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Original Research Article

A Comparative Study between Role of X Ray and Ultrasound in Clinically Diagnosed Cases of Neonatal Respiratory Distress Syndrome

Jayanta Pal[1], Sharif Anwar Ahmed[2]

[1]Associate Professor, Department of Radiology, Murshidabad Medical College, Berhampore, West Bengal, India.

[2]Assistant Professor, Department of Radiology, Murshidabad Medical College, Berhampore, West Bengal, India.

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Corresponding author: Dr. Jayanta Pal

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Abstract

Background: Neonatal respiratory distress syndrome is leading cause of hospital admission of newborn. Diagnosis of cause of respiratory distress is challenging. Chest X – ray only imaging modality and we had to depend on clinical sig and symptoms in past. We have now USG along with X- ray for diagnosing cause of respiratory distress in NICU set up now days. In this study we attempted to compare the sensitivity and specificity of X ray and USG in diagnosing NRDS and evaluating them their efficacy in ruling out or excluding other causes of respiratory distress in newborn.

Method: 52 patients, who are clinically suspected of NRDS, are included in this study. USG and X- ray were done to all Neonates. Sensitivity and specificity were calculated, for X-ray and USG.

Results: 40 cases out of 52 cases show "Pleural line abnormality", and do not show features of any other disease like Meconium aspiration syndrome or TTN by Chest X-ray. These 40 cases were finally diagnosed to have NRDS. Out of these 40 cases 33 were found to be positive for "Sub pleural consolidation". Only 25 cases show reticulo granular or ground glass pattern. Sensitivity and specificity of "Pleural line abnormality", "Sub pleural consolidation" and "Chest X-ray" were calculated.

Conclusion: Chest X-ray was used as the only imaging mode for diagnosis in past. Hence forth we consider Chest X ray as the gold standard for diagnosing NRDS. Ultrasound was found to be more sensitive whereas X-ray found to be more specific. "Pleural line" and "Sub-pleural consolidation" were found to be positive in most cases of clinically suspected cases of NRDS.

Keywords: Neonatal respiratory syndrome, Pleural line abnormality, Sub pleural consolidation, Reticulo granular pattern, Ground glass pattern.

Introduction

Respiratory distress syndrome (RDS) is one of the commonest disorders and cause of morbidity in new-borns. It occurs among 4 - 7 % of all neonates and is the reason for 30 - 40% of admissions in the Neonatal Intensive Care Unit (NICU). [1] Immature type II pneumatocytes in premature babies do not produce enough surfactant. The deficiency of surfactant causes increase in surface tension within alveoli which in turn causes collapse of lung alveoli. This hampers the smooth transition from in-utero to ex-utero physiology and manifests as various degrees of respiratory distress in new born. Sometimes genetic disorders and diabetes in the mother also can cause decreased surfactant production and they may present as RDS.

Neonatal respiratory distress syndrome is one of the leading causes of mortality and morbidity in pre-term new born babies (< 37 wks. gestational age). [2] In countries with large pockets of poverty, mortality rate runs 10 times higher than in wealthier countries. In resource-poor countries the mortality rate reaches as high as 60%. In the U.S. respiratory distress is among the most common cause of death in the first month of life. [3] Lung ultrasound is a non- invasive, bed side and reproducible point of care method that could improve management of Neonatal respiratory distress. It is accurate and reliable to identify patients who will need treatment. [4] Lung ultrasound has been proved to be highly sensitive for detection of neonatal respiratory distress syndrome. [2] Neonatal respiratory distress syndrome is not only one of the commonest causes of death of infants within first month of life, but is also responsible for considerable amount of morbidity later in life. Neonatal RDS is also a threat for different reasons. For example, in one

recent study, 1.9% of premature babies who had RDS in early neonatal period latter developed cerebral palsy, compared with 0.5% of premature babies who did not have RDS. [3]

X ray and ultrasound of chest are two important investigations that are non-invasive and informative.

In respiratory distress syndrome (RDS), the classic chest radiographic findings consist of

1. Ground glass pattern and 2. Reticulo granular pattern

In advanced cases, there may be diffuse white opacities in lung (the typical 'white-out lung).

Common ultrasound features seen in lung ultrasound are:

- Pleural line: Linear echogenic line moving continuously with respiration. It reflects
- pleura. Absence of pleural line: Discontinuous pleural line.
- Sub pleural consolidation: consolidation in sub pleural aspect of lung.

'A' line: A series of echogenic horizontal parallel lines equidistant from one another below pleural line. They reflect reverberation artefact from pleural line.

'B' line: They are lung comets, hyperechoic artefacts passing from pleural line to deeper structure. [5,6] They suggest lung pathology. If more than 3 lines are seen in a frame it is called "Interstitial syndrome".

Abnormalities of pleural line and disappearance of "A" line found in a case of Lung disease". [7] One signs of lung ultrasound help us differentiate a case of RDS from T.T.N. i.e. "Double lung point". There are very compact comet tail artefacts in the inferior fields while these were rare in superior fields. We designate this finding the "Double lung point" and it was not observed in healthy infants, infants with Respiratory distress syndrome, Atelectasis, Pneumothorax. [8] Absence of "A" line may be pathognomic. The main signs of neonates with lung disease on USG were as follows: absence of "A" line, pleural line abnormalities, Interstitial syndrome, lung consolidation, air bronchograms, pulmonary oedema and lung pulse. [7] Lung ultrasound is helpful in differentiating neonatal respiratory syndrome from other causes of respiratory distress like Transient Tachypnea of New born. We found LUS to be reliable and non-invasive tool and its differentiation from other causes of neonatal respiratory distress. in near and full term Egyptian neonates. [9] Lung ultrasound helps us to assess and plan for next treatment in a case of neonatal respiratory distress syndrome. Early lung ultrasound is a useful tool to determine which neonates admitted with respiratory distress will require mechanical ventilation. [10]

Michela vergine et al studied 59 neonates and found that LUS has sensitivity of 95.6% and specificity of 94.4% with a positive predictive value 91.6% and negative predictive value 97.1%. They have found chest X-ray has sensitivity of 91% and specificity of 84%. [11]

Allessandro Perri et al studied 56 new born with mean gestational age 31 weeks and mean birth weight 1442g. LUS show higher accuracy than X ray score in the early recognition of infants with respiratory distress syndrome requiring surfactant treatment. It showed higher sensitivity (86% vs. 82%); higher specificity (88% vs. 76%), better positive (83% vs. 69%) and negative (91% vs. 87%) predictive value. [4] Shui-Wen Chen et al have studied 2658 cases with lung diseases and 747 cases without lung diseases. There were 81 cases that could not be diagnosed as lung disease by C.R. were discovered to have lung disease on LUS. [7] Roberto Copetti found that "Double lung point" is very effective in excluding TTN. It was not observed in healthy infants, infants with respiratory distress syndrome, atelectasis, and pneumothorax. [8] M. Ibrahim studied 65 neonates in the study. "Double lung point" has 69.6% sensitivity and 100 % specificity, 100% PPV and 39.1% NPV for detecting TTN. [9] If LUS is to be used as a first line investigation for NRDS, it must be carried out soon after birth in order to maximise positive health outcomes. [2]

Lung ultrasound is a basic application of critical ultrasound, defined as a loop associating urgent diagnoses with immediate therapeutic decisions. It requires the mastery of ten signs: the bat sign (pleural line), lung sliding (yielding seashore sign), the A-line (horizontal artefact), the quad sign, and sinusoid sign indicating pleural effusion, the fractal, and tissue- like sign indicating lung consolidation, the B-line, and lung rockets indicating interstitial syndrome, abolished lung sliding with the stratosphere sign suggesting pneumothorax, and the lung point indicating pneumothorax. Two more signs, the lung pulse and the dynamic air bronchogram, are used to distinguish atelectasis from pneumonia". [12]

Aims and Objectives

To compare between X-ray and Ultrasound of chest—which one is a better tool in diagnosing Neonatal respiratory distress syndrome

Material and Methods

A prospective analytical study was done in Department of Paediatrics, Dr. B. C. Roy P.G.I.P.S. in Kolkata. The study was mainly conducted in

N.I.C.U. and S.N.C.U. with "VIVID S60N" of GE Health care and "ECUBE 8" of Alpinion with excellent image resolution. About 52 neonates diagnosed with N.R.D.S. diagnosed clinically of N.R.D.S. in N.I.C.U and S.N.C.U. was included in the study. X ray and USG were done before treatment started. Neonates suspected of having congenital malformation were excluded from this study. Neonates to whom treatment was already initiated and neonates whose mother did not want to participate in this study were excluded from this study. Data regarding Mode of delivery, Gender, Gestational age and birth weight was taken and tabulated in a chart. Proper statistical methods are applied to compare sensitivity and specificity of ultrasound and X-ray each.

Results

Amongst 52 clinically suspected 35 were male 17 were female. 12 neonates showed gestational age between 31 weeks and 34 weeks. 40 neonates showed less than 31 weeks, among them 20 neonates show gestational age less than 28 weeks.16 neonates show birth weight less than 1000 g, 24 neonates show birth weight more than 1000 g but less than 1500g. 12 neonates show birth weight more than 1500 g.

Presence of NRDS found to be more in low birth weight and pre mature infants. It is more commonly seen in infants less than 1500 g birth weight and gestational age less than 31 weeks of gestational age.

Table 1: Gender wise distribution of cases

Total patients	52
Male	35
Female	17

Table 2: Gestational age wise distribution of cases

Total patients	52
Gestational age 34 wks. To 31 wks.	12
Gestational age 31 wks. To 28 wks.	20
Gestational age less than 28 wks.	20

Table 3: Birth weight wise distribution of cases

Total patients	52
Birth eight more than 1500g	12
Birth weight 1500g>>1000g	24
Birth weight < 1000g	16

52 premature neonates with respiratory distress with rapid shallow breathing were included with in study. Chest X-ray or Lung ultra sound had been done within first 24 hours. 12 of those included in this study, were diagnosed to be a case of TTN, congenital malformation or Meconium aspiration syndrome (by Chest X-ray). 40 were diagnosed finally as case of RDS. Diagnosis was done by clinically assessment combined with chest X-ray or LUSG. Among 52 neonates' clinical signs and symptoms of NRDS, 45 neonates were showing abnormality of pleural line, 35 were showing sub pleural consolidation. Only 25 neonates were showing reticulo-granular shadows in both lungs. 2 of them had associated pneumothorax and one of them had associated pleural effusion. Among the 45 neonates who were positive for Pleural line abnormality 40 neonates were finally diagnosed to have RDS 5 were diagnosed to have other disease like Meconium aspiration syndrome or TTN (by Chest X-ray). In 35 positive case of subpleural consolidation 33 had RDS. 2 of them diagnosed to have TTN by Chest X ray. All 25 neonates who were positive for reticulo granular shadows (in both lungs) were found to have RDS.

True positive for Pleural line abnormality is 40 out of 40

False negative for Pleural line abnormality 0.

True positive for sub-pleural consolidation 33 out of 40

False negative for sub-pleural consolidation 7 out of 40.

True positive for CXR (Reticulo granular pattern) 25 out of 40

False negative for CXR (Reticulo granular pattern) 15 out of 40.

$$\text{Sensitivity of a test} = 100x \frac{\text{True positive}}{(\text{True positive} + \text{false negative})}$$

Sensitivity of pleural line abnormality 100%

Sensitivity of sub-pleural consolidation = 100x 33/35+5=100 x33/40

=82.5%

Sensitivity of CXR = 100x 25/25+15= 100x 25/40= 62.5%

Similarly

$$\text{Specificity of a test} = 100 \times \frac{\text{True negative}}{(\text{True negative} + \text{false positive})}$$

Specificity of pleural line abnormality is 100x 7/7+5= 100x 7/12=58.3%

Specificity of sub pleural consolidation is 100x 19/19+2= 90.4%

Specificity of chest X-ray is 100 x 27/27+0= 100%

Discussions

Although USG has very high sensitivity (100%), it has low specificity (58.3%). Pleural line abnormality can be seen in other conditions which clinically mimics RDS like TTN, Meconium aspiration syndrome etc. Chest X ray on the hand has low sensitivity (62.5%) but it found to have high specificity (100%). Pleural line abnormality and sub-pleural consolidation is also seen in TTN and Meconium aspiration syndrome. However reticulo granular pattern seen in X ray is only NRDS. On the other hand Meconium aspiration syndrome and TTN does not show Reticulo granular pattern. Instead Meconium aspiration syndrome shows widespread patchy inhomogeneous opacities. Some cases of NRDS also show ground glass pattern which progresses to obscure cardiac borders. Rapid improvement of X-ray findings could be seen on administration of surfactants. However 15 cases out of 40 cases of NRDS do not show any significant CXR findings. On comparison all 40 cases of NRDS show "Pleural line abnormality" and 33 cases out of 40 cases show "Sub-pleural consolidation". It shows high sensitivity of USG findings in cases of NRDS, compared to CXR findings. "Pleural line abnormality" show maximum sensitivity; followed by "Sub- pleural consolidation". "Pleural line abnormality" is also seen to be positive in 5 cases, other than NRDS. "Sub-pleural consolidation" is seen in 2 cases other than NRDS. Thus the specificity of USG in diagnosing NRDS is as low as 58.3% and 90.4 % for "Pleural line abnormality" and "Sub-pleural consolidation" respectively.

Hosney M.A. Elmasry et al [5] in their studies showed 19 patients out of 64 neonates showed concordance of Xray and USG findings. The complete white out lung formed by multiple confluent "B" lines correspond well with severely reduced lung lucency and blurred cardiac and diaphragmatic outlines in X ray. They found concordance of Xray and USG findings are more commonly seen in severe RDS patients than in mild to moderate forms. Vergine M et al [11] found that sensitivity and specificity of lung USG of 95.6% and 94.4% respectively for R.D.S. We found in our study pleural line abnormality has sensitivity of 100% but specificity to be low (58.3%). Shui-Wen-Chen et al [7] in their study included 3405 patients. Out of them 747 neonates without lung disease showed "B" line in first 3 days of life and 256 neonates showed "B" line in first week of life. Thus Lung ultrasound has lower specificity in differentiating normal and abnormal lungs. And can be positive in normalhealthy neonates.

Conclusions

Chest X-ray is considered as gold standard for diagnosing NRDS, as it was only available tool in past. We found Ultrasound to be more sensitive whereas X-ray found to be more specific. "Pleural line" and "Sub-pleural consolidation" were found to be positive in most cases of clinically suspected cases of NRDS. Chest X-ray turned to be more specific for NRDS. Reticulo granular or Ground glass pattern were found to be more specific for NRDS than "Pleural line abnormality" in Lung USG.

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