

CLINICAL SIGNIFICANCE OF HEART MURMURS DETECTED DURING ROUTINE CLINICAL EXAMINATION IN THE FIRST WEEK OF LIFE: A DESCRIPTIVE STUDY

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ABSTRACT

BACKGROUND

The prevalence of heart murmur during the first week of birth varies from 0.6-44.7% and congenital heart disease (CHD) varies from 4-50 per 1000 live births in different studies. Though most are clinically insignificant, few are associated with various structural abnormalities. Our study was conducted to determine the prevalence of cardiac murmurs and congenital heart disease in neonates of rural Kerala.

METHODS

1000 consecutive live born neonates were enrolled in our descriptive study during a period of 10 months conducted at Sree Gokulam Medical College & Research Foundation Venjaramoodu. Neonates were screened after 24 hours of birth by residents using 3M® Littman™ paediatric stethoscope and all detected murmurs were referred to cardiologist for echocardiography. Study was conducted after approval from Institutional Ethics Committee and written informed consent was obtained from all participating mothers. Data was collected in semi structured questionnaire and are expressed as proportions.

RESULTS

19 and 14 neonates had audible murmur and CHD with a prevalence of 19 and 14 per 1,000 live births respectively. 85.7% (n=12) of lesions were acyanotic lesions and 14.3% (n=2) were cyanotic. Congenital heart diseases encountered were atrial septal defect (26.3%), ventricular septal defect (26.3%), patent ductus arteriosus (5.3%), cyanotic heart with multiple lesions (10.5%), tetralogy of Fallot (5.3%) and hypoplastic left heart syndrome (5.3%).

CONCLUSIONS

Structural lesion was seen in 73.7 cardiac murmurs. Atrial septal defect and ventricular septal defects were the most common structural lesions.

KEYWORDS

Neonate, Congenital Heart Disease, Cardiac Murmurs.

HOW TO CITE THIS ARTICLE: Shaji SM, Mujeeb Rahman MKT, Nair PMC. Clinical significance of heart murmurs detected during routine clinical examination in the first week of life: a descriptive study. J. Evid. Based Med. Healthc. 2019; 6(25), 1705-1709. DOI: 10.18410/jebmh/2019/346

BACKGROUND

Heart murmurs arise due to turbulent blood flow around the structures of the heart and is common in healthy infants, children and adolescents.¹ Though it is observed in normal neonates, they are the most common clinical finding in neonates to suspect a cardiac abnormality and for referral to cardiology department.^{2,3} The prevalence of heart murmurs during the first week of life varies widely from 0.6 to 44.7%⁴

and the incidence of congenital heart disease (CHD) varies between 4 to 50 per 1000 live births.⁵ Wide variations in the prevalence of structural malformations and innocent murmurs at neonatal screening has been observed from different geo-ethnic areas of the world.⁶⁻⁸ CHD are more prevalent in infants with a positive family history of CHD, sudden cardiac death, sudden infant death syndrome⁵ and is seen associated with aneuploidy, connective tissue disorders, inborn errors of metabolism, congenital defects of other organ systems and syndromes with dysmorphic features.⁵ Other prenatal and perinatal risk factors include maternal alcohol consumption, consumption of teratogenic drugs (e.g. selective serotonin reuptake inhibitors), intrauterine infections, maternal diabetes mellitus and preterm delivery.⁵ Of the CHD's, 20-25% are ventricular septal defects (VSD), 8-13% are atrial septal defects (ASD), 6-11% are patent ductus arteriosus (PDA), 10% are Tetralogy of Fallot (TOF), 7.5-9% are pulmonary stenosis,

Financial or Other, Competing Interest: None.
Submission 30-05-2019, Peer Review 06-06-2019,
Acceptance 16-06-2019, Published 18-06-2019.

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DOI: 10.18410/jebmh/2019/346



5.1-8.1% are coarctation of aorta, 5-6% are aortic stenosis, 5% are transposition of great arteries, 2-3% are total anomalous pulmonary venous connection and 1.4% are tricuspid atresia and a small fraction are the extremely rare hypoplastic left heart syndrome (HLHS) and truncus arteriosus.⁵ The complete routine newborn examination preferably within the first 48 hours of birth is decisive to evaluate the readiness of the neonate for life outside the mother's womb. Newborns are at higher risk of having a serious structural heart disease that presents as a murmur. 1% of newborns have detectable cardiac murmurs and 31-86% of these neonates are detected with structural heart disease.^{4,8} However, routine neonatal examination fails to detect 44-45% of babies with CHD and the likelihood of structural heart disease and life threatening cardiac disorders in asymptomatic neonates is high.^{4,9} When not considering the deaths from unrecognized heart diseases which accounts for 30% deaths in infancy, a very low prevalence of serious CHD has been observed. Studies have identified the differences in the occurrence of CHD among different geographical and ethnic groups and prevalence studies on cardiac murmurs from Kerala are very few. Hence this study is conducted to ascertain the prevalence of cardiac murmurs during first week of life and also to ascertain the prevalence and pattern of CHD detected via auscultation and echocardiography.

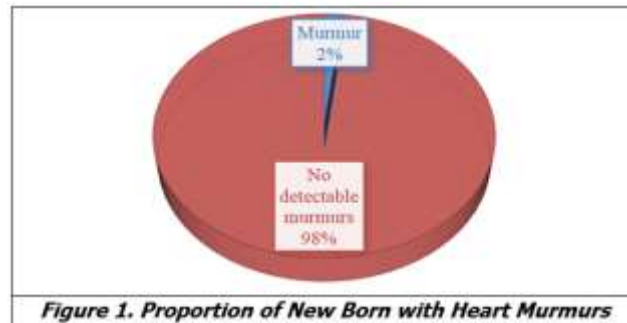
METHODS

Our descriptive study enrolled 1000 newborn infants of gestational age of more than or equal to 34 weeks at Neonatology & Child health department of Sree Gokulam Medical College & Research Foundation, Venjaramoodu in the time period between October 2015 and September 2016. Sample size was calculated assuming α of 0.05, β of 0.2 and 80% power. Study commenced after obtaining approval from Institutional Ethics committee and written informed consent was obtained from all participating mothers. Maternal parameters collected were age, parity, gestational age, antenatal and post-natal history and neonatal parameters collected were APGAR score, respiratory rate, heart rate, heart sounds and oxygen saturation. Data was collected in semi structured case record forms. Examination was done at 24 hours after delivery and before discharge from the hospital by resident using 3M® Littman™ paediatric stethoscope. Neonates with detected murmurs underwent echocardiogram to evaluate for structural abnormalities of the heart. Data was analysed using R®™ and are expressed as proportions and are rounded off to single decimal.

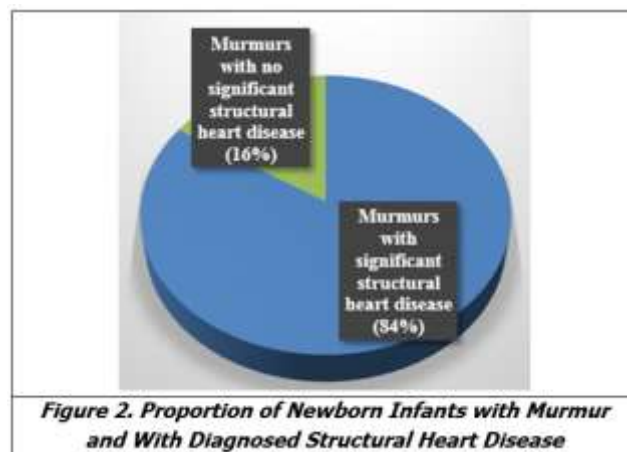
RESULTS

Our descriptive study enrolled 1000 neonates delivered at Sree Gokulam Medical College & Research Foundation, Venjaramoodu, Trivandrum. 54.6% (n=546) were males and 45.4% (n=454) were females. 91.1% (n=911) were term deliveries and 8.9% (n=89) were preterm deliveries. Cardiac murmurs were detected in 1.9% (19) neonates

(Figure 1) and the prevalence was 19 cases per 1000 live births.



Among the neonates with murmurs, 57.9% (n=11) were males and 42.1% (n=8) were females. 89.5% (n=17) newborns with murmurs were term deliveries and 10.5% (n=2) were preterm deliveries. 84.2% (n=16) newborns with murmurs had significant structural heart disease (Figure 2).

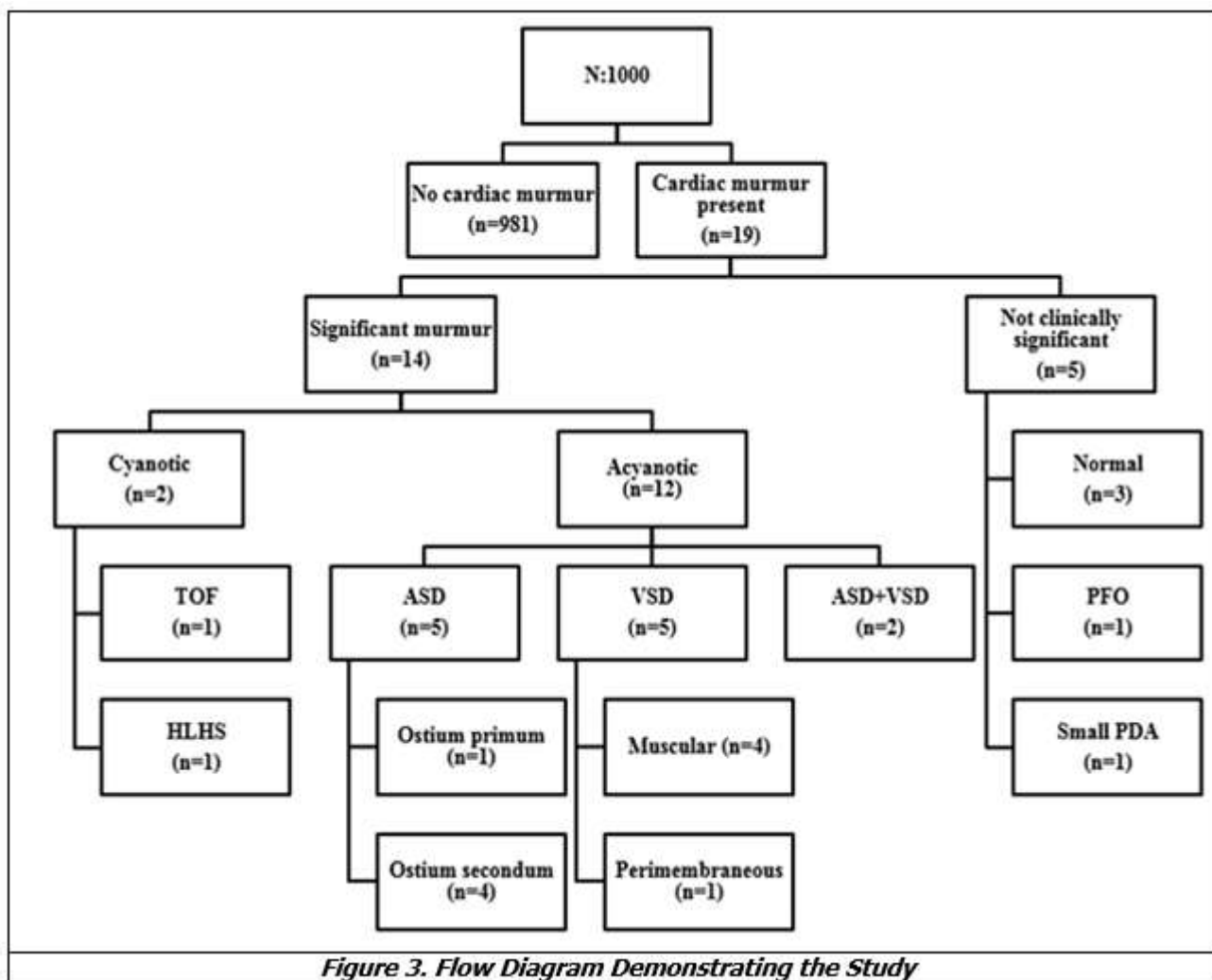


85.7% (n=12) newborns with heart murmurs had acyanotic lesions and 14.3% (n=2) had cyanotic features. Among the newborns with congenital heart disease, the most common were ASD (31.3%, n=5) and VSD (31.3%, n=5) (Table 1).

Type of Congenital Heart Disease	n (%)
ASD	5 (31.3%)
VSD	5 (31.3%)
ASD + VSD	2 (12.5%)
Small PDA	1 (6.3%)
TOF	1 (6.3%)
HLHS	1 (6.3%)
Patent Foramen Ovale (PFO)	1 (6.3%)

DISCUSSION

54.6% neonates were males which has been reported previously from Kerala as for every 1000 females 1300-1500 males are born but due to higher vulnerability of male fetus¹⁰ the gender ratio stabilizes at 1060 males for 1000 female during late neonatal period. 91% of the deliveries were term, which could indicate the lower incidence maternal risk factors in pregnancy due to better patient care, increased awareness and counselling among mothers¹¹ in Kerala.



This lower incidence of maternal risk factors could be due to egalitarian health care policies of the state government. Cardiac murmurs were present in 1.9% neonates and has been reported with varying prevalence of 0.6-3.1%^{4,12,13} in different geographical areas of the world. The prevalence was lower than what was reported previously from India¹² and cannot be explained on the basis of currently available literature. This could be due to difference in prevalence of cardiac disorders producing murmurs in various geographical areas. Innocent murmurs were observed in 16% which is significantly lower than previous reports of 72% children detected with innocent murmurs at some point of life.¹⁴ Innocent murmurs are due to non-pathological causes such as physiologically increased turbulent flow due to narrow ventricular tracts, high output states such as anaemia, false tendons in ventricles, vessel wall narrowing in times of linear growth etc.¹⁵ Structural heart disease was observed 1.6% of newborns and in 84% newborns with detected cardiac murmurs. There has been wide variations in the incidence of CHD and it ranges from 1-8%.^{1,16} Various methods have been suggested to identify CHD in neonates which includes neonatal physical examination, antenatal echocardiography and pulse oximetry.¹⁷ Neonatal examination and echocardiography fail to detect ~30% of the CHD and pulse oximetry has been described as a screening tool capable of detecting the CHD's

missed during physical examination and echocardiography. Owing to the low cost it is often used as a screening tool in resource poor countries.¹⁷ Identification of antenatal murmurs is the commonly used screening method in Kerala. Though the per capita income of Kerala is very low, and one would suggest the use of pulse-oximeter as screening tool most appropriate for Kerala, the health care and educational status of Kerala is considered equivalent to developed Western countries. Also detecting murmurs and CHD is considered as a talent that has to be acquired among residents and junior faculty members which could also be the reason for this method to be used for screening of CHD.

A small PDA and a PFO was encountered in our study, these were also considered clinically insignificant since the only reported rare complication associated with these are cryptogenic stroke.¹⁸ The prevalence of small PDA was lower than Computed tomography evaluation of participants undergoing routine cardiac check-up in U.K.¹⁸ This could be due to the higher proportion of participants with pre-existing cardiac diseases undergoing voluntary cardiac evaluation. Published literature on prevalence of PFO are of autopsy studies 20-34%¹⁹ and our study reported a lower prevalence. Our study reports higher prevalence of murmurs among males in contrast to Iranian reports.¹² This difference in observation could be due to the difference in gender-based prevalence of CHD and murmurs clinically significant,

non-significant and innocent among Keralites. Only 10.5% preterm neonates had clinically significant cardiac murmurs. The association between preterm deliveries and cardiac murmurs has not been clearly described. Since we have excluded all deliveries before 34 weeks of gestation the scientific validity of this observation becomes questionable. 84% of neonates with murmurs had significant structural heart disease. The prevalence of structural heart disease in neonates have been described with wide variations and has been rarely described from Kerala. Since echocardiography is required for confirming diagnosis of CHD, this will remain unanswered. 14% neonates with murmurs had cyanotic heart disease, which is lower than previous reports of 2-2.25 per 1000 live births²⁰ and since cyanotic cardiac disease is considered sporadic²⁰ the significance of this observation remains at question. 50% cyanotic heart diseases were TOF and 50% were HLHS. TOF has been described as the most frequent cyanotic heart disease and accounts for ~ 5% of all cyanotic heart diseases²⁰ and HLHS accounts for 2-9% of all congenital heart diseases and is associated with high mortality rates.²¹ We only encountered 2 cyanotic cardiac disease hence the prevalence might not be a true representation of the community, hence larger samples of CHD's are required to evaluate the prevalence in Kerala. Most frequently encountered acyanotic cardiac diseases were ASD (41.7%) and VSD (41.7%). The prevalence of ASD and VSD were significantly higher than previously described prevalence of 1.1% and 2.7% respectively.²² This higher prevalence could be due to the high prevalence of associated risk factors such as male gender and gestational diabetes mellitus among Keralites.^{23,24} Among ASD, ostium secundum was most commonly encountered (80%) and muscular VSD (80%) was commonly encountered among VSD. ASD accounts for 8-12% of all CHD,²⁵ most frequently reported ASD is PFO followed by ostium secundum defect.²⁶ We encountered only one PFO, further studies determining the prevalence of ASD and its types are required. Membranous VSD are reported to be most prevalent²⁷ and this difference in observed prevalence requires further evaluation. The prevalence of ASD with VSD was 0.2% which corresponds to previous reports of 0.3%.²²

Our study emphasizes the significance of the auscultatory findings during routine neonatal examination, usually done after 24 hours of delivery. We only enrolled 1000 live born neonates and the long term follow up for detection of proportion that underwent spontaneous resolution, those required intervention and the outcome of interventions and those who underwent the nature's benign course was not investigated due to the limitations in the design of the study and resources. The prevalence of audible cardiac murmurs in our setting was 19 per 1,000 live births (1.9%). We have excluded neonates born of gestational age <36 weeks, this is not a community representation since gestational age and birth weight are important risk factors for septal defects.²³ Among the newborns with cardiac murmurs, 73.3% had CHD and a prevalence of 14 per 1,000 live births was observed. The intensity of the murmur was not related to the presence or absence of CHD. Neonatal

examination detects only 45% of cardiac malformations,²⁸ thus over half of CHD are missed during routine neonatal examination and since bulk of studies are institutional, they might not reflect the true prevalence in the community. This study was limited to live born neonates and did not include stillbirths or autopsy findings in still born. Published literature over a decade old have shown that 0.6-60% of neonates were detected with cardiac murmurs during routine neonatal examination in their early neonatal period, but recent studies have demonstrated a lower prevalence of 0.6-1.6%. Our study detected a prevalence within the described range of the recent studies, however studies with different reported prevalence are also available during literature search. One such example is an Iranian study which detected a prevalence of 31 per 1,000 live births and CHD prevalence of 16 per 1,000 live births.¹² Other international studies reports regional difference in prevalence of CHD. A Bangladeshi study has reported 68% of neonates with cardiac murmurs were found to have structural heart defects.²⁹ A large two-year prospective study concluded that neonatal examination detects only 44% of cardiac malformations which presents during infancy and 54% of neonates with detected murmurs has underlying cardiac abnormality⁴. Japanese reports of 22 per 1,000 live births and 14 per 1,000 live births³⁰ prevalence of cardiac murmurs and CHD. The prevalence of CHD in Pakistan, Beijing and Baltimore were 15,³¹ 6.7³² and 2.4 per 1,000 livebirths³³ respectively. These differences in prevalence with our study could be due to the methodological differences, geographical and ethnic differences. Regional studies in North India and Mysore have shown ASD, VSD and PDA as common lesions but in variable proportions.

Limitations

Small sample size and lack of long term follow up to detect the course of progression of disease are major limitations of the study.

CONCLUSIONS

Routine neonatal examination demonstrated a 1.9% prevalence of cardiac murmurs and 1.4% prevalence of CHD. Our study demonstrated a 73.7% chance of a CHD in case of detection of cardiac murmur in routine clinical examination, with 86% acyanotic and 14% cyanotic lesions. ASD (26.3%) and VSD (26.3%) were the most common CHD detected on echocardiogram. Other malformations included PDA (5.3%) and acyanotic heart with multiple lesions (10.5%), TOF (5.3%) and HLHS (5.3%).

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