

Original Research Article

LUNG ULTRASOUND AS A DIAGNOSTIC TOOL FOR NEONATAL RESPIRATORY DISTRESS SYNDROME: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Neonatal Respiratory Distress Syndrome (RDS) is a leading cause of neonatal morbidity and mortality. Early and accurate diagnosis is essential to initiate prompt treatment. Traditionally, chest X-ray has been the standard imaging modality; however, concerns regarding radiation exposure in neonates have prompted investigation into alternative imaging techniques such as lung ultrasound (LUS). **Objective:** To evaluate the diagnostic value of lung ultrasound in RDS in newborn infants and its correlation with X-ray imaging in assessing disease severity.

Materials and Methods: This was a hospital-based prospective observational study conducted over one year (April 2015–March 2016) in the NICU of Government Medical College, Srinagar. A total of 59 newborns with suspected RDS were enrolled based on clinical features. All underwent both chest X-ray and lung ultrasound within 24 hours of admission. The severity of RDS was staged using respective imaging criteria. Statistical analysis included sensitivity, specificity, predictive values, diagnostic accuracy, and correlation assessment.

Results: Lung ultrasound showed a sensitivity of 100%, specificity of 93.33%, PPV of 97.78%, NPV of 100%, and diagnostic accuracy of 98.31%. Significant correlation was observed between LUS and chest X-ray in staging RDS, though LUS could not differentiate between stage III and IV.

Conclusion: Lung ultrasound is a highly accurate and non-invasive diagnostic tool for neonatal RDS. It offers a reliable alternative to chest X-ray and has the potential to reduce radiation exposure in neonates.

Keywords: Lung ultrasound, Neonatal RDS, NICU, Diagnostic imaging, Chest X-ray.

INTRODUCTION

Neonatal respiratory distress syndrome (RDS), also referred to as hyaline membrane disease, is a clinical condition marked by progressive respiratory difficulty, typically affecting premature infants. First identified in 1903 by Hochheim and later studied extensively through the 1950s, RDS has been closely associated with surfactant deficiency due to lung immaturity. The central pathophysiological mechanism involves insufficient production of pulmonary surfactant by type II pneumocytes, leading to alveolar collapse, impaired gas exchange, and ultimately respiratory failure.^[1,2]

The condition presents clinically with symptoms such as tachypnea, nasal flaring, expiratory grunting, and cyanosis. Radiological evaluation traditionally relies on chest X-rays, showing characteristic features like reticulogranular patterns, air bronchograms, and "white-out" appearances in advanced stages.^[1,3] However, repeated radiographs expose neonates to ionizing radiation, raising concerns about potential long-term adverse effects, including malignancies.^[4]

To mitigate these risks, lung ultrasound (LUS) has emerged as a valuable diagnostic tool. Advantages include its non-ionizing nature, bedside accessibility, low cost, repeatability, and real-time dynamic imaging capability. Ultrasound findings indicative of

RDS include abnormal pleural lines, B-lines (comet-tail artifacts), interstitial syndrome, consolidations, and the "white lung" appearance.^[5,6] This study explores the diagnostic accuracy of LUS in neonatal RDS and its correlation with chest X-ray findings.

Aims and Objectives

1. To evaluate the value of lung ultrasound in the diagnosis of respiratory distress syndrome (RDS) in newborn infants.
2. To study the correlation between ultrasound and X-ray imaging in describing the severity of respiratory distress syndrome.

MATERIALS AND METHODS

Study Design: Hospital-based prospective observational study conducted from April 1, 2015 to March 31, 2016.

Setting: Department of Pediatrics, G.B. Pant Hospital, Government Medical College Srinagar—a tertiary referral center catering to both rural and urban populations.

Inclusion Criteria: Newborns admitted to NICU within 72 hours of life, clinically suspected of having RDS based on signs such as tachypnea, grunting, nasal flaring, subcostal retractions, and cyanosis.

Exclusion Criteria: Neonates with respiratory distress due to causes other than RDS (e.g., meconium aspiration, sepsis), congenital anomalies, or chromosomal disorders.

Procedure: All eligible neonates underwent a clinical evaluation, arterial blood gas analysis, chest X-ray, and LUS within 24 hours of admission. X-ray staging followed a four-tier system; LUS staging followed a three-tier ultrasound severity scale. LUS was performed using LOGIQ-Qe machine by a radiologist blinded to X-ray results. Data were analyzed using SPSS v20.0. Diagnostic parameters including sensitivity, specificity, PPV, NPV, and diagnostic accuracy were computed.

RESULTS

Out of 59 neonates, 33 were male and 26 female. 83.1% were preterm. Most presented within 3 to 11 hours of life. 66.1% were delivered via lower segment cesarean section (LSCS). X-ray identified 44 cases as RDS, while LUS detected 45 cases. One patient not diagnosed on X-ray was positive on LUS. Correlation between X-ray and LUS staging revealed:

Stage I: 10 cases matched

Stage II: 16 cases matched

Stage III/IV: 18 cases on X-ray, 19 on LUS (LUS unable to differentiate between stage III and IV)

LUS performance metrics:

Sensitivity: 100%

Specificity: 93.33%

PPV: 97.78%

NPV: 100%

Diagnostic accuracy: 98.31%.

DISCUSSION

This study demonstrated high diagnostic accuracy of lung ultrasound for neonatal RDS, consistent with previous literature. The inability of LUS to differentiate between X-ray stages III and IV was noted, but correlation in early-stage diagnosis was strong. LUS was effective in identifying pleural line abnormalities, interstitial syndrome, and consolidations in a majority of cases. The non-invasive nature and ease of bedside application make LUS a valuable tool, especially in resource-limited settings.^[2,3,6,7]

Comparison with previous studies (Cattarossi et al,^[2] Liu et al,^[6] Hosam El-Deen et al,^[3]) reinforces the validity of LUS as an alternative diagnostic method. The strong correlation with radiographic findings supports its use in reducing unnecessary radiation exposure.

CONCLUSION

Lung ultrasound is a highly sensitive and specific diagnostic tool for neonatal RDS. It provides a safe, non-invasive, and efficient alternative to chest radiography, particularly in NICUs where minimizing radiation exposure is crucial. Its application allows for early diagnosis, targeted surfactant administration, and improved clinical outcomes.

Limitations: Small sample size may limit generalizability

Operator-dependent technique requiring experienced personnel

Limited ability of LUS to identify certain complications like pneumomediastinum

Conflict of Interest: None declared.

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