Original Research Article

Role of ultrasonography done in first few minutes of life of newborn delivered by caesarean section in anticipating risk of respiratory distress

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Abstract

Background: Newborn babies delivered by caesarean section (CS) have a higher incidence of respiratory distress and NICU admissions compared to those delivered vaginally, primarily due to a delayed and insufficient lung liquid clearance due to absence of normal birth stress. So it is imperative that any health care practitioner caring for newborn infants can readily recognize the signs and symptoms of respiratory distress, and initiate management strategies to prevent significant complications or death. **Aims and Objectives:** The aim is to evaluate reliability of LUS performed in first few minute after delivery in predicting admission to the NICU for respiratory distress in full term, late preterm infants delivered by CS. **Material and Methods:** Prospective observational study of neonates delivered by CS in KBN Hospital from December 2018 to September 2019 was done. The criteria for respiratory distress set .LUS was carried out in the first 30 minutes of life (T0) directly in the delivery room, with infants supine, Second check was performed 4 hours after birth (T1).A USG machine equipped with a high frequency linear array probe use 3 point scale by Raimondi was used for scoring of each lung and classified in 3 types based on image patterns that reflect the presence of fluid accumulation in the alveolar-interstitial space. Results were obtained using appropriate statistical methods. **Results:** Significant association between admission to the NICU and the LUS score at T0 (p: 0.002) noted. **Summary and Conclusion:** LUS performed in the first 30 minutes of life is a safe ,reliable tool in predicting hospitalization for respiratory distress, the need of non-invasive ventilation in newborns delivered by CS .This can be extremely useful in small and peripheral birth centers, to identify patients who may need intensive cares that should be transferred to more specialized centers equipped with NICU.

Keywords: Caesarean Section (CS), Lung Ultrasound (LUS), Neonatal Intensive Care Unit (NICU), Respiratory Distress Syndrome (RDS)

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INTRODUCTION

Respiratory distress is one of the most common reasons an infant is admitted to the neonatal intensive care unit[1]. Fifteen percent of term infants and 29% of late preterm infants admitted to the neonatal intensive care unit develop significant respiratory morbidity; this is even higher for infants born before 34 weeks' gestation[2].Certain risk factors increase the likelihood of neonatal respiratory disease. These factors include prematurity, meconium-stained amniotic fluid (MSAF), caesarean section delivery, gestational diabetes, maternal

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chorioamnionitis, or prenatal ultrasonographic findings, such as oligohydramnios or structural lung abnormalities. However, predicting which infants will become symptomatic is not always possible before birth. Regardless of the cause, if not recognized and managed quickly, respiratory distress can escalate to respiratory failure and cardiopulmonary arrest. Therefore, it is imperative that any health care practitioner caring for newborn infants can readily recognize the signs and symptoms of respiratory distress, differentiate various causes, and initiate management strategies to prevent significant complications or death. Newborns delivered by caesarean section (CS) have a higher incidence of respiratory distress and NICU admissions compared to those delivered vaginally, primarily due to a delayed and insufficient lung liquid clearance caused by the absence of normal birth stress [1-3].Lung ultrasound (LUS) is a safe and valid method to assess lung liquid content through detection and quantification of the "B-lines", hyperechoic vertical comet-tail artifacts originating from the pleural line that reflect the presence and the entity of fluid accumulation in the alveolar-interstitial space [4-8].

METHODOLOGY

Prospective time bound observational study done on neonates delivered by caesarean section (either elective or emergency) in Khaja Banda Nawaz Teaching and General Hospital, Kalaburagi, Karnataka in a period from December 2018 to September 2019.

Inclusion Criteria: Neonates born by caesarean section

Exclusion criteria: Infant with prenatal diagnosis of fetal anomaly.

The criteria for the definition of respiratory distress were breath rate >60 breaths/minute associated with at least one other symptom such as tachycardia (heart rate > 160 bpm), chest wall or jugular retractions, nasal flaring, expiratory grunting and hypoxia (SpO2 < 85% in room air) [1]. Umbilical-cord blood gas analysis (pH and Base Excess) and O2-Saturation (Sat-O2) were included in the clinical evaluation. To predict the risk of hospitalization we considered also: Gestational Age (GA), Birth Weight (BW), intra-uterine growth restriction (IUGR), sex, Apgar score (1 minute and 5 minutes after birth), type of caesarean delivery (elective or in urgency), type of pregnancy (single or twin pregnancy) and presence of gestational diabetes. LUS was carried out in the first 30 minutes of life (T0) directly in the delivery room, with infants in supine position in the incubator. The operator was blinded to the clinical status of the patient. A second check was performed 4 hours after birth (T1). All examinations were performed using a GE LOGIQ series Ultrasound Machine equipped with a curvilinear and linear array probe. We divided each hemitorax into 4 areas delimited by parasternal, anterior and posterior axillary lines: antero-superior / antero-inferior / lateral-superior / lateral-inferior. We did not examine posterior areas of the chest to minimize the handling of the infants. Longitudinal (probe perpendicular to the ribs) and transversal (probe parallel to the ribs) scans of each zone were obtained. We assigned a score to each lung using a three-point scale adapted from a previously validated score by Raimondi *et al*. and based on the presence and density of B-lines, hyperechoic vertical comet-tail artifacts that reflect the presence and the entity of fluid accumulation in the alveolar-interstitial space [4-5].

Each lung was classified as:

"Type 1": uniform hyper echoic appearance of the lung caused by the presence of coalescent B-lines (White Lung) [Fig.1];

"Type 2": characterized by numerous non compact B-lines (Black and White lung) [Fig.2];

"Type 3": normal aerated lung, without B-lines and with the presence of A-lines, horizontal hyperechoic lines parallel to the pleural line (Black lung) [Fig.3].

Patients were then classified in 5 different profiles based on the appearance of both lungs:

A (both lungs type 1), B (one lung type 1), C (both lungs type 2),

D (one lung type 3), E (both lungs type 3).

Statistical Analysis

Statistical analysis was performed using the IBM software SPSS Statistic v.20. The univariate relation between hospitalization and possible predictive factors of admission to the NICU was assessed using the Chi Square test for categorical data and the Students t test for continuous variables. Then, multivariate logistic regression analysis was performed, using hospitalization as dependent variable and the significant variables identified on univariate analyses as independent variables. In all tests p values < 0.05 were considered statistically significant.

We defined as "True Positive" (TP) all infants with Profile A and B (ie total LUS score 2.5) admitted to the NICU, "False Positive" (FP) infants with Profile A and B who did not required admission to the NICU, "True Negative" (TN) infants with Profile C, D and E (ie total LUS score < 2.5) who did not required hospitalization, and "False Negative" (FN) infants with Profile C, D and E admitted to the NICU. Sensitivity is defined as TP/(TP +FN), Specificity as TN/(TN+FP); Positive Predictive Value (PPV) is defined as TP/(TP +FP) and Negative Predictive Value (NPV) as TN/(TN+FN).

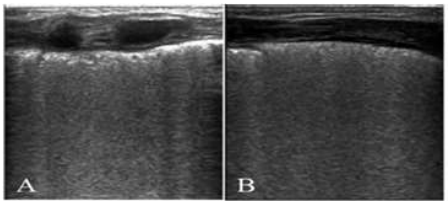

Figure 1

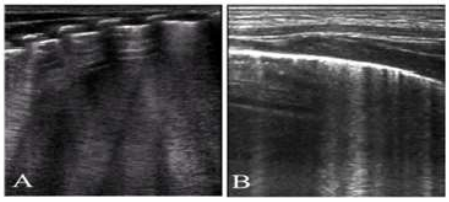

Figure 2

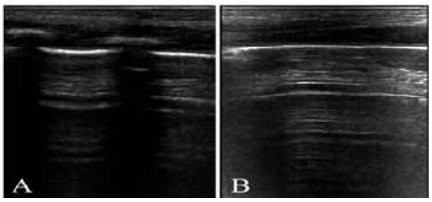

Figure 3

Figure 1: Longitudinal (A) and transversal (B) scan of "Type 1" lung, characterized by uniform hyper echoic appearance caused by the presence of coalescent B-lines with irregular thickening of th/e pleural line (White Lung); **Figure 2:** Longitudinal (A) and transversal (B) scan of "Type 2" lung, characterized by numerous non compact B –lines (Black and White Lung); **Figure 3:** Longitudinal (A) and transversal (B) scan of "Type 3" lung, without B-lines and with the presence of A-lines, horizontal hyper echoic lines parallel to the pleural line, that is normal (Black lung)

RESULTS

A total of 100 newborns (51 male / 49 female; 12 twins) were enrolled in the study, 86 delivered by elective CS and 14 delivered by emergency CS. 7 infants were admitted to the NICU in the first hours of life for respiratory distress and treated with nCPAP for at least 24 hours.The mean time point of the first clinical and echographic evaluation (T0) was 14.4 ± 0.2 minutes (range: 6 - 28 minutes).Gestational age was between 33w+6d and 41w+4d (mean GA 38w+2d ± 1w+6d): 86 infants were full-term (GA > 37 weeks) and 14 infants were late preterm (GA > 33w+6d and <36w+6d).85 infants had a birth weight >2500 gram and 15 infants <2500 gram; 20 were classified as having IUGR (birth weight <10 percentile for gestational age). 16% of pregnancies were complicated by gestational diabetes, but none of the children born to diabetic mothers was admitted to the NICU. Demographic characteristics and clinical features of the study population are summarized in tables 1 and 2.Among the demographic characteristics only BW was significantly related to the admission to the NICU (p:0.001); GA, type of CS and presence of gestational diabetes were not significantly associated to hospitalization. At T0 22 infants (22%) showed clinical signs of respiratory distress, 18 were treated with free-flow O2 in the incubator and, among these, 5 infants were hospitalized for worsening of the respiratory status. Other 2 neonates, without significant symptoms at T0, developed respiratory distress later and were admitted to the NICU.We found significant correlation between admission to the NICU and Sat-O2 at T0 (p:0.002), and presence of clinical signs of distress at T0 (p:0.005).

DISCUSSION

LUS evaluation

Results of the LUS assessment are summarized in table 3.At T0 patients were classified as follows: 5 Profile A, 6 Profile B, 62 Profile C, 10 Profile D and 17 Profile E. All infants classified as Profile A were admitted to the NICU and treated with nCPAP for at least 24 hours; only one patient with Profile B and one with Profile C were hospitalized. We found a significant association between admission to the NICU and the LUS score at T0 (p: 0.002). Subsequently the significant variables in the univariate analysis were put in the multivariate analysis, excluding BW that is influenced by the presence of late preterm infants. We found that a LUS score 2.5 (Profiles A and B) was the only variable significantly associated with the admission to the NICU, with a sensitivity of 85.7% and specificity of 94.6%; the corresponding PPV and NPV were 54.5% and 98.9%.Since all false positives were Profiles B, we recalculated sensitivity and specificity considering as true positives only infants with Profile A, that showed a sensitivity and specificity respectively of 100% and 71.4% in predicting admission to the NICU for respiratory distress, with corresponding PPV and NPV respectively of 100% and 97.8%; thus Profile A at T0 is strongly associated with hospitalization.

Table 1: Demographic characteristics of the study population

	All PATIENTS(100)	NICU PATIENT (7)	p VALUE
GESTATIONAL AGE	38 w+2 ± 1w +6	35 w +4 ±1w+6	
BETWEEN 33 W + 6 and 36W + 6	14	5	ns
BETWEEN 37 W and 41W+4	86	2	
BIRTH WEIGHT	2965 ±504 grams	2203±606 grams	
<2500 GRAMS	15	5	0.001
>2500 GRAMS	85	2	
IUGR	20	0	ns
SEX			
MALE	51	6	ns
FEMALE	49	1	

APGAR SCORE			
-1 MIN	8.9± 0.5	8.2±1.2	ns
-5MIN	9.7± 0.2	9.7±0.4	
PREGNANCY			
Single	88	5	ns
Twin	12	2	
GESTATIONAL DIABETES	16	0	ns

Table 2: Clinical features of the study population

	All patients	NICU	Other	p Values
Umbilical cord blood gas analysis				
pH	7.28± 0.10	7.33±0.11	7.28±0.10	ns
BE	2.18±2.6	-1±0.7	-2.2±2.6	ns
SAT -O_2	97.1±1.7	95.2±1.6	97.3±1.6	0.002
Clinical sign of distress at T0	22	6	16	0.005
Clinical sign of distress at T1	11	6	5	Ns

Table 3: LUNG ULTRASOUND ASSESSMENT AT T0 AND T1

	ALL PATIENTS	NICU PATIENTS	OTHERS	P VALUES
LUS at T 0	**100**	**7**	**93**	0.002
PROFILE A	5	5	0	
PROFILE B	6	1	5	
PROFILE C	62	1	61	
PROFILE D	10	0	10	
PROFILE E	17	0	17	
LUS AT T1	**100**	**7**	**93**	
PROFILE A	0	0	0	
PROFILE B	0	0	0	ns
PROFILE C	31	6	25	
PROFILE D	16	0	16	
PROFILE E	53	1	52	

CONCLUSION

LUS performed in the first 30 minutes of life is a safe and reliable tool in predicting hospitalization for respiratory distress and the need of non-invasive ventilation in newborns delivered by CS. This can be extremely useful in small and peripheral birth centers, to identify patients who may need intensive cares and that should be transferred to more specialized centers equipped with NICU.

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