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Original Research Paper

Radio-Diagnosis

LUNG ULTR ASOUND AS A USEFUL ALTERNATIVE TOOL IN DIAGNOSIS OF RESPIRATORY DISTRESS SYNDROME IN NEWBORN INFANTS.

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ABSTRACT

Introduction: Respiratory distress syndrome is one of the most common causes of respiratory failure and mortality in newborn infants. Chest radiograph is routinely used for the diagnosis of RDS and lung ultrasound is usually not included in diagnostic work up. Lung ultrasound has been one of the most important tools in newborn point-of-care ultrasound in recent years. Several recent studies have demonstrated that US imaging is as successful as, if not more effective than, x-rays. Lung Ultrasound is more convenient, faster, and less expensive than X-rays. **Objective:** To study the utility of lung ultrasound in RDS in comparison with chest xray. **Materials And Methods:** This study was approved by the ethical committee of BLDEU SHRI BM PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA. From november 2021 to april 2022 , 70 newborns with RDS and another 70 newborns in whom lung pathology was ruled out by chest x ray were Study was done using a high-resolution linear probe with a frequency of 7.5 MHz (generally 11-12 MHz) (GE Voluson). After admission, bedside lung US examination was done by a single expert immediately. Longitudinal scan of the anterior and posterior chest walls was done by a transthoracic approach. An AP chest x-ray was done bedside on Respiratory Distress Syndrome patients immediately following the lung US, and was interpreted by a radiologist. **Results:** Consolidation, abnormalities of pleural line, white out lung (bilateral) and disappearance of A-lines were observed almost everytime in Respiratory Distress Syndrome patients and these signs were never observed in control group. Consolidation, abnormalities of pleural lines and bilateral white out lung, or consolidation, abnormalities of pleural lines and disappearance of A-lines, was found to have a sensitivity of 94.2 % and a specificity of 100 % in our study. Lung pulse detected by real-time ultrasound also confirms RDS diagnosis, with a sensitivity of 31.4 % and a specificity of 100 % for the diagnosis of neonatal respiratory distress syndrome. **Conclusion:** Respiratory Distress Syndrome is a common clinical dilemma and diagnostic evaluation becomes primarily important to know prognosis. Routinely chest radiograph is used as investigation of choice, however in our present study we have found that US findings are equally effective and accurate in achieving same target, additionally it is radiation free, can be done bedside/when baby is in incubator reducing handling, temperature variations & taking care of IV/respiratory lines. Therefore we are of opinion that US should be used routinely in neonatal care.

KEYWORDS : LUNG US, RDS, CHEST X-RAY.

INTRODUCTION:

One of the most common causes of respiratory failure and mortality in newborn infants is respiratory distress syndrome. The pathophysiology of Respiratory Distress Syndrome is immaturity in the development of the lungs causing deficiency of surfactant. With increasing gestational age and foetal birth weight, the risk of Respiratory Disease Syndrome reduces, with an incidence of 80 percent in newborns less than 28 weeks of gestation, 60 percent at 29 weeks, 15-30 percent from 32 to 34 weeks, and 5 percent at 35-36 weeks. Therefore, the Respiratory Distress Syndrome incidence is approximately 80% in infants with birthweight less than 750 grams at the time of birth and 55% for infants with birth weight 750-1000g**1.** However, with the use of antenatal corticosteroids and surfactant, incidence of RDS in premature infants has significantly declined. With increasing awareness of RDS, a more accurate diagnosis can be made in term neonates2-4. In a study conducted by Bouziri et al3 it was found that Respiratory Distress Syndrome accounts for 6.8% of cases of RDS at term or nearing term. RDS accounts for 3.6% of all term in-patients5. Clinical characteristics, ABG analysis, and chest radiographs are used to diagnose Respiratory Distress Syndrome. The diagnosis of newborn Respiratory Distress Syndrome usually does not include a lung ultrasound. Lung US has recently been utilised to diagnose a variety of lung diseases6-13 and numerous studies have found infant RDS on lung USG14-15. Lung ultrasound has been one of the most important tools in newborn point-of-care ultrasound in recent years. Several recent studies have demonstrated that US imaging is as successful as, if not more effective than, x-rays. Lung Ultrasound is more convenient, faster, and less expensive than X-rays.

MATERIALS AND METHODS:

This study was approved by the ethical committee of BLDEU SHRI BM PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA. From november 2021 to june 2022, 70 newborns with RDS and another 70 newborns in whom lung pathology was ruled out by chest radiograph were enrolled in this study, all the newborns were admitted to the Neonatal Intensive Care Unit.

Inclusion Criteria:

a)Term/preterm neonates
b) acute onset respiratory distress in first 24 hours of life
c) an acute perinatal event such as severe infection in the perinatal period, birth asphyxia, MAS (meconium aspiration syndrome) , LSCS, etc
d) clinical features of respiratory distress syndrome (dyspnea, grunting, cyanosis etc.,) or severe dyspnoea requiring CPAP support for a minimum of 72 hours
e) characteristic chest x-ray findings such as Reduced lung expansion, granular opacities, air bronchograms, GGO's, blurring of cardiac borders, white-out lungs.
f) ABG analysis showing hypoxia & hypercapnia.

Exclusion Criteria:
a)outborn babies
b) babies with congenital lung anomalies
c)babies over 24 hours old.

Methods:
Study was done using a high-resolution linear probe with a frequency of 7.5 MHz (generally 11-12 MHz) (GE Voluson). After admission, bedside lung US examination was done by a single expert immediately. Longitudinal scan of the anterior and posterior chest walls was done by a transthoracic approach. An AP chest *radiograph* was done bedside on Respiratory Distress Syndrome patients immediately following the lung US, and was interpreted by a radiologist.
US Indices used:
1) Pleural line: seen directly beneath the superficial layers of the thorax (appears as a thin hyper-reflective line) that moves during respiration; abnormalities include disappearance, opacity, or a width > 0.5 cm16.
2) A-line: the pleural line's reverberation artefacts are a sequence of hyperreflective, horizontally and parallel arranged lines at equal distances from each other beneath the pleural line.17,18.
3) B-lines: Hyperreflective artefacts with a narrow base that spread from the pleural line to the screen's edge19.
4) Lung consolidation: as hepatisation (tissue pattern) areas with air bronchograms 18,20.
5) Pleural effusion: fluid collection in the pleural space20.
6) Comet-tail artefact: an artefact that looks similar to a ring-down artefact but is more attenuated, shorter, and tapering in depth, like a comet's tail. Reverberation artefact is the mechanism that causes comet tail artefacts to form21.
7) Interstitial syndrome is described as the presence of more than three B-lines or patches of 'white lung'. 15.
8) Bilateral white lung: the presence of a compact B-line in each of the six examined areas without horizontal reverberation15.
9) Lung pulse: The early specific US sign of complete atelectasis is a form of pulsing that is synchronised with heart activity and replaces lung sliding22.

Statistical Analysis:
SPSS for Windows was used to analyse the data. Both groups' findings were compared using a Student's t test with one degree of freedom, and Fisher's exact test was used to corroborate the results. A P value of less than 0.05 was considered statistically significant.

FINDINGS:
The mean gestational age was 32 ± 2.7 weeks in Respiratory Distress Syndrome patients and 32 ±2.8 weeks in patients without RDS. The mean weight at birth was 1.63±353 gms in neonates with RDS and 1.56 ±411 gms in neonates without RDS. At the time of Ultrasound examination, the average gestational age of newborn infants was 12 +/- 3.3 hrs after birth. Prematurity, low birth weight, birth asphyxia, and maternal-fetal infections were the most common risk factors for Respiratory Distress Syndrome.

Table 1 General Information

Group	GA(mean)	Birthweight(mean)	Gender(m/f)	Grade of RDS on CXR			
				Grade I	Grade II	Grade III	Grade IV
Preterm (n=58)	30±4 weeks	1.2kgs ±420g	22/36	2 cases	25 cases	25 cases	6 cases
Term (n=12)	37±1 weeks	2.0kgs ±220g ms	3/9	2 cases	5 cases	5 cases	0 cases
RDS (n=70)	32 ±2.7 weeks	1.63± 353 g	25/45	4 cases	30 cases	30 cases	6 cases
Controls (n=70)	32 ±2.8 weeks	1.56 ±411 g	22/48	NORMAL			

DISCUSSION:
Ultrasound Findings In Respiratory Distress Syndrome Patients
Consolidation with air bronchograms was seen in all the (94.2%) infants with RDS, which was mostly localised to the subpleural region in RDS (graded II on chest x-ray) and in few cases air bronchograms were not seen .In severe Respiratory Distress Syndrome (graded III~IV on chest x-ray) consolidation was seen involving even the deep lung parenchyma. Also the air bronchograms were more evident in neonates with severe Respiratory Distress Syndrome. Bilateral white out lung was observed in 94.2% of Respiratory Distress Syndrome neonates. Abnormality of pleural lines (thickened / blurred pleura) was seen in 94.2% of patients with Respiratory Distress Syndrome.Disappearance of A lines in 94.2% of RDS patients. Lung pulse was observed in 18 grade III to IV Respiratory Distress Syndrome patients (36 cases) and 4 grade II Respiratory Distress Syndrome (30 cases)

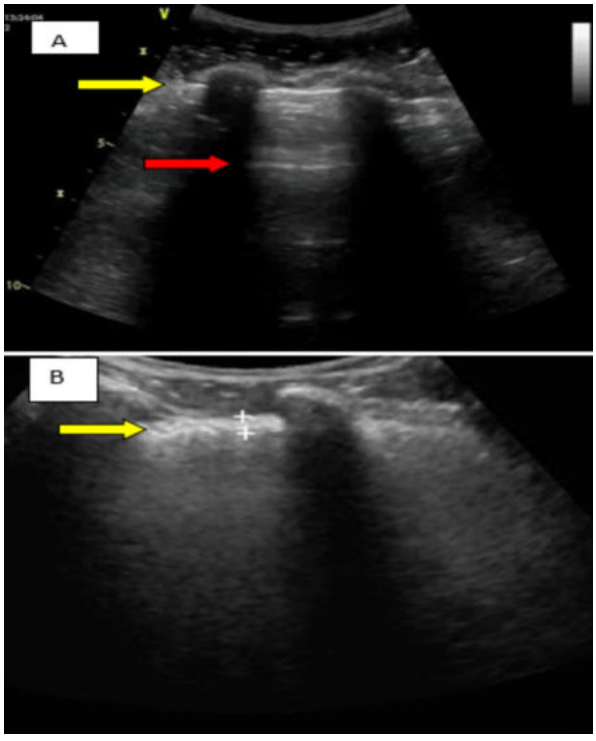

Fig 1: Pleural Line (Arrow), Normal (a) – Note the Reverberation artifacts from the pleural line – A lines – Red Arrow, Thickened and irregular in RDS patient (b).

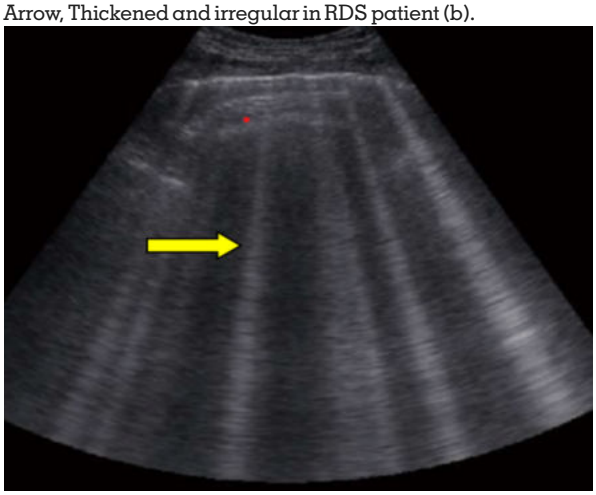

Fig 2: B lines.

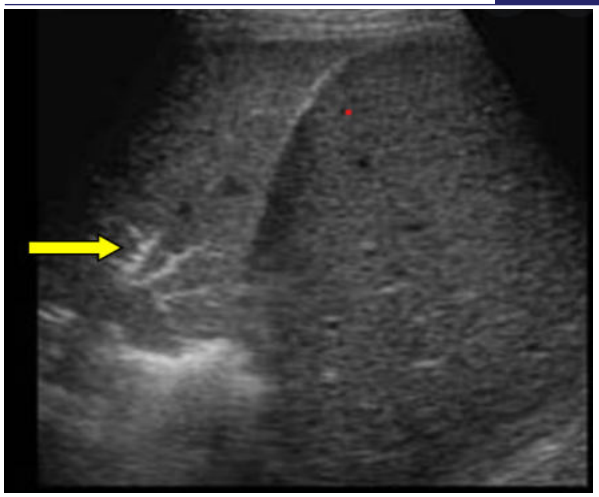

Fig 3: Hepatisation Of Right Lower Lobe (suggestive Of Consolidation) With Multiple Linear Hyperechoic Areas Suggestive Of Air Bronchograms.

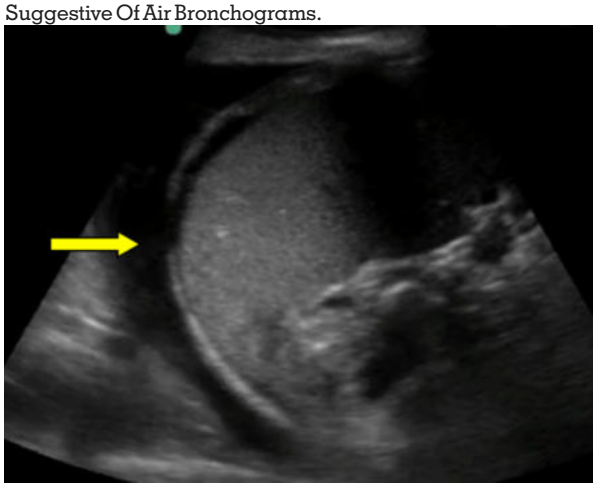

Fig 4: Mild to moderate left pleural effusion.

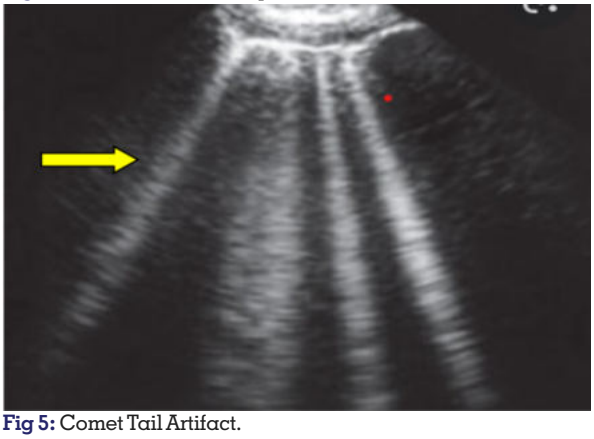

Fig 5: Comet Tail Artifact.

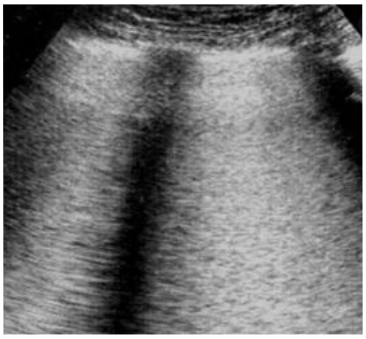

Fig 6: White lung in a case of Neonatal RDS

Table- 2 Distribution Of Findings In USG In Two Groups

USG Findings	RDS group (n=70)	Non-RDS (control) group (n=70)	P Value
Consolidation	66	0	< 0.001
Pleural Effusion	0	0	< 0.001
A-Line	4	70	< 0.001
B-Line	4	20	< 0.001
Lung Pulse	22	0	< 0.001
Interstitial syndrome	70	0	< 0.001
Pleural Line abnormality	66	0	< 0.001
Bilateral white out lung	66	0	< 0.001

The Sensitivity And Specificity Of Ultrasonography Signs:

Consolidation, abnormalities of pleural line, white out lung (bilateral) and disappearance of A-lines were observed almost everytime in Respiratory Distress Syndrome patients and these signs were never noted in control group. Consolidation, abnormalities of pleural lines and bilateral white out lung, or consolidation, abnormalities of pleural lines and disappearance of A-lines, was found to have a sensitivity of 94.2 % and a specificity of 100 % in our study. Lung pulse detected by real-time ultrasound also confirms RDS diagnosis, with a sensitivity of 31.4 % and a specificity of 100 % for the diagnosis of neonatal respiratory distress syndrome.

Table 3 Consolidation, Abnormalities Of Pleural Line And Bilateral White Out Lung For The Diagnosis Of Neonatal Respiratory Distress Syndrome (Sensitivity And Specificity).

	RDS (n=70)	Control (n=70)	Total
With 3 signs	66 (a)	0(b)	66
Without 3 signs	4(c)	70(d)	74
Total	70 (a+c)	70(b+d)	140

Table 4 - Consolidation,abnormalities Of Pleural Line And Disappearance Of A-line For The Diagnosis Of Neonatal Respiratory Distress Syndrome (sensitivity And Specificity).

	RDS(n=70)	Control (n=70)	Total
With 3 signs	66(a)	0(b)	60(a+b)
Without 3 signs	4 (c)	70(d)	74(c+d)
Total	70 (a+c)	70(b+d)	140

CONCLUSION:

Respiratory Distress Syndrome is a common clinical dilemma and diagnostic evaluation becomes primarily important to know prognosis. Routinely chest radiograph is used as investigation of choice, however in our present study we have found that US findings are equally effective and accurate in achieving same target, additionally it is radiation free, can be done bedside/when baby is in incubator reducing handling, temperature variations & taking care of IV/respiratory lines. Therefore we are of opinion that US should be used routinely in neonatal care.

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