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PROMPT ANALYSIS OF CONGENITAL HEART DEFECTS IN NEONATES

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Abstract:

Of 26,266 live births over a 3-year period, 163 newborns (6.2 per 1,000 live births) were diagnosed with congenital heart disease (CHD) before discharge from the hospital. The median time to detect CHD was significantly longer in cyanotic CHD (44 hours) than in cyanotic CHD (6 hours). Most newborns had asymptomatic heart murmur (74.8%) and central cyanosis (11.6%). The most common symptom in a cyanotic group was asymptomatic heart murmur (75.5%), while in the cyanotic group it was cyanosis (63.3%). However, an asymptomatic heart murmur may also be a symptom in the cyanosis group (34.6%). We conclude that a routine physical examination at birth and before discharge can detect CHD in the newborn. However, some CHDs may not be detected before discharge.

Place and Duration: *In the Pediatric Unit-II of Sir Ganga Ram Hospital Lahore for one-year duration from December 2019 to December 2020.*

Key words: *congenital heart disease, cyanosis, newborn*

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INTRODUCTION:

The overall incidence of congenital heart disease (CHD) is approximately 8 to 10 in 1,000 live births. Early diagnosis is important to predict the postnatal care of a newborn with CHD to prevent further serious illness and mortality. However, some neonates with significant coronary artery disease may not be detected in the neonatal period. This study was designed to evaluate the effect of a routine postnatal and pre-discharge physical exam in detecting coronary artery disease.

METHODS:

The medical records of all newborns> 36 weeks of gestation diagnosed with CHD were retrospectively reviewed over a period of 3 years from June 2017 to June 2020. Isolated cardiac arrhythmias, physiological heart murmur, patent foramen ovale, premature age <36 weeks, and acquired heart disease, including dilated or hypertrophic cardiomyopathy, were excluded from the study. All newborns underwent at least two routine medical examinations by pediatricians during the first 24 hours of life and then prior to discharge. Age at first CHD detection was determined in hours. After initial testing including oxygen saturation from pulse oximetry, CXR, and ECG; echocardiography using a Hewlett Packard Sonos 4500 machine, obtained by a pediatric cardiologist in charge within 24-48 hours for the final diagnosis.

Statistical analysis: The statistical analysis was performed using the SPSS program (version 21.5). Data presented as number, percent, median (minmax). Chi-square test or exact Fisher test used to test dichotomous variables. A p value of <0.05 was considered statistically significant.

RESULTS:

Of the 26,266 live births, 163 newborns (74 men) (0.62%) were diagnosed with coronary heart disease, resulting in an incidence of CHD of 6.2 per 1,000 live births that could be detected before discharge from hospital. The overall mean time of detection was 40.5 hours (range 0 to 72 hours). The median time of detection in the cyanotic group was significantly longer than in the cyanotic group (44 hours vs 6 hours). Overall, the most common symptom was asymptomatic heart murmur (75.5%), followed by central cyanosis (11.6%), transient cyanosis (3.6%) and associated multiple abnormalities (3.6%). All CHDs were divided into a-cyanotic (n = 134) and cyanotic (n = 29) groups (Table 1).

TABLE 1. Number and type of congenital heart defect

Type of heart defects	Number of neonates (%)
Acyanotic lesions (Left to right shunt)	
Small patent ductus arteriosus	46 (28.2)
Small ventricular septal defect	42 (28.2)
Combined atrial and ventricular septal defects	32 (19.6)
Large ventricular septal defect	04 (2.4)
Large patent ductus arteriosus	02 (1.2)
Small atrial septal defect	01 (0.6)
Acyanotic lesions (Obstructive lesions)	
Valvular pulmonic stenosis	04 (2.4)
Supravalvular aortic stenosis	02 (1.2)
Supravalvular pulmonic stenosis	01 (0.6)
Interrupted aortic arch	01 (0.6)
Coarctation of aorta	01 (0.6)
Cyanotic lesions	
Tetralogy of Fallot	08 (4.9)
Pulmonary atresia with ventricular septal defect	08 (4.9)
Pulmonary atresia with intact ventricular septum	03 (1.8)
Heteotaxy syndrome	03 (1.8)
Tricuspid atresia	01 (0.6)
Truncus arteriosus	01 (0.6)
Ebstein's anomaly	01 (0.6)
Hypoplastic left heart syndrome	01 (0.6)
Pulmonary vein agenesis	01 (0.6)

The leading symptom of a-cyanotic CHD was asymptomatic heart murmur (85.7%), followed by congestive heart failure (CHF) (3.8%), associated multiple abnormalities (3.8%) and transient cyanosis (3.8% (Fig. In cyanotic CHD, central cyanosis was the most common (63.3%) followed by asymptomatic heart murmur (34.6%) (Fig. 1).

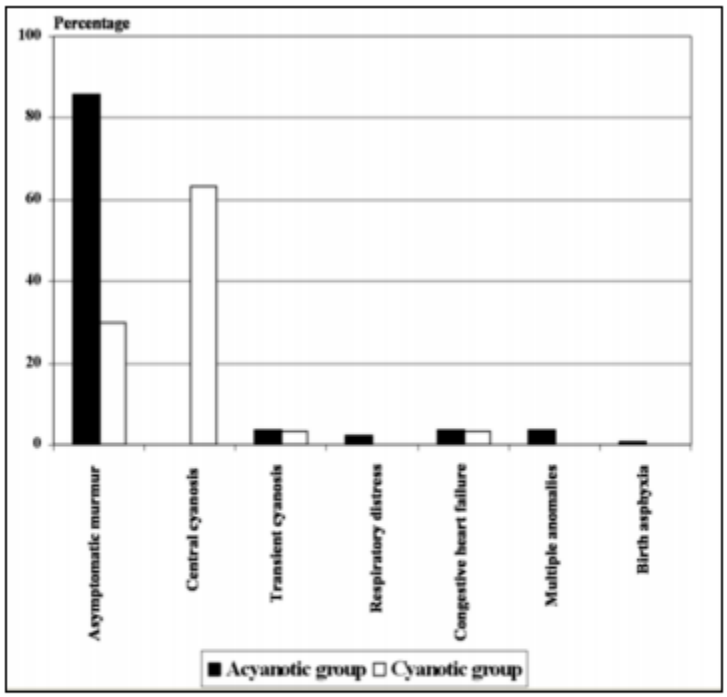

Fig 1: Clinical presentations and type in both acyanotic and cyanotic groups. Black bar graph represents neonates in acyanotic group whereas white bar graph represents cyanotic group.

Thirteen newborns with CHD had an associated syndrome (Table 2).

TABLE 2. Number and type of multiple anomalies or syndrome

Type of syndrome	Number of neonates (%)
Trisomy 21	3 (1.8)
Trisomy 13	2 (1.2)
22q11 deletions	2 (1.2)
Trisomy 18	1 (0.6)
Triple X chromosome	1 (0.6)
Beckwidth-weidemann	1 (0.6)
William syndrome	1 (0.6)
Cornelia de Lange	1 (0.6)
Noonan	1 (0.6)

Documented CXR results in this study were available in 125 (76.7%), the remaining 38 (23.3%) were inappropriate, lost or not obtained videos. The abnormal CXR found in the cyanosis group was 71.4% (Table 3) compared with 10.3% in the cyanosis group (p <0.001).

TABLE 3: Correlation between chest x-rays (CXR) results and type of congenital heart defects (CHD)

	Number of cyanotic CHD (%)	Number of acyanotic CHD (%)
Abnormal CXR	20 (71.4)	10 (10.3)
Normal CXR	08 (28.6)	87 (89.7)
Total	**28 (100)**	**97 (100)**

The sensitivity, specificity, positive and negative predictive values of CXR in differentiating cyanosis from a-cyanotic CHD were 71.4%, 89.7%, 66.6% and 91.5%, respectively. Documented ECG was available in 146 (89.5%), the remaining 17 (10.5%) were lost or not obtained. The abnormal ECG in the cyanosis group was 42.8% (Table 4) compared with 9.3% in the cyanosis group (p0.001).

TABLE 4: Correlation between electrocardiography (ECG) results and type of congenital heart defects (CHD)

	Number of cyanotic CHD (%)	Number of acyanotic CHD (%)
Abnormal ECG	12 (42.8)	11 (09.3)
Normal ECG	16 (57.2)	107 (90.7)
Total	**28 (100)**	**118 (100)**

The sensitivity, specificity, positive and negative predictive values of ECG in differential cyanosis and acyanotic CHD were 42.9%, 90.7%, 52.2% and 87%, respectively. The minimum mean oxygen saturation detected by pulse oximetry in the cyanotic group was 97.2% (95% CI = 96.6-97.7) (Fig. 2)

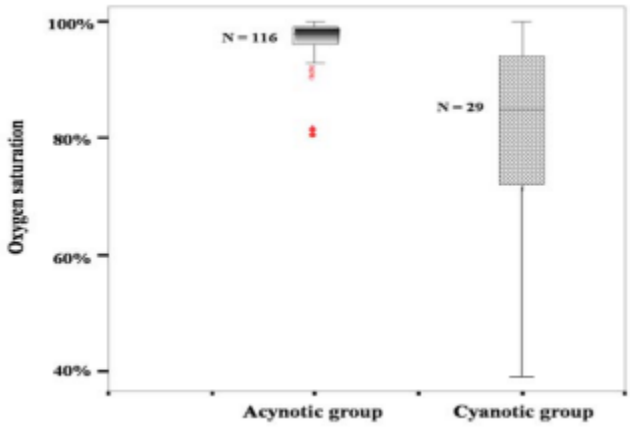

Fig 2: Range of oxygen saturation (%) in both acyanotic and cyanotic groups.

and 82.2% in the cyanotic group (95% CI = 76.8-87. The maximum mean oxygen saturation in the cyanotic group was 98.9% (95% CI = 98.5 - 99.2), and in the cyanotic group - 86.3% (95% CI = 81.4 - 91.1). The highest sensitivity (75.9%) and specificity (93.1%) in the diagnosis of cyanotic coronary heart

disease with positive and negative predictive values, 73.3% and 93.9%, respectively, were characterized by the oxygen saturation of the cut-off of <95%.

DISCUSSION:

The timing of CHD detection varied in many studies. Meberg et al. reported 76% of diagnoses of CHD in their pre-discharge series, while Richmond et al. reported only 45% of those diagnosed before discharge. In this study, we were able to diagnose 6.2 per 1,000 live births compared to previous reports of the overall prevalence of CHD (8-10 per 1,000 live births). Some newborns cannot be diagnosed with coronary heart disease before discharge and will develop later after discharge. In general, clinical symptomatic cyanosis can be detected when an oxygen saturation of <85% results in late detection of cyanosis or clinically undetected CHD cyanosis. In addition, newborns with some CHD did not have a heart murmur. The current guidelines recommend initial screening for CHD in the neonatal period with follow-up at 6-8 weeks, and possibly almost all infants with CHD. The clinical picture that led to the detection of CHD was different in both groups. Cyanosis, the leading figure in the cyanosis group, was evident if present. This explains why cyanobacteria were detected earlier (median 6 hours) than in the non-cyanotic group (median 44 hours). However, the asymptomatic heart murmur, the leading picture in the asymptomatic group, was still needed to distinguish cyanotic CHD from acyanotic CHD, since the asymptomatic heart murmur may turn out to be cyanosis. CXR and EKG can be added to a physical examination to aid in the diagnosis, especially in cyanotic CHD and not in acyanotic CHD. Oxygen saturation was an important and simple test to differentiate between cyanosis and acyanotic coronary artery disease. It was found that oxygen saturation cut-off of 95% differentiated the cyanotic from the acyanotic group. This finding was similar to the previous report5 that pulse oximetry screening saturation> 95% was an effective way to rule out cyanotic CHD. Only about 77% of murmurs detected in newborns had CHD in the Du et al series 6. This may explain why the time to detect acyanotic coronary heart disease was longer. CHF was not the predominant symptom in the acyanotic group in this study because most of the acyanotic lesions were slight left-to-right leakage. Even with large left-to-right leaking lesions, CHF will not occur early in the neonatal period because in the early neonatal period, pulmonary vascular resistance is still high. The associated multiple abnormalities or symptoms of the syndrome lead to the detection of accompanying CHD even in a normal cardiac examination. Routine echocardiography may be necessary in the presence of multiple abnormalities or syndrome to detect accompanying CHD.

CONCLUSIONS:

Routine postnatal and pre-discharge physical examination for heart murmurs and cyanosis remains an important tool for detecting CHD in newborns in the first days of life. However, this may not be sufficient to screen all neonatal cardiovascular disease before discharge from the hospital. Additional X-ray, ECG and oxygen saturation testing may facilitate the differential diagnosis of cyanotic CHD from acyanotic CHD, especially in neonates with asymptomatic heart murmurs.

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