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ORIGINAL ARTICLE

Spectrum of Common Congenital Heart Diseases in Preterm Neonates

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ABSTRACT

Objective: To determine the frequency and clinical spectrum of common congenital heart disease (CHD) in preterm newborns attending public sector tertiary care hospital.

Methods: A descriptive cross-sectional study was conducted at Neonatal Intensive Care Unit (NICU) of Liaquat National Hospital Karachi from October 2016 to March 2017. Record of preterm newborns having gestational age ≤37 weeks admitted to NICU were included. Cardiovascular examination and echocardiography were performed. If a defect was discovered on echocardiography, the type of CHD was also documented. CHD was labeled as positive based on the presence of anyone of the following: visual septal defect (VSD), atrial septal defect (ASD), patent ductus arteriosus (PDA) and tetralogy of fallot (TAF).

Results: Of 106 patients, CHD was observed in 21 (19.8%) cases. Of these, VSD was found in 8 (38.1%), ASD in 5 (23.8%), while PDA and TOF in 4 (19%) each. A significant association of CHD was observed with birth weight (p-value <0.001), history of CHD in siblings (p-value <0.001), consanguinity (p-value 0.005), and history of unexplained deaths in siblings (p-value 0.011). The mean birth weight was found significantly higher among neonates without CHD as compared to the neonates with CHD i.e., 2.83 ± 0.61 kg vs. 2.05 ± 0.56 kg (p-value <0.001).

Conclusion: The current study findings revealed that twenty percent of the preterm neonates admitted in NICU had CHD. Furthermore, an increased risk of CHD was observed in premature low birth weight neonates, those with history of CHD in siblings, history of unexplained deaths in siblings, and consanguineous marriage.

Keywords: Congenital Heart Disease, Echocardiography, Preterm Newborns.

INTRODUCTION

Congenital heart disease (CHD) is a major and fast-growing worldwide health issue for children.[1] In Pakistan, the estimated incidence is 1.5% with estimated mortality of 1.66%.[2,3]

Preterm birth and cardiovascular deformity are the second most common causes of newborn and infant death, accounting for approximately a third of all significant congenital defects. Clinical deterioration and collapse prior to identification and treatment are key causes to increased newborn mortality and morbidity.[4]

The incidence of CHD in Pakistan is underestimated due to home deliveries and early discharge of mothers and their neonates from hospitals without a proper neonatal examination pertinent to the cardiovascular system by a qualified and experienced person, as well as a lack of qualified paediatric cardiologists. Hospital based reports showing a higher mortality rate in low birth weight or preterm infants with CHD.[5] Preterm newborns with CHD face unique diagnostic and treatment issues; as neonatology develops, this population is likely to rise in size and need for medical resources.

CHD can appear at any age, from birth to puberty, and many cases are asymptomatic until they are discovered by chance during a normal health visit. Other symptoms include cyanosis, clubbing of fingers, tiredness, and even full-blown congestive heart failure.[6] A complete cardiovascular examination is required for every neonate. Normal examination and absence of murmur does not exclude CHD.[7] A high index of suspicion, detailed history, physical, cardiovascular, and other systemic examination such as chest x-ray and electrocardiogram (ECG) along with the use of echocardiography helps to diagnose most of the cases of CHD.[8]

The rationale of this study is that identification of spectrum of CHD in preterm newborns is important as the CHD are more common in preterm and is a significant determinant of mortality and morbidity so timely identification of congenital cardiac malforma-

tion can help provide better outcome. In addition, there is the paucity of local data so the study might help to the presently available data on prevalence of CHD in preterm neonates in local population. Although, the studies are available, but sample size is inadequate without addressing the effect modifier therefore the results are not appropriate for preterm newborn.

METHODS

This descriptive cross-sectional study was conducted at the Neonatal Intensive Care Unit (NICU) of Liaquat National Hospital from October 2016 to March 2017. Ethical committee of Liaquat National Hospital Karachi approved the study. Moreover, signed informed consent had been taken from parents of the preterm newborns and the objective of the study had been explained to them.

WHO software was used for sample size calculation by taking prevalance = 16%[3], d = 7 %, and 95% confidence interval. The calculated sample size was 106 patients. All preterm newborns of any gender having gestational age ≤37 weeks admitted to NICU were consecutively enrolled. While all preterm newborns diagnosed prenatally by fetal echocardiography, full term babies having gestational age > 37 weeks, and syndromic babies in which multiple organ system involved like Downs, Marfans were excluded.

CHD was labeled as positive based on the presence of any one of the following type visual septal defect (VSD), atrial septal defect (ASD), patent ductus arteriosus (PDA) and Tetralogy of fallot (TAF). VSD was defined as defect in membranous septum or muscular septum with left to right shunt. ASD was defined as defect in any portion of atrial septum with left to right shunt and dilated right ventricle and atrium. While PDA was defined as the connection that runs above left atrium and between aorta and pulmonary artery.

Registration of study subjects was done via medical record number. It was followed by a complete cardiovascular examination and echocardiography at the Liaquat National Hospital. If echocardiography meets the diagnostic criteria it was taken as confirmed case of CHD. In the event that an anomaly was discovered on echocardiogram, the type of abnormality was also documented, and parents were instructed on how to proceed. Echocardiography was done by a single trained pediatric cardiologist having more than 2 years of experience in Paediatric Echocardiography.

Data were entered and kept confidential, and the data collected included, hospital medical record number, age, gender, date and time, birth weight, gestational, history of CHD in siblings, history of unexplained deaths in siblings, maternal age, and consanguinity. Confounding variables, bias and ethical issues are controlled.

SPSS version 24 was used for the purpose of statistical analysis. Independent t-test was applied to see the mean difference between quantitative variables like gestational age, maternal age, and birth weight in between CHD and non-CHD neonates. Moreover, Chi-square test/Fisher-Exact test was applied to see the association of CHD with baseline characteristics. The p-value of ≤0.05 was considered as significant.

RESULTS

Of 106 neonates, the mean gestational age of the preterm neonates was 35.38 ±0.72 weeks. Most of the preterm neonates had ≤35 weeks of gestation, i.e., 60 (56.6%). The mean birth weight was 2.67 ±0.68 kg. There were 51 (48.1%) neonates with ≤2.5 kg of neonatal weight. Normal vaginal delivery was observed in 71 (67%) and cesarean section in 35 (33%) neonates. Of 89 neonates having siblings, history of CHD was observed in 10 (11.2%) siblings.

The mean maternal age was 29.08 ±3.24 years. Age of majority of the mothers was 64 (60.4%) years. Consanguineous marriage was observed among 22 (20.8%) mothers while history of abortion was reported by 34 (32.1%) mothers.

CHD was observed in 21 (19.8%) neonates. A significant association of CHD was observed with birth weight (p-value <0.001), history of CHD in siblings (p-value <0.001), consanguinity (p-value 0.005), and history of unexplained deaths in siblings (p-value 0.011). (Table 1) The mean birth weight was found significantly higher among neonates without CHD as compared to the neonates with CHD i.e., 2.83 ± 0.61 kg vs. 2.05 ± 0.56 kg (p-value <0.001). However, the mean gestational age (p-value 0.967) and maternal age (p-value 0.810) had insignificant differences amongst neonates with and without CHD. (Table 2)

Of 21 CHD patients, VSD was found in 8 (38.1%), ASD in 5 (23.8%), while PDA and tetralogy of fallot (TOF) in 4 (19%) each. (Figure 1) Types of CHD and their baseline characteristics are shown in table 3.

DISCUSSION

Weeks of gestation, indicating that newborns with cardiovascular malformations have a more than two-fold risk of preterm. Furthermore, with VSD, ASD, and

Table 1: Association of CHD with baseline characteristics (n=106)

Variables	Total	CHD		p-value
		Yes (n=21)	No (n=75)	
Gestational age, weeks				
≤35	60	11 (18.3)	49 (81.7)	0.663†
>35	46	10 (21.7)	36 (78.3)	
Birth weight, kg				
≤2.5	51	18 (35.3)	33 (64.7)	<0.001†
>2.5	55	3 (5.5)	52 (94.5)	
Mother's age, years				
≤30	64	13 (20.3)	51 (79.7)	0.873†
>30	42	8 (19.0)	34 (81.0)	
History of CHD in siblings (n=89) ∫				
Yes	10	8 (80)	2 (20)	<0.001‡
No	79	6 (7.6)	73 (92.4)	
Consanguinity				
Yes	22	9 (40.9)	13 (59.1)	0.005‡
No	84	12 (14.3)	72 (85.7)	
Type of delivery				
Cesarean Section	35	6 (17.1)	29 (82.9)	0.628†
Normal Vaginal Delivery	71	15 (21.1)	56 (78.9)	
History of unexplained deaths in siblings (n=89) ∫				
Yes	7	4 (57.1)	3 (42.9)	0.011‡
No	82	10 (12.2)	72 (87.8)	
History of abortions				
Yes	34	4 (11.8)	30 (88.2)	0.153†
No	72	17 (23.6)	55 (76.4)	

CHD: Congenital Heart Disease, Kg: Kilogram
∫Only 89 preterm had siblings
†Chi-square test applied, ‡Fisher-Exact test applied, p-value <0.05 considered significant

Table 2: Gestational age, birth weight and maternal age mean differences in CHD (n=106)

	CHD		p-value	95% CI
	Yes (n=21)	No (n=85)		
	mean ±SD	mean ±SD		
Gestational Age, weeks	35.38 ±0.80	35.39 ±0.71	0.967	-0.36 to 0.34
Birth Weight, kg	2.05 ±0.56	2.83 ±0.61	<0.001	-1.08 to -0.49
Mother age, years	29.23 ±3.43	29.04 ±3.21	0.810	-1.38 to 1.76

Independent t-test applied, p-value <0.05 considered significant

TOF, more infants were delivered preterm with pulmonary atresia diagnosis.[18]

Birth weight and period of gestation have always been the two important determinants of CHD, reported incidence being 2-3 times higher in low birth weight and preterm infants.[19] In our study the average gestational age at the time of birth was 35 weeks and average birth weight of the newborn 2.6 kg.

As per current study findings, CHD was found considerably higher among preterm neonates with history of unusual deaths in siblings and history of CHD in siblings. Previous studies also reported that the higher incidence of CHD among siblings of CHD patients is always a source of concern.[20,21]

In the current study, consanguinity was considerably higher among preterm neonates with CHD. Similar

Table 3: Types of CHD and their baseline characteristics (n=21)

	Gestational age, (weeks)	Birth weight, (kilogram)	Mother's age, (years)	CHD in siblings	Consanguinity	Type of delivery	Unexplained deaths in siblings	History of abortions
VSD (n=8)								
1	34	2.5	32	No	Yes	CS	No	Yes
2	35	2.4	24	No	Yes	CS	No	No
3	36	1.5	32	Yes	Yes	NVD	No	Yes
4	35	1.85	36	Yes	Yes	NVD	No	Yes
5	35	1.9	35	No	No	NVD	No	No
6	36	1.85	27	Yes	Yes	CS	Yes	No
7	34	1.5	27	No	No	NVD	No	No
8	35	2.6	29	No	No	NVD	No	No
ASD (n=5)								
1	35	1.6	25	Yes	Yes	NVD	No	No
2	36	1.6	28	Yes	Yes	CS	Yes	No
3	36	1.8	29	No	No	NVD	No	No
4	36	2.1	32	No	No	NVD	No	No
5	35	3.0	33	Yes	Yes	CS	No	No
PDA (n=4)								
1	34	2.5	32	No	Yes	CS	No	Yes
2	35	2.4	24	No	Yes	CS	No	No
3	35	2.0	25	No	Yes	CS	No	Yes
4	36	3.4	28	No	Yes	NVD	No	No
TOF (n=4)								
1	35	2.0	25	No	Yes	CS	No	Yes
2	36	2.4	32	Yes	No	NVD	Yes	No
3	36	2.5	27	Yes	No	NVD	Yes	No
4	37	2.2	32	No	No	NVD	No	No

Abbreviations: CHD: Congenital heart disease, ASD: Atrial septal defect, VSD: Ventricular septal defect, PDA: Patent ductus arteriosus, TOF: Tetralogy of fallot, CS: Cesarean section, NVD: Normal vaginal delivery

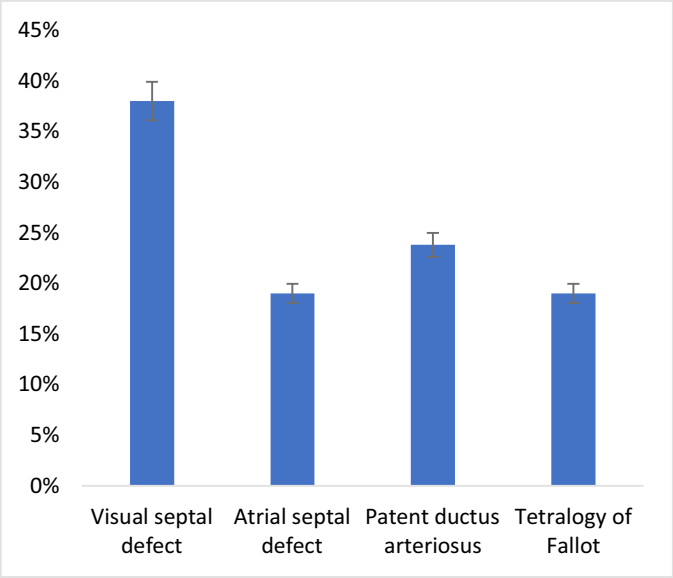

Figure 1: Types of CHD present in preterm neonates (n=21)

findings were reported by various previous studies as well.[22] Moreover, the current study showed that VSD was the commonest CHD in preterm newborns that was detected, followed by ASD. A recent investigation of the incidence of CHD in an Asian pediatric population found that TOF was more common than left sided obstructive lesions.[23] As a high percentage of the neonates were studied echocardiographically, our results might merely reflect a more accurate picture of the incidence of CHD in the neonatal population as a whole, which previously may have been underestimated. Another previous study[24] reported an incidence of VSD in the healthy neonatal population of 53.2/1000, based on echocardiographic studies of 1053 consecutive term neonates. They found an incidence of 56.6/1000 in a study of 159 consecutive preterm neonates.[25]

There are certain limitations in the current study. Firstly,

this study was cross-sectional in nature and thus lacks temporal association. Secondly, follow-up was not performed in the current study. Lastly, therapeutic characteristics, CHD defect in association with neonates' gender and maternal associated conditions like diabetes, pregnancy induced hypertension of the participants were also not reported. Despite of these limitations, this study has reported findings from a large private tertiary care hospital of metropolitan city Pakistan that caters a large number of urban populations not only from Karachi city but from outside Karachi as well. Still, there are dire need of further studies on the topic that can longitudinally follow these patients and see the prognosis of the disease in terms of both morbidity and mortality.

CONCLUSION

The current study findings revealed that almost twenty percent of the preterm neonates admitted in NICU had CHD. Furthermore, an increased risk of CHD was observed in premature low birth weight neonates, those with history of CHD in siblings, history of unexplained deaths in siblings, and consanguineous marriage. As the CHD is more common in preterm and is an important determinant of mortality and morbidity, echocardiography as advance technology should be used for timely identification of congenital cardiac malformation. This will help provide better management (early diagnosis, treatment services / early referral) to these neonates. Our study gave clear implication that increasing technological advances are allowing diagnoses to be made that would previously have been missed.

ETHICAL APPROVAL: Ethical approval of this study was obtained from the Research Committee of the Liaquat National Hospital Karachi, Pakistan.

AUTHORS' CONTRIBUTION: SS: Conception and design of the work, drafting, revising and final approval. NT: Conception or design of the work & drafting. KA: Revising it critically and final approval of the version to be published. SS: Final approval for the publication.

CONFLICT OF INTEREST: The authors declared no conflict of interest.

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