

EVALUATION OF NEONATAL CARDIAC MURMURS

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ABSTRACT: Cardiovascular malformations are the most common cause of congenital malformations, the diagnosis of which requires a close observation in the neonatal period. Early recognition of CHD is important in the neonatal period, as many of them may be fatal if undiagnosed and may require immediate intervention. The objectives of this study are to study the epidemiology of neonatal cardiac murmurs, to identify clinical characteristics which differentiate pathological murmur from functional murmurs and to assess the reliability of clinical evaluation in diagnosing CHD. Method of study included all neonates admitted to the NICU, postnatal ward, attending pediatric OPD or neonatal follow up clinic and were detected to have cardiac murmurs. It was a cross sectional study over a period of 16 months. A clinical diagnosis was made based on history and clinical examination. Then Chest X-ray and ECG, Echocardiography was done in all neonates for confirmation of the diagnosis. These neonates were again examined daily till they were in hospital and during the follow-up visit at 6 weeks. The results of 70 neonates in this study conducted over a period of 24 months included the incidence of cardiac murmurs among intramural neonates which was 13.5 for 1000 live births. Most frequent symptom was fast breathing in 10(14.3%) cases. VSD was the most common diagnosis clinically in 23 (33%) babies. The most frequent Echo diagnosis was acyanotic complex congenital heart disease in 25(36%) cases followed by 12(17%) cases each of VSD and ASD respectively. Overall in our study 77.1% (54cases) of the murmurs were diagnosed correctly and confirmed by Echocardiography The study concluded that it is possible to make clinical diagnosis in many cases of congenital heart diseases, the functional murmurs could be differentiated from those arising from structural heart disease and evaluation of the infants based only on murmurs, few congenital heart diseases can be missed.

KEYWORDS: Neonatal cardiac murmurs, Clinical Evaluation, Echocardiography

INTRODUCTION: Congenital heart disease is one of the most common congenital malformations. Congenital heart disease was defined by Mitchell et al ¹ as "a gross structural abnormality of the heart or intra thoracic great vessels that is actually or potentially of functional importance."

The common clinical features with which neonates present are heart murmur, cyanosis, congestive cardiac failure along with abnormal chest X-ray findings and abnormal ECG findings. Diagnosis is based on the clinical suspicion of finding a cardiac murmur, congestive cardiac failure, poor pulses and cyanosis. Murmur is an important finding and mostly represents congenital heart disease. However it may be functional murmur without any underlying heart disease.

A thorough assessment of the neonate presenting with an asymptomatic heart murmur to ensure that, where possible, infants with duct dependent CHD² are not discharged home inappropriately. Careful evaluation and early diagnosis of CHD is important. Echocardiography remains the gold standard for the description of specific lesions.

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In most centers echocardiography is not immediately available and therefore careful clinical assessment is necessary before sending home. The prevalence of congenital heart diseases was 5.3 cases per 1000 live births.^{3,4} When diagnosed solely by means of clinical examination the prevalence is 8 to 10 cases per 1000 live births. The prevalence has been constant throughout the world over many years.⁵

Most common problems during the newborn period are⁶ heart murmur, cyanosis, or inability to raise oxygen saturation to normal ranges with administration of oxygen; Congestive heart failure (CHF); Arrhythmias; Abnormal chest x-ray findings; Abnormal ECG findings.

MATERIALS AND METHODS: Source of data included all neonates detected to have cardiac murmurs. Inclusion criteria included in study were all intramural neonates with murmurs, all neonates admitted to neonatal intensive care (NICU) with murmurs, any neonate attending the OPD with a murmur.

Exclusion criteria included in study was echocardiography done for any reason.

It is a cross-sectional study done over a period of 24 months. Data was collected from all neonates admitted to the NICU, Postnatal ward, attending Pediatric OPD or neonatal follow up clinic and were detected to have cardiac murmurs. Birth details of the neonate were noted and if symptoms were present the details were collected. Once the murmur was detected, the day of identification of murmur and the murmur characteristics on examination were noted.

A clinical diagnosis was made based on history and clinical examination. Chest X-ray and ECG were done in symptomatic infants. The usefulness of these investigations in aiding the diagnosis was noted. Echocardiography was done in all neonates for confirmation of the diagnosis. These neonates were again examined daily till they were in hospital and during the follow-up visit at 6 weeks.

RESULTS: A total of 70 neonates were included in the study. Out of the 70 neonates 29 babies were extra mural and 41 were intramural babies. History of Consanguinity was present in parents of 25 newborns (36%). Total number of live births during the study period was 2700 and 41 out of these intramural babies had murmur.

Only intramural neonates were considered for the incidence of murmurs and the incidence of cardiac murmurs among them babies was 15.1 for 1000 live births. A total of 440 of extramural neonates were admitted during the study period with 29 of them presenting with murmurs and the incidence of murmur was 10.7% of admissions.

Sex distribution of the study population:

Sex	Frequency	Percent
Male	37	53
Female	33	47
Total	70	100

TABLE 1

In the present study it was observed that there were 37(53%) males and 33(47%) female. Distribution of the study population by gestational age

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Gestational class	Frequency	Percentage
Preterm	23	33
Term	47	67
Total	70	100

TABLE 2

In the present study there were 23(33%) preterm babies and 47(67%) term babies.
Weight Distribution of the study population

	Frequency	Percent
SGA	21	30
AGA	48	69
LGA	1	1
Total	70	100

TABLE 3

In the present study it was observed that there were 21(30%) babies who were small for gestational age, 48 (69%) appropriate for gestational age and only 1(1%) large for gestational age baby in this study. Accordingly appropriate for gestational age babies were more frequent in this study group.

Risk Factors observed in the study population

	Frequency	Percent
Diabetes	2	3.3
IUI	4	6.6
SLE	1	1.6
Polyhydramnios	12	19.7
Oligohydramnios	3	4.9

TABLE 4

The most frequently associated risk factor was poly hydramnios 19.7% (12cases), followed by other conditions like diabetes 3.3% (2 cases), intrauterine infections 6.6% (4) and oligo hydramnios 4.9% (3cases).

Symptoms observed in the study population

Symptom	Frequency	Percent
Cyanosis	8	11.4
Fast breathing	10	14.3
Feeding difficulty	7	10
Sweating	1	1.4

TABLE 5

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Most frequent symptom with which the neonates have presented was fast breathing in 10 (14.3%) cases. These neonates presented with one or more of the symptoms like cyanosis, fast breathing, feeding difficulty, sweating. The neonates who had fast breathing had ASD, VSD and PDA; who had cyanosis had TGV, PS, Cor triatriatum, rudimentary left ventricle and who had respiratory distress with cyanosis had TGV, ASD-PAH-VSD in ECHO respectively.

Clinical examination findings of the study population

Clinical features	Frequency	Percent
Dys morphic features	8	11.4
Cyanosis	6	8
Pallor	5	7
Edema	1	1.4
Diaphoresis	1	1.4
Respiratory distress	15	21.4
Bounding pulses	8	11.4
Precordial pulsations	7	10

TABLE 6

The following are the clinical features found in the neonates on clinical examination. Dysmorphic features were seen in 8 (11.4%) babies. One (1.4%) neonate had edema and the explanation for the edema was non cardiac in origin and secondary to hypoalbuminemia. 8 neonates had bounding pulses.

5 out of 11 neonates with PDA had bounding pulsations. However, 3 neonates with bounding pulses had other lesions also, large PDA with a VSD, PDA with an ASD and Cor triatriatum with pulmonary venous obstruction.

Day of detection of murmur in inborn infants

Day of Life	Frequency	Percentage
0 - 24 hrs	6	16.2
24 - 48 hrs	16	43.2
48 - 72 hrs	6	16.2
72 hrs - 1 week	5	13.5
1 - 2 weeks	2	5.4
2 - 3 weeks	1	2.7
3 - 4 weeks	1	2.7

TABLE 7

Only intramural neonates were considered as they were examined from the day of birth and day of onset of murmur was noted. However the same was not possible with the extramural babies as they were admitted on different days of their life.

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Murmurs were most commonly detected in the first 24-48hrs of birth among the inborn babies which was 43.2% of the total. In the weeks 2nd –3rd and 3rd –4th it just constituted one case each (2.7% each).

Location of murmurs

Location	frequency	Percent
Apex	1	1.3
Left lower sternal border	52	67.5
Left upper sternal border	24	31.2
Total	77	100

TABLE 8

Most murmurs heard in the left lower sternal border constituting 47 (67.5%) of all case. In one case diagnosed with ASD and PDA the murmur was heard in the apex as well as in the upper left sternal border.

Clinical diagnosis

	Frequency	Percent
Functional	9	13
Structural	61	87

Table 9

Clinical diagnosis revealed 9(13%) murmurs as functional and the remaining 61(87%) murmurs due an underlying structural heart disease.

Diagnosis based on clinical examination

	Frequency	Percent
ASD	5	7
VSD	23	33
PDA	14	20
Acyanotic complex	14	20
Complex	8	11
Functional	6	9

TABLE 10

VSD was the most common diagnosis clinically in 23(33%) babies. The next common diagnosis was for acyanotic complex heart disease in 14(20%) cases, followed by PDA in 14(20%) cases with ASD and complex congenital heart disease constituting 5(7%) and 6(9%) of the cases respectively.

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Usefulness of x-ray:

	Frequency	Percent
Yes	11	37
No	19	63

TABLE 11

30(43%) neonates out of 70 had X-rays done and it aided 11(37%) neonates in the diagnosis of congenital heart disease.

Usefulness of ECG:

	Frequency	Percent
Yes	5	42
NO	7	58

TABLE 12

ECG was done on 12(17.1%) babies and was helpful in 5 (42%) symptomatic neonates for diagnosis

Echo diagnosis

Echo	Frequency	Percent
ASD	3	4
VSD	12	17
PDA	12	17
Acyanotic complex	25	36
Complex	8	12
Functional	10	14

TABLE 13

The most frequent Echo diagnosis was acyanotic complex congenital heart disease in 25 (36%) cases followed by 12 (17%) cases each of VSD and PDA respectively. Complex congenital heart disease was present in 8 (12%) of the cases. The least common lesion was ASD in only 3 (4.1%) neonates. 10 (14%) of cases were diagnosed as functional murmurs.

Diagnosis by Clinical and Echo

Clinical	Echo
3ASD	1ASD-PDA, 1PDA-TR-mild PH,1ASD -VSD
6VSD	2 VSD – PDA,1PDA –VSD -ASD, 2 ASD -PDA,1 ASD –VSD
2 PDA	PDA –VSD -mild PS, PDA – ASD
1TAPVC	ASD –VSD

Table 14

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A diagnosis of acyanotic complex congenital heart disease was clinically made but the echo diagnosis revealed 2 lesions having PS (diagnosed clinically as VSD, PDA), PDA. The clinical diagnosis of Acyanotic complex congenital heart disease had a Sensitivity of 47.8%, Specificity 94.73%, Positive predictive value 84.61 % and Negative predictive value 75% Functional murmurs. 6 out of 10 functional murmurs were detected by clinical examination.

Out of them there were 8 cases of patent foramen ovale and 2 cases were murmurs associated with birth asphyxia. There were other 4 murmurs diagnosed as functional by echo but were diagnosed clinically as ASD, three cases of VSD. The characteristics of functional murmurs diagnosed were no associated dysmorphisms, no cyanosis, all murmurs were systolic in nature, no murmur was associated with thrill, and all but one murmur persisted at 6weeks of follow up.

OUTCOME OF MURMURS: 5 neonates whose murmur had disappeared at discharge did not follow up at 6 weeks. 10(14.2%) more neonates at follow up at 6 weeks did not have murmur. 41 (58.5%) neonates did not come for follow up. The diagnosis of congenital heart disease in which the murmur persisted were one VSD, one PFO, one Congenital pulmonary valvular stenosis, one ASD, one Cortriatriatum with pulmonary venous obstruction, one Tricuspid regurgitation with mild pulmonary hypertension and Bicuspid aortic valve, one small right pulmonary artery with mild AR, along with,

Two cases of VSD with ASD and three cases of large PDA-VSD. Death occurred in 4 neonates and the cause of death was attributed to birth asphyxia, sepsis, apnea, ventilated, preterm, RDS, pulmonary hemorrhage. None of the deaths were attributed to complex congenital heart diseases.

As the study involved only those neonates with murmur, there were 6 other congenital heart diseases without murmur. The diagnosis of these neonates was hypoplastic left heart syndrome, tricuspid regurgitation, corrected TGA, PDA in a neonate with Down syndrome, ASD, TGV

DISCUSSION: Congenital heart disease is one of the most common congenital malformations. Cardiac murmur is an important finding of congenital heart disease. However not all murmurs that are heard in a neonate is due to structural heart disease, so it is important to differentiate murmurs due to functional cause from an structural cause. Also it is important to know that all congenital heart disease need not present with a murmur.

The earlier the congenital heart disease is diagnosed better is the prognosis. Therefore this study was done to evaluate the murmurs in the neonatal period. In this study all neonates with murmur both preterm and term neonates were included. A clinical diagnosis was made based on the clinical characteristics that were later confirmed by echocardiography, which is the gold standard for diagnosis of congenital heart disease.

A total of 70 neonates were included in the study. The study was conducted over a period of 16 months. 29 (41.4%) babies were extramural and 41(59.6%) were intramural babies. History of Consanguinity was present in parents of 25 newborns (36%). Total number of live births during the study period was 2700 with 41 out of these intramural babies had murmur. The incidence of cardiac murmurs among the intramural babies was 13.5 for 1000 live births.

Ainsworth et al⁷ in their study have shown an incidence of 6 in 1000 babies having murmurs undergoing routine neonatal examination by junior pediatricians. About 50% of murmurs were due to underlying structural cardiac malformation and this examination led to recognition of 37% of all heart disease diagnosed in infancy.

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Bansal et al⁸ in their study have shown 23.81 per 1000 live birth having murmur. Farrer et al⁹ studied 8096 babies and found murmurs in 112 babies with a prevalence of 13.8 per 1000 live birth. The study conducted by Farrer et al⁹ had a similar incidence of 13.8 per 1000 live birth as against 13.5 per 1000 live births in our study. There were 23.8 per 1000 live births having murmurs in the study by Bansal et al⁸ the explanation for such higher incidence was not available.

Also we have found that out of 440 extramural admissions during the study period 24 neonates had murmur and constituted 5.45% of all extramural admissions as having murmur. This high incidence could be explained in terms of referral pattern of high risk neonates for tertiary care. 18 (25.7%) neonates were symptomatic and presented with cyanosis, fast breathing, feeding difficulty and sweating.

The most frequent symptom noted was fast breathing in 10 (14.3%) infants. Bounding pulse was detected in 8 (11.4%) of neonates. As bounding pulse is characteristic of PDA in a neonate, we found only 5 (41.6%) out of 12 neonates with PDA having bounding pulsations. However the remaining 3 (25%) neonates with bounding pulses had other lesions also like a large PDA with VSD, PDA with an ASD and Cortriatriatum with pulmonary venous obstruction.

In our study 74.2 % (52cases) of the murmurs were diagnosed correctly and confirmed by Echocardiography. Our study revealed 10 (14.3%) murmurs as functional among 70 neonates and the remaining 60 (85.7%) as murmurs because of structural heart lesion. Farrer et al⁹ out of 90 infants evaluated found 21 (23.3%) were diagnosed having significant cardiac abnormality.

In a similar study Bansal et al⁸ found 28 (45.9%) out of 62 babies having structural heart disease. There is a wide variation in the number of neonates having murmur and structural heart disease. Murmurs were most commonly detected in the first 24-48hrs of birth amounting to 43.24% of all the cases. PDA was noted in 4 term newborns and in 8 preterm infants.

Murmurs presented within the first 5 days of life in 5 cases (50%) The most frequent congenital heart disease detected in this study is acyanotic complex heart disease which amounted to 25 cases (35.7%). But the most common single lesion diagnosed was PDA and VSD comprising of 17.1% each (12 lesions each). But Bansal et al⁸ found VSD as the most common lesion amounting to 65.63% of the lesions.

This high incidence could be because preterm infants were not included in the above study. Ainsworth ⁷et al in their study also found that the most common diagnosis was a ventricular septal defect, which was 37% (54/147), followed by patent ductus arteriosus 23% (34 newborns). 7 (11.4%) of cases in our study had complex congenital heart disease. Similarly Ainsworth⁷ reported seven newborns (5%) having complex heart disease.

In this study chest x-rays and ECG's were done in symptomatic neonates. A total of 29 neonates had X-rays done and it aided 9(31% symptomatic) infants in diagnosis, similarly ECG was done which helped 3 (30%symptomatic) out of 10 babies. Swenson et al ¹⁰ in his study of the patients aged 1-14years with the initial diagnosis of possible heart disease, ECG and CXR helped to rule out significant lesions in 28% of patients and diagnose definite heart disease in 20% of patients.

In the patients diagnosed with definite heart disease, ECG and CXR helped to confirm the diagnosis of heart disease in 33% of patients. 67% of the subjects did not have abnormalities in either CXR or ECG.As the study was done on a different age group comparison could not be made. In our study 8(88.8%) all the innocent murmurs disappeared by 6 weeks of life. And Farrer et al⁹ in his study demonstrated that 64% of the innocent murmurs resolved by 6weeks of life.

ORIGINAL ARTICLE

Our study revealed that murmurs had disappeared in 15 (21.4%) neonates before discharge. 5(7.1%) neonates whose murmur had disappeared at discharge did not follow up at 6 weeks. 10(14.2%) more neonates at follow up at 6 weeks did not have murmur.

33 (47.1%) neonates did not come for follow up. So one of the limitations to know which murmurs persisted was a poor follow up. Six infants with PDA were treated with Ibuprofen for closure of PDA and the murmur disappeared in 4(66.67%). Among the complex congenital heart disease 3 were referred for surgery and the other four went DAMA. (Discharged against medical advice)

Death occurred in 4 neonates and the cause of death was attributed to birth asphyxia, sepsis, apnea, ventilated, prematurity, pulmonary hemorrhage. None of the deaths were attributed to congenital heart diseases.

CONCLUSION: It is possible to make clinical diagnosis in many cases of congenital heart diseases. By evaluation of these infants only based on murmurs few congenital heart diseases can be missed.

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