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Utility of chest x-rays in neonatal respiratory distress: A descriptive analytical study

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Abstract
Introduction: Chest radiography is one of the most usual diagnostic tools for respiratory distress. The aim of this study was to assess the specificity, sensitivity and clinical value of chest radiography of neonates with respiratory distress.
Objective: To find out Utility of Chest X-rays in Neonatal Respiratory Distress.
Methods and Materials: A descriptive- analytical study was conducted on 102 neonate's patients that were in Dept. of Radiology and Imaging, Dhaka Shishu (Children) Hospital, Dhaka during July 2018 to June 2019. After confirming the neonate's respiratory distress and taking CXR, the radiography was described by a radiologist and final diagnosis was confirmed.
Results: Most of the neonates (64.7%) were born with caesarian section and were premature (78.4%) this study. Respiratory distress syndrome (RDS) was the most common reason for respiratory distress (38.2%). Chest radiography had the most sensitivity and specificity in pneumothorax and hernia (100%). For pneumosepsis, radiography had 73% sensitivity and 87% specificity, for RDS the sensitivity and specificity were 35% and 82% respectively, for congenital heart disease sensitivity of zero and specificity of 98% and for Transient tachypnea of neonates (TTN) sensitivity of zero and specificity of 100%. The conformity of clinical and radiography was also calculated as 79.4% in respiratory distress.
Conclusion: Although chest radiography is used as one of the most usual and accessible diagnostic tools in respiratory distress syndrome, but inaccurate specificity and sensitivity in some disease must be considered, especially in neonates.

Keywords: chest x-ray, neonate, respiratory distress.

Introduction

Two third of the neonatal mortality is related to neonates who weight lower than 2500 gr at the time of birth, and even though very low birth weight infants consist less than 1% of all births, 50% of neonatal mortality is related to this group [1, 2].The most common causes of pre-term neonatal mortality are bronchopulmonary dysplasia and Respiratory distress syndrome (RDS). Bronchopulmonary dysplasia (BPD) is a chronic lung disease that is seen most often in severely premature babies (birth weight lower than 1,000 grams at birth) who developed RDS. Respiratory distress syndrome is a life-threatening lung disorder in which a baby's lungs are not fully formed and cannot function outside the uterine. This condition primarily affects premature babies [3-5]. Pneumothorax, congenital diaphragmatic hernia, pneumonia, sepsis, temporary tachypnea and respiratory distress syndrome (RDS) have been proposed as the main causes of respiratory distress. RDS is one of the most common causes of death in premature infants [6] which is caused by developmental insufficiency of surfactant production and structural immaturity in the lungs [7]. Labored breathing which is characterized by grunting, nasal flaring and the use of accessory muscles of respiration is the most common clinical sign of RDS. Low birth weight has been regarded as one of the leading causes of RDS as most of the neonate with birth weight of 500-1500 suffer from RDS [8]. Chest X-rays (CXR) have shown promising results regarding the early diagnosis of respiratory distress [7]. Fisch in 2006 declared that chest X-rays in preterm neonates can provide useful information for diagnostic procedures [9]. Diffuse reticulogranular, grand glass pattern and air-bronchogram are classic radiographic signs of respiratory distress [8]. Also it has been declared that normal radiographic patterns 6 hours after labor exclude any chance of RDS [10-12]. Although chest X-rays showed promising results in detecting respiratory distress, they cannot efficiently differentiate initiating causes of respiratory distress like RDS and pneumonia. Since there are no conclusive studies regarding the specificity and sensitivity of radiographs in detecting respiratory distress causes, the present study was designed to determine the sensitivity, specificity and clinical value of chest radiography of neonates with respiratory distress.

2. Objective

To find out Utility of Chest X-rays in Neonatal Respiratory Distress.

3. Methods and Materials

This was a descriptive-analytic study which was held in the Dept. of Radiology and Imaging, Dhaka Shishu (Children) Hospital, Dhaka, Bangladesh during July 2018 to June 2019. 102 patients who were admitted in radiology and imaging dept. with respiratory distress diagnosis were included in the present

study. When respiratory distress was confirmed, useful information (maternal age, history of mother disease, history of drug use birth weight, height, gender, delivery mode, date of delivery, Apgar score at birth, symptoms at time of referring, etc.), were recorded in the questionnaire. RDS was diagnosis by a neonatal specialist based on clinical symptoms and course and Arterial blood gas (ABG) and infection rule out and chest X-ray, then chest X-ray was given to a radiologist without awareness of the above diagnosis and then the results were statistically collected. Different interpretations included: collapses, pneumothorax, pleurisy, heart disease, mediastinal mass, pulmonary vessels, diaphragm condition, lucencies in the lung and the presence of any cavity, mass and unusual opacity were diagnosed and recorded in the questionnaire. After specific clinical and para-clinical procedures the definite diagnosis was made and recorded in the questionnaire. Finally, final diagnosis has been confirmed by another neonatologist. We assessed the prevalence of these parameters and performed the statistical analysis by SPSS version 19. Chi-square test and exact fisher test were used. The statistical significance was at ($P<0.05$) and the confidence interval was 95% for all these tests in our study.

4. Results

Fifty-eight (56.9%) of neonates were male and 44 (43.1) were female and 66 (56.9%) were born with cesarean and 36 neonates (35.3%) with natural delivery and also 88 (76%) birth weight <2500 gr. In the present study 20.6%, 78.4% and just 1% of labors were term, preterm and post term respectively. We observed Apgar score ≤3 in 2 patients, Apgar score 4-7 in 18 cases (17.6%), and Apgar score ≥8 in 82 cases (80.4%). The most common clinical sign of the neonates was granting (73.5%) and then organs and mucosal cyanosis (21.6%). Diagnosis of the disease was performed based on neonate's age, presence or absence of delivery events, clinical course, ABG, and also observation of CXR evidences, presence or absence of evidence of infection and blood cultures, echocardiography. Invasive proceeding such as chest tube insertion, needle aspiration and finally Surgery were performed. (Table 1) demonstrates the frequency of radiographic observations in chest X-rays. It can be concluded that chest X-ray haziness and bronchogram were the most common radiographic signs. Also presence of the pneumothorax was the least common sign in X-rays.

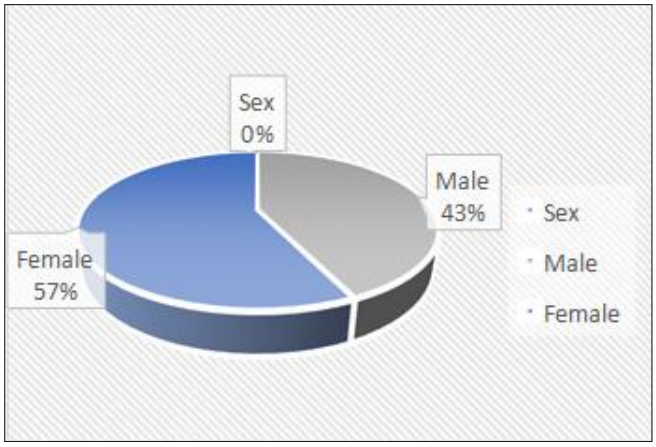

Fig 1: Sex distribution of the patients

After the signs of pneumothorax intensified, missed cases were revised and definitive diagnosis was assigned after consulting with the radiologist. According to [Table 2] it can be said that totally 79.4% of clinical diagnosis were confirmed by radiographs and in 20.6% of cases there was no coordination between clinical and radiological observations. [Table 3] represents the false positive and negative radiological and clinical observations for different radiologic diagnosis. Also [Table 1] show the final clinical diagnosis of patients who were admitted with clinical signs of respiratory distress. According to the [Table 3], it was seen that RDS had the highest rate of frequency following by Transient tachypnea of the newborn (TTN). Also hernia showed the least rate of frequency. In [Table 1] represents the frequency rate of final radiographic diagnosis. It was observed that RDS, pneumonia and bronchopneumonia had the highest rate of frequency. Interestingly in 18% of cases, neonates were diagnosed to be radiographically healthy. Based on [Table 1], it can be concluded that from 39 clinical diagnosis of RDS 25 of them were confirmed by radiographs (64.1%). All clinical diagnosis of hernia and pneumothorax were confirmed by radiographs. These results are presented in [Table 1].

Fig 2: Respiratory Distress Syndrome Imaging.

Respiratory distress syndrome (RDS) of the newborn is an acute lung disease caused by surfactant deficiency, which leads to alveolar collapse and noncompliant lungs. Previously known as

hyaline membrane disease, this condition is primarily seen in premature infants younger than 32 weeks' gestation. RDS is Usually diagnosed with a combination of clinical signs and/or symptoms, chest radiographic findings, and arterial blood gas results.

Table1: Frequency and percent of Radiographic observations in chest x-rays, Abnormal finding in chestX-rays, Final clinical diagnosis of patients, Final radiographic diagnosis (n=102)

Variables	Name of the variables	Frequency (N)	Percentage (%)
Frequency of radiographic Observations in chest x - rays.	Haziness	76	74.5
	Air Broncho gram	52	51.0
	Collapse	8	7.8
	Pneumothorax	5	4.9
	Pulmonary lucencies	33	32.4
Frequency of abnormal finding in chest X-rays	Heart size & shape	22	21.6
	Lung hills	18	17.6
	Pulmonary vessels	15	14.7
	Mediastina condition	12	11.8
	Diaphragm	8	7.8
	RDS	39	38.2
Final clinical diagnosis of patients.	Transient tachypnea of neonates	17	16.7
	Pneumothorax	4	3.9
	Pneumonia	15	14.7
	Congenital heart diseases	7	6.9
	Asphyxia	19	18.6
	Congenital diaphragmati chernia	1	1.0
Final radiographic diagnosis	Normal	19	18.6
	RDS	25	24.5
	Pneumothorax	4	3.9
	Pneumonia	22	21.6
	Bronchopneumonia	22	21.6
	Congenital heart diseases	1	1.0
	Collapses	6	5.9
	Emphysema	2	2.0
	Hernia	1	1.0
	Total	102	100.0

Table 2: Final clinical diagnosis of patients (n=102)

Disease	Final clinical diagnosis (N)	Clinical diagnosis which were confirmed by radiographs (N)	Percent of accurate Diagnosis by radiographs (%)
RDS	39	20	51.8
Transient tachypnea of neonates	17	0	0
Pneumothorax	4	4	100.0
Pneumonia	15	4	26.6
Congenital heart diseases	7	1	14.2
Asphyxia	19	0	0
Hernia	1	1	100.0
Total	102	30	29.4

Table 3: False positive and negative of radiological finding (n=102)

Variables		Radiographic finding		Total
		Positive	Negative	
RDS	Positive	20	25	39
	Negative	5	52	63
	Total	25	77	102
Pneumothorax	Positive	4	0	4
	Negative	0	98	98
	Total	4	98	102
Pneumonia	Positive	4	4	15
	Negative	18	76	87
	Total	22	80	102
Congenital heart disease	Positive	1	6	7
	Negative	1	94	95

	Total	2	100	102
congenital diagraphmatic hernia	Positive	1	0	1
	Negative	0	101	101
	Total	1	101	102
Transient tachypnea of neonates	Positive	0	17	17
	Negative	0	85	85
	Total	0	102	102

5. Discussion

Chest X-ray is one of the main steps in respiratory distress diagnostic procedure, therefore it is necessary to investigate the value of radiography role in this disease. In the Marini study in 1997 the sensitivity and specificity of chest x-ray in neonates were 89.1% and 86.9% respectively in detecting respiratory distress [13]. In the present study we precisely determined the sensitivity and specificity of chest X-rays in detecting different causes of respiratory distress. In the present study the interpretation of chest X-rays was based on the criteria. It was concluded that chest X-ray haziness and bronchogram were the most common radiographic signs. In the present study, boys consisted 56.9% of patients who were admitted to Pulmonology dept. Dhaka Shishu (Children) Hospital, Dhaka, Bangladesh. This finding is in agreement with Hashemizadeh's study which declared that 61% of patients suffering from respiratory distress were boys [14]. In Berg's study respiratory distress was said to be one of the major complications of cesarean [15]. This finding was also confirmed in the present study as just 35.3% of neonates had natural delivery. In the present study the specificity (the percentage of healthy people who are correctly identified as not having the condition) and sensitivity (the percentage of sick people who are correctly identified as having the condition) of the radiographic test was 82.5 and 35.8% respectively. While in the Kurl's study clinical and radiographic diagnosis matched properly in 95% of cases [11].The specificity and sensitivity of the test in diagnosing Pneumothorax were 100%. In Marini study there were 5 patients suffering from pneumothorax and all of them were diagnosed [13]. Also Kurl indicated that the consistency of radiographic and clinical diagnosis is 78% [11].The sensitivity and specificity of the radiographic tests were 73% and 87% respectively in the present study. In Mathur study in 2002, chest X-rays were normal in 15% of patients suffering from pneumonia (sensitivity 15%) [12].16.6% and 98% sensitivity and specificity were reported for radiographic tests respectively in the present study. In Fonseca study in 2004 the chest X-rays represented low sensitivity for heart structural disease (26%-59%) [16]. Also it was revealed that chest x-rays do not change the trend of treatment and diagnosis of patients with congenital heart diseases [17].In the present study the sensitivity and specificity of radiographic tests were 100%. In Marini C study 3 cases of hernia were clinically diagnosed and all of these cases were confirmed by radiographs [13].The sensitivity and specificity of radiographic tests were 0 and 100% respectively. In Kurl study just 48% of clinical and radiographic diagnosis matched properly [11]. In the present study none of the neonates who were suffering from TTN were diagnosed by radiographs. Also Ponhold revealed that the diagnosis of TTN is mainly based on clinical signs and symptoms [18]. Finally in the Present study 79.4% of clinically diagnosed cases were confirmed by radiographs. Also in Kurl's study, 66.6% of clinical and radiographic diagnosis matched properly [11].

6. Conclusion

Although chest radiography is used as one of the most usual and accessible diagnostic tools in respiratory distress syndrome but diagnostic value of RDS based on radiologist opinion were about two-third of all cases and has high sensitivity.

Conflict of Interest: None

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