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ORIGINAL RESEARCH

EVALUATION FOR CONGENITAL HEART DISEASE IN NEONATES BY USE OF CHEST X-RAYS

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ABSTRACT

Aim: To evaluate for congenital heart disease by using chest X-rays in neonate

Material and methods: Of the 180 patients, this research included 100 patients who had had echocardiography in the NICU for suspected cardiac problems. On each subject's chest film, the following factors were evaluated: heart size, visceroatrial situs, aortic arch sidedness, pulmonary blood flow, and the risk of serious heart disease. Significant cardiac disease was defined in this investigation as structural or functional disease that was reasonably predicted to be related with clinical and radiographic findings.

Results: The high proportion of preterm newborns in the research group, a left-to-right shunt via a patent ductus arteriosus was a frequent cardiovascular finding, seen in 40(40%), a mixing lesion in 30%, and a right-to-left shunt in 20% of the cases. Unclassified lesion 3% and Obstructive lesion 7%.Using echocardiographic diagnosis as the standard, we computed sensitivity 81% and specificity 86%. 44% negative predictive value and 82% positive predictive value. We examined chest films from smaller (2 kg) and younger (35 weeks of gestation) infants to see whether neonatal size or gestational age affected the outcomes of chest film interpretation.

Conclusions: The chest film is not useful as a screening tool for newborns with suspected cardiac disease, especially in tiny or preterm neonates. Clinical examination of newborns with suspected heart disease should always include echocardiography, even if chest radiographs do not reveal CHD, and especially if radiography does not suggest pulmonary parenchymal pathology.

Key words: Congenital heart disease , Neonatal echocardiography, Chest radiography

Introduction

Most often, babies are born with a cardiac defect called congenital heart disease (CHD). Even though CHD screening is commonplace throughout pregnancy, most cases aren't discovered until after delivery.[1-3] Therefore, congenital heart disease is still considered a likely cause of respiratory distress or desaturation in newborns admitted to the NICU. There is some evidence that suggests a positive correlation between early diagnosis and outcome .[4] It might be difficult to tell the difference between cardiac and respiratory illness based on a patient's history, physical exam, blood gas analysis, and pulse oximetry alone. Although echocardiography is now the gold standard for diagnosing CHD in newborns and children, it is still prohibitively costly and needs specialised training and equipment that is not always easily accessible in newborn nurseries. The chest film, on the other hand, is still cheap and readily accessible. Whether or whether the conventional chest film is helpful in diagnosing cardiac problems in children who are no longer in the newborn phase has been the subject of previous research.[5-8] Radiography is included in the clinical assessment of the baby with suspected CHD according to many investigator-developed algorithms.[5] However, the value of the regular chest film in assessing unwell newborns with suspected CHD has not previously been comprehensively studied outside of a single publication addressing the clinical and radiographic findings in the preterm child with a patent ductus arteriosus.[4] The purpose of this research was to evaluate the use of the standard chest film as a screening tool for CHD in unwell newborns with suspected CHD, given the essential role it plays in the diagnosis of pulmonary parenchymal disease.

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Material and methods

Of the 180 patients, this research included 100 patients who had had echocardiography in the NICU for suspected cardiac problems. On each subject's chest film, the following factors were evaluated: heart size, visceroatrial situs, aortic arch sidedness, pulmonary blood flow, and the risk of serious heart disease. Significant cardiac disease was defined in this investigation as structural or functional disease that was reasonably predicted to be related with clinical and radiographic findings.

Nonobstructive bicommissural (or bicuspid) aortic valve, mitral valve prolapse, small to moderate patent ductus arteriosus, persistent pulmonary hypertension, small to moderate atrial septal defect, and small ventricular septal defect are examples of structural disease that would not meet such a definition. Expected chest film findings were documented based on the echocardiographic results, and echocardiographic findings were categorised by illness type. Chest film results were expected to contain a description of heart size, visceroatrial situs, aortic arch sidedness, and pulmonary blood flow. The size of the duct, size of the left ventricle (left ventricular end diastolic dimension), size of the left atrium, pulmonary-to-systemic blood flow ratio, pulmonary vascular resistance, and speed and direction of flow through ductus arteriosus were used to predict heart size and pulmonary blood flow on chest film in subjects with isolated patent ductus arteriosus. The main cardiac diagnosis, diagnostic type (obstructive, left-to-right shunt, right-to-left shunt, or mixing lesion), and presence or absence of severe cardiopulmonary illness (as previously specified) were recorded for each individual. Chi-square and kappa statistics were used in the statistical analysis to measure agreement between chest film interpretation and echocardiography findings.

Results

The overall demographics of the study population are shown in Table 1. All neonates under the age of 30 days Chest films were taken three days after the echocardiography. Because of the high proportion of preterm newborns in the research group, a left-to-right shunt via a patent ductus arteriosus was a frequent cardiovascular finding, seen in 40(40%), a mixing lesion in 30%, and a right-to-left shunt in 20% of the cases. Unclassified lesion 3% and Obstructive lesion 7%. Kappa values range from 0.43 to 0.49. We also compared the interpretation of chest films to echocardiographic diagnosis. In terms of the existence of a major CHD, we found that chest film interpretations showed poor concordance with echocardiograms (kappa numbers of 0.16). Using echocardiographic diagnosis as the standard, we computed sensitivity 81% and specificity 86%. 44% negative predictive value and 82% positive predictive value. We examined chest films from smaller (2 kg) and younger (35 weeks of gestation) infants to see whether neonatal size or gestational age affected the outcomes of chest film interpretation. Sensitivities for severe CHD reduced in 35 chest films from patients weighing less than 2 kg for the whole newborn group (Table 3). The negative predictive values fell as well. In the interpretation of chest images from patients 35 weeks of gestation, similar declines in sensitivities and negative predictive values were seen (Table 4).

Table 1. Demographic and clinical characteristics

Parameter	
Postnatal age	1-30 days
Gestational age	24-42 week

CHD subgroup	**100 out of 180**
Left-to-right shunt	40
Mixing lesion	30
Right-to-left shunt	20
Obstructive lesion	7
Unclassified lesion	3

Table 2. Sensitivity and specificity of CXR for CHD

	%
Sensitivity	81
Specificity	86

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Positive predictive value	82
Negative predictive value	44

Table 3. Sensitivity and specificity for smallest neonates (weight < 2 kg

	%
Sensitivity	80
Specificity	85
Positive predictive value	81
Negative predictive value	43

Table 4. Sensitivity and specificity for smallest neonates (<35 weeks of gestation)

	%
Sensitivity	79
Specificity	84
Positive predictive value (	80
Negative predictive value	42

Table 5. Sensitivity and specificity for earliest chest films <24 hours and 48 hours

	%
Sensitivity	78
Specificity	80
Positive predictive value	79
Negative predictive value	40

We also wanted to see whether seeing chest films sooner after birth affected the interpretation. We discovered that the sensitivities for 52 chest films taken 24 hours after birth and 82 chest films obtained 48 hours after delivery were lower than the sensitivities for all chest films. (Table 5).

Discussion

Prenatal diagnosis of CHD has been shown to improve outcomes for newborns compared to postnatal diagnosis.[2,8] The fact that many newborns with ductal-dependent CHD aren't discovered to have the condition until they show up in the emergency room in a state of shock many days or weeks after being released from the hospital is thought to be a contributing factor. With the exception of echocardiography, no single test has been established as a reliable screening technique for congenital heart disease in babies. Pulse oximetry has been proposed as a screening method to reduce the proportion of babies with serious, ductal-dependent CHD that are missed before being sent home from the nursery.7 The present research set out to ascertain whether the commonly used, low-cost, and simple chest film is sensitive enough to serve as a screening tool for newborns with suspected CHD. In older babies and children attending to paediatric cardiology outpatient clinics, the chest film has been studied as a screening tool for CHD in a number of studies.[9-15] Based on the results of these trials, it seems that the chest film is not a useful screening tool and does not substantially supplement a detailed history and physical examination in predicting the risk of CHD. The only group to reach a different result was Swenson et al.[12], and that may be because the radiologists who analysed the chest radiographs were familiar with the patients' individual presentations. It is reasonable to assume that the prevalence of CHD is at least as high, if not greater, in the group of newborns in the critical care unit of an academic children's hospital as in asymptomatic older children. It was for this reason that we set out to assess the value of the chest film in identifying coronary heart disease in a patient group that was both younger and more unwell. Based on our findings, it seems that the standard chest film is not an effective screening test for CHD in newborns, as it is in older babies and children. Both the sensitivity and the predictive value were found to be rather poor. The results of this study indicate that there is little to no association between chest radiographs and echocardiograms. That is to say, there aren't enough indicators of congenital heart disease on the chest film to make a diagnosis in newborns. More training for doctors in interpreting chest films is not likely to significantly reduce this shortcoming. Patients weighing less than 2 kg or those who were born before 35 weeks of gestation

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fared worse than the group average when screened with a chest film. Concerns that chest films taken in the first 24-48 hours after birth may be especially restricted in their capacity to test for CHD were unfounded, as we showed that the chest film had comparable sensitivity and specificity for CHD as those identified in prior investigations in older infants.11 When data from just patients whose chest films were taken during this time period was compared to that of the complete group, there was no discernible difference. Only one research has looked at the effectiveness of chest films as a CHD screening tool for newborns. Oeppen et al.[10] observed a similar poor sensitivity and negative predictive value for regular chest radiography in their study of 68 asymptomatic infants with cardiac murmurs. However, it may be assumed that acute care settings have a far greater clinical need to diagnose and chance of finding CHD than outpatient settings do. Thus, we hypothesised that the chest film may have played a more significant screening function for the ill neonate than for the asymptomatic infant, and because no such research had been conducted, we set out to do so. The data we gathered did not lend credence to this theory. There are a number of reasons why the chest film is ineffective as a screening tool for congenital heart disease in newborns. Firstly, any left-to-right shunt is limited by the persistently high pulmonary arteriolar resistance for many days or more after birth. Since this is the case, our research suggests that it may be challenging to evaluate pulmonary blood flow on chest images in the first few days of birth. Second, detecting pulmonary edoema is complicated by the presence of residual lung fluid. Third, infants have rapid respiratory rates, therefore chest films are often captured during exhale. This makes the diagnosis of cardiomegaly difficult. Finally, with different tube distances, portable anterior-posterior supine radiographs might amplify and create the erroneous appearance of cardiomegaly. This research may have a flaw due to the fact that it only included chest films taken during the first 24 hours after birth. Chest films are more difficult to read at this time than at any other point in the neonatal era. However, chest films taken during the first 24 hours after birth were just as sensitive as those taken at any other time in the neonatal period for diagnosing CHD (1-3 days following delivery). One other restriction is that there were only one observers, therefore extra care must be used before generalising to other NICUs. Also, several of our patients had a patent ductus arteriosus (left-to-right shunt lesion), and this lesion type was the least sensitive of all disease subtypes. The sensitivity of the chest radiograph to identify patent ductus arteriosus in the preterm newborn was similarly poor as reported by Davis et al.[4] Potentially more sensitive chest films for CHD detection exist in groups with different distributions of disease subtypes and gestational ages. The usefulness of the chest film in assessing the ill newborn for pulmonary parenchymal disease is not questioned, even though our results show a limited capacity for the chest film to test for CHD in sick neonates.

Conclusions

The chest film is not useful as a screening tool for newborns with suspected cardiac disease, especially in tiny or preterm neonates. Clinical examination of newborns with suspected heart disease should always include echocardiography, even if chest radiographs do not reveal CHD, and especially if radiography does not suggest pulmonary parenchymal pathology.

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