PULSE OXIMETRY SCREENING OF NEWBORNS FOR DETECTION OF CONGENITAL HEART DISEASE IN A NEONATAL INTENSIVE CARE UNIT FROM A TERTIARY CARE HOSPITAL OF NORTH EAST INDIA

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ABSTRACT

BACKGROUND

Congenital heart diseases are the most common congenital malformations and account for 6-10% of all infant deaths. Congenital heart defects affect 8 to 10 out of every 1000 live births. Pulse oximetry in newborn screening can detect mild hypoxemia that may not be recognised by clinical examination. Thus, pulse oximetry can help to identify babies that may be affected with critical congenital heart disease before they leave the newborn nursery. There are many studies carried out on pulse oximetry with different sensitivity and specificity for detection of congenital heart disease. The objectives of the present study were to screen all newborns admitted in NICU to rule out congenital heart disease before discharge and to find out the utility of pulse oximetry to detect congenital heart disease.

METHODS

This prospective study was conducted in Neonatal Intensive Care unit, Gauhati Medical College and Hospital in 1720 neonates over a period of 12 months (February 2015 to January 2016). Both pulse oximetry and clinical examination were done. Persistent pulse oximetry (SPO_2) reading below 95% or more than 3% difference between right hand and one foot, it was considered as positive pulse oximetry. Newborns with positive pulse oximetry and abnormal clinical examination findings were subjected to echocardiography.

RESULTS

Positive pulse oximetry cases were 47(2.73%), out of which 39 cases had only positive pulse oximetry (with negative clinical examination). Positive clinical examination cases were 58(3.37%), out of which 50 cases had only positive clinical examination findings (with negative pulse oximetry). Eight (8) cases had both positive pulse oximetry and positive clinical examination. Total congenital heart disease cases detected in our study was 34(1.98%) out of 1720. VSD was the most common CHD followed by PDA, TOF, TGA in this study. The sensitivity, specificity, positive predictive value and negative predictive value of pulse oximetry were 41.18%, 98.04%, 29.79%, 98.80% respectively.

CONCLUSION

Pulse oximetry is a useful tool to detect congenital heart disease. Its accuracy in detecting congenital heart disease increases if combined with positive clinical examination.

KEYWORDS

Newborn, pulse oximetry, screening, congenital heart disease, clinical examination.

INTRODUCTION: Congenital heart diseases are the most common congenital malformation and account for 6-10% of all infant deaths.[1] It also accounts for 20-40% of all infant deaths that occur due to malformation.[1] Congenital heart

defects affect 8 to 10 out of every 1000 live births.[2,3] A congenital heart defect refers to a problem in the development of the heart that usually presents at birth but might manifest later in life also. This problem can range from mild, never requiring surgery to more severe one, requiring major heart surgeries. Critical congenital heart disease (CCHD) represents a group of heart defects that cause serious life threatening symptoms and requires intervention within the first few days of life. CCHD is often treatable if detected early. From various studies, it is observed that about 25% of congenital heart diseases are life threatening and may manifest before the first routine clinical

examination.[1,4] If the CCHDs are not detected early after birth it leads to delay in the referral and increased mortality and morbidity. Hence, it is important to identify critical congenital heart diseases as early as possible. Pulse oximetry in newborn screening is a noninvasive test that can detect mild hypoxemia that may not be recognised by clinical examination. Thus, pulse oximetry can help to identify babies that may be affected with critical congenital heart diseases before they leave the newborn nursery. If we could detect early, infants affected with CCHD can often be treated timely and they lead longer, healthier lives. The following life threatening congenital heart diseases which can be ruled out through pulse oximetry are pulmonary atresia, Tetralogy of Fallot, total anomalous pulmonary venous return, transposition of great arteries, single ventricle, tricuspid atresia and hypoplastic left heart syndrome.[5] The first abstract examining pulse oximetry as a screening tool for CCHD was published in 1995.[6] Since then, many studies were carried out on pulse oximetry with different sensitivity and specificity for detection of congenital heart disease. Recent studies reported a high sensitivity and specificity of pulse oximetry screening in newborn to detect congenital heart diseases.[7,8,9] We carried out the study with the following aims and objectives: 1. To screen all newborns admitted in NICU to rule out congenital heart disease before discharge from nursery. 2. To find out the utility of pulse oximetry to detect congenital heart disease.

METHODS: This hospital based prospective study was conducted in neonatal intensive care unit (NICU), Gauhati Medical College & Hospital, Guwahati, Assam over a period of twelve months from February 2015 to January 2016. All babies admitted in neonatal intensive care unit were included in this study. The babies who were very sick, those on mechanical ventilator and those babies in whom stable pulse oximeter signals could not be obtained were excluded from the study. This study was approved by the Institutional Ethics Committee of Gauhati Medical College & Hospital, Guwahati, Assam. A written informed consent was taken from parent and the purpose of the screening was explained to them. Pulse oximetry screening was performed by using Pulse oximeter (Schiller Truscope II, multichannel monitor). Pulse oximetry was done after 24 hours of birth and before discharge from neonatal intensive care unit. The pulse oximeter probe was applied over right hand and either foot. The recordings were noted after obtaining stable pulse

oximeter signals. If the reading (SPO2) was below 95% or there was more than 3% difference between right hand and one foot, then the reading was considered to be abnormal.[7] We recorded 3 more readings at one hour interval for these abnormal readings. If the abnormality persists till the last reading, these newborns were considered as positive for pulse oximetry screening. Clinical examination screening was performed for all newborns with special reference to signs and symptoms related to cardiovascular system to detect congenital heart disease. Presence of central cyanosis, abnormal precordium, abnormal peripheral pulses, heart murmurs on cardiac auscultation, tachypnoea, (respiratory rate>60/min.) and chest retractions were taken as positive clinical examination findings suggestive of congenital heart disease.[10,7] The newborns with positive pulse oximetry screen and those with positive clinical examination underwent echocardiography. Collected data was analysed statistically using MedCalc statistical software online. Sensitivity, specificity, positive predictive value and negative predictive value of pulse oximetry and clinical examination were calculated and interpreted accordingly.

RESULTS: A total number of 1720 newborn cases were included in the study. Out of 1720 screened cases for pulse oximetry, 47(2.73%) had positive pulse oximetry. On the other hand, on clinical examination, 58(3.37%) newborns had positive findings suggestive of congenital heart disease. Eight (8) newborns were found positive for both pulse oximetry and clinical examination. In this study, 39 newborns had only positive pulse oximetry and 50 had only positive clinical examination. On echocardiography of all these 97 positive cases, we found 34 newborns had congenital heart disease. All 8 cases who had both positive pulse oximetry and positive clinical examination had congenital heart disease. Out of 39 positive pulse oximetry cases, without positive clinical examination, 6 cases had congenital heart disease. 20 newborns had congenital heart disease out of 50 cases having positive clinical examination without positive pulse oximetry. Total congenital heart disease cases detected in our study was 34(1.98%) out of 1720 newborns. We found ventricular septal defect (VSD) was the most common congenital heart disease followed by patent ductus arteriosus, Tetralogy of Fallot and transposition of great arteries in this study.
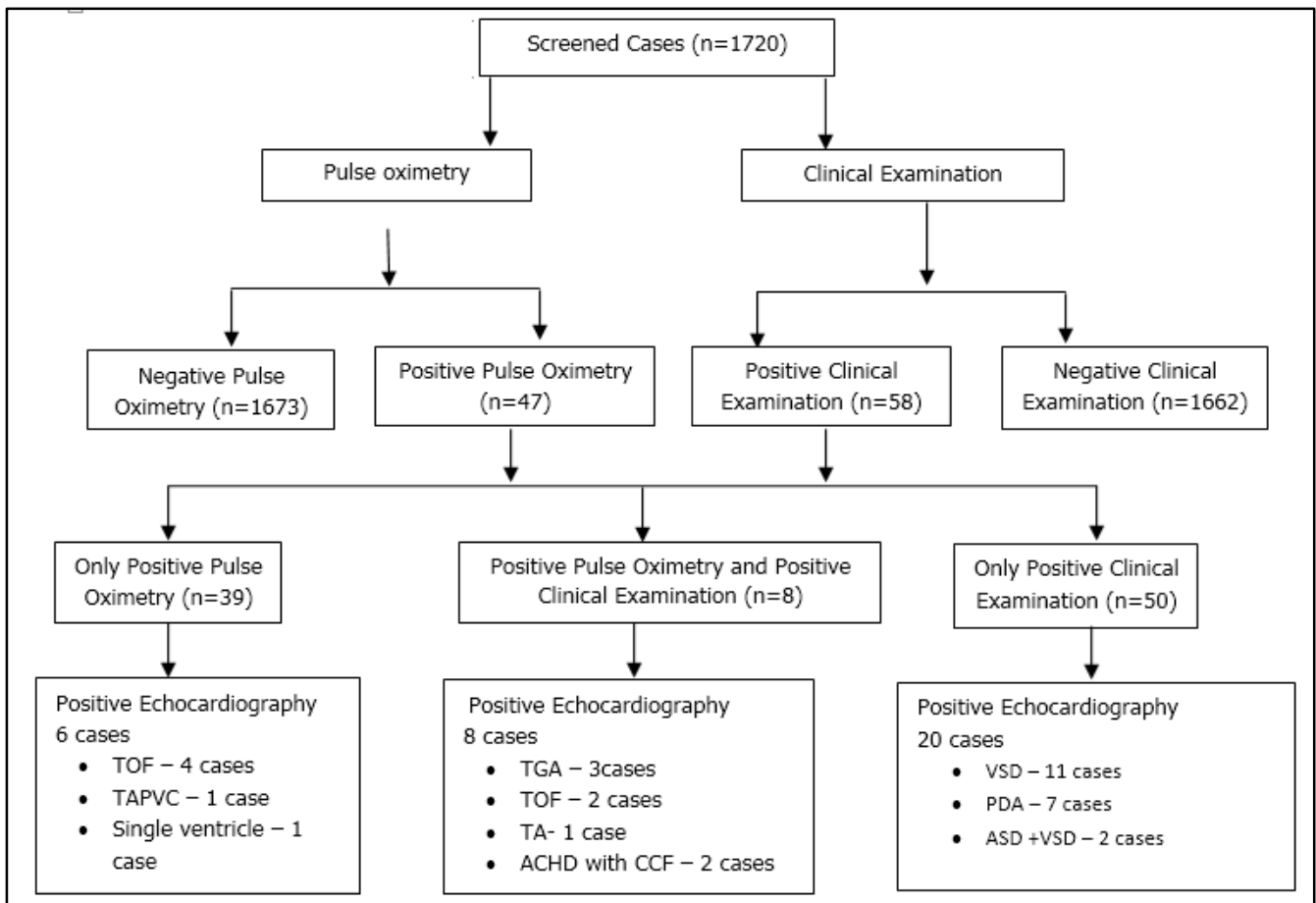
Fig. 1: Shows the details of pulse oximetry screening and clinical examination of the newborn cases under study

	Pulse oximetry (POS)	Clinical examination (CE)
Sensitivity	41.18%	82.35%
Specificity	98.04%	98.22%
positive predictive value	29.79%	48.28%
negative predictive value	98.80%	99.64%

Table 1: Shows sensitivity, specificity, positive predictive value and negative predictive value of pulse oximetry screening and clinical examination

DISCUSSION: In our study, 34(1.98%) newborns were detected to have congenital heart disease out of total 1720 screened cases. Ventricular septal defect (VSD) was the most common congenital heart disease followed by patent ductus arteriosus, Tetralogy of Fallot and transposition of great arteries. Further, Tetralogy of Fallot was more common followed by TGA and single ventricle among the cyanotic congenital heart disease cases. Fernanda Cruz De et al, 2015 found 9(0.23%) cases with congenital heart disease in their study in 4,027 newborns. However, in another study conducted by Mathur NB et al, 2015 detected 72(7.57%) cases with congenital heart disease out of 950 screened cases, which was much higher than our study.[10] Our findings is comparable to Fernanda Cruz De et al, 2015.[7]

The present study reviews the sensitivity, specificity, positive predictive value and negative predictive value of pulse oximetry screening and clinical examination. In our study, we found the sensitivity of pulse oximetry screening to detect CHD was low (41.18%). Fernanda Cruz De et al, 2015, also reported 44.44% sensitivity of pulse oximetry screening in their study, which was similar to us. But, many other studies show high sensitivity value for pulse oximetry screening. Riede F T et al, 2010 observed 77.78% sensitivity, 99.90% specificity, 25.93% positive predictive value and 99.99% negative predictive value of pulse oximetry screening in their study.[11] However, many other workers reported low sensitivity for pulse oximetry screening, one in particular carried out in Kerala by Vaidyanathan B et al(2011) observed 11.4% sensitivity and 90.9% specificity.[4] In background of work overload, technical and human factors might contribute to such low sensitivity. In this study, we found high sensitivity (82.35%) and specificity (98.22%), of clinical examination which are comparable with the observations made by Fernanda Cruz De, et al, 2015 having sensitivity 88.89% and specificity 99.55%. But, some studies reported unsatisfactory result of clinical examination to detect congenital heart disease. It is known to us that clinical examination depends on expertise of the clinician. Hence, appropriate training of health professionals will enhance the sensitivity and specificity of clinical examination. In our study, eight (8) newborns were found positive for both pulse

oximetry and clinical examination. All 8 cases had congenital heart disease (100%). Therefore, combination of clinical examination with pulse oximetry will help in detection of congenital heart disease.

CONCLUSION: Pulse oximetry can help to detect newborns with critical congenital heart diseases before they leave the newborn nursery. If we could detect early, infants affected with CCHD can often be treated timely and they lead longer, healthier lives. Hence, pulse oximetry is a useful tool to detect congenital heart disease. Its accuracy in detecting congenital heart disease increases if combined with positive clinical examination.

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