,249 grams. On days 3, 7, 14, and 28, the diameters of the left ventricle were measured. During the first month of life, all left ventricle measurements increased gradually and significantly, according to this study. All of the metrics were linked to birth weight, but not gestational age or gender. The baseline left ventricle dimensions and gestational age were not found to be significantly related in this investigation.

Abushaban, L et al,[23] reported serial measurements of left ventricular dimensions over the first nine weeks of life in a preterm infant population with a body weight of 588-3,380 grams and a gestational age of 24-35 weeks. The majority of left ventricular diameters were shown to have a significant relationship with gestational age and body weight. Over time, the proportions of the left ventricle grew increasingly larger and more significant.

In our study mean IVSd, IVSs, LVIDd, LVIDs, LVPWd, LVPWDs, LA size and aorta root size between term and preterm found to be significant where the values where less in preterm babies compared to the term babies (P value <0.001). Similarly, observation was observed in Abushaban, L et al,[23] study where they studied the values at different time periods and found the rate to increase in first four weeks of birth and rate of increase decreased in post 5 weeks of life. Further in our study with correlation of birth weight with mean IVSd, IVSs, LVIDd, LVIDs, LVPWd, LVPWDs, LA size and aorta root size found a significant increase in the measurements with increased birth weight compared to the low birth weight. (P value <0.001). However, we found insignificant

difference in physical examination between term and preterm babies. (P value >0.05). The present study findings could not be compared to the other studies as our study did not compare the values at different time life and correlation of gestational age with weight was not done. But in common we found significant values in term neonates compared to preterm neonates.

CONCLUSION

The present study found significant IVSd, IVSs, LVIDd, LVIDs, LVPWd, LVPWDs, LA size and aorta size in relation with weight and gestational between term and preterm. This study found value significantly less in preterm babies compared to the term babies with no significant difference in the physical parameters between the groups.

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