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Original Article OPEN ACCESS

Bedside Prediction of Neonatal Pulmonary Maturity by Single Step Gastric Aspirate Shake Test

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Abstract

Introduction: *Respiratory distress syndrome occurs primarily in preterm neonates. Such a baby may need advanced support like NICU admission for ventilation. Preterm LBW is a common problem in our country. Available few centers cannot accommodate all preterm LBW babies. So early prediction of RDS by a simple tool may help to decide whether a baby needs NICU admission for ventilation or not and early referral from a low-facility hospital would be possible.*

Aims: *To assess the reliability of gastric aspirate shake test in predicting respiratory distress syndrome in newborns immediately after birth.* ***Materials and Methods:*** *This prospective study was conducted in the Department of Gastroenterology, Bangabandhu Sheikh Mujib Medical University (BSMMU) and Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh, from September 2009 to May 2010. We included 60 inborn neonates who were admitted to BSMMU and DMCH. Of all the newborns, 30 were pre-term and 30 were term.* ***Results:*** *In this study, we found that 75% of preterm neonates with a negative shake test (9 out of 12) developed RDS, and 50% of preterm neonates with an intermediate result (2 out of 4) developed RDS. None of the 14 preterm neonates with a positive shake test developed RDS. None of the term neonates developed RDS.* ***Conclusion:*** *It can be concluded that the gastric aspirate shake test is a simple, inexpensive, non-invasive, and reliable test. It can be an excellent beside tool for predicting respiratory distress syndrome in newborns immediately after birth.*

Keywords: *Single Step Gastric Aspirate Shake Test, Neonates, Bedside Prediction, Pulmonary Maturity.*

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Introduction:

Premature infants are most affected by respiratory distress syndrome (RDS), which has a negative correlation with both birth weight and gestational age. It affects 60–80% of newborns born before 28 weeks, 15–30% of those born between 32 and 36 weeks, about 5% of those born beyond 37 weeks, and very rarely at term[1]. RDS is primarily caused by a lack of surfactant, which is frequently made worse by an excessively compliant chest wall[2]. The search for tests for fetal lung maturity began with an estimation of the lecithin/sphingomyelin (L/S) ratio in amniotic fluid[3-5]. However, estimation of the L/S ratio has to be done by thin-layer chromatography which is an expensive and slow technique and needs trained personnel[6]. Biochemical tests for measuring phosphatidylglycerol (PG) levels or immunoassays for surfactant-associated proteins and other proteins require technical skill and are expensive[7,8,9]. Foam stability test or 'shake test' with amniotic fluid is simple, and economical with high sensitivity and specificity but could only be performed in centers where amniocentesis is available [10,11]. The gastric aspirate shake test was the 1st clinical postnatal test to identify immaturity of the lungs[12]. The foam stability test on gastric

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aspirate is a valid indicator of prenatal lung maturity in newborns whose amniotic fluid is not v. lable[13]. Other studies also established that the shake test used with aspirate may be used as a predictor of idiopathic respiratory distress syndrome[14-16]. Studies of gastric aspirate shake test (GST) in India resulted in the Camplification of the test to a single tube dilution method. They demonstrated the overall usefulness of GST for predicting respiratory distress syndrome[6,17-19]. A rapid bedside test to identify neonates who are surfactant deficient would have clinical and economic benefits. The importance of identifying infants with surfactant deficiency as soon as possible after delivery, to facilitate their early transfer to a neonatal intensive care unit for entilator support and early surfactant therapy[20,21]. Surfactant administration prophylactically also has benefits compared with rescue surfactants given to infants with established RDS[22-24].

A simple and reliable test of pulmonary maturity in the newborn infant at risk would therefore be of great value. One recent Iranian study concluded that the gastric aspirate shake test is a rapid and simple procedure to rule out RDS and surfactant requirements[25]. Data on the single-step shake test on gastric aspirate in the rapid evaluation of pulmonary surfactant maturity at birth in Bangladesh is not available. Therefore, the present study was undertaken on newborns to assess the reliability of the single-step shake test.

Materials and Methods:

This prospective study was conducted in the Department of Gastroenterology, Bangabandhu Sheikh Mujib Medical University (BSMMU) and Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh, from September 2009 to May 2010. We included 60 inborn neonates who were admitted to BSMMU and DMCH. Of all the newborns, 30 were pre-term and 30 were term. These are the following criteria to be eligible for enrollment as our study participants:

Inclusion criteria were -All inborn neonates both admitted and non-admitted in BSMMU and DMCH within the study period and -Parents who were willing to participate were included in the study. **Exclusion criteria were** - Outborn babies, Failure to collect gastric aspirate within 30 min of birth, Any oral feeding is given before the collection of the sample, Infants with meconium or blood-stained gastric aspirate and Infants with any history of acute illness (e.g., renal or pancreatic diseases, ischemic heart disease, asthma, COPD etc.) were excluded from our study.

Data Collection: This study was done by the researcher himself. After obtaining informed written consent from parents or legal guardians a detailed history and careful physical examination were done. Within 30 min of birth 0.5 ml gastric aspirate was collected through a 6 gauge nasogastric tube into a test tube then after mixing of equal quantity of normal saline the solution was shaken vigorously for 10 sec. Then 1 ml of 95% ethanol was added and again shaken for 15 sec. Then the test tube was kept in a vertical position for 15 min and the air-liquid interface was examined for the presence of small bubbles[6]. The test was taken as (a) Positive (Surface when bubbles covered more than 2/3rd of the liquid surface) ;(b) Intermediate (when bubbles covered 1/3rd to 2/3rd of the liquid surface); (c) Negative (when bubbles covered less than 1/3rd of the liquid surface)6. The babies were closely monitored for their respiratory status during 1st 24 hours after birth. The infants were diagnosed as RDS when she/he had met 5 of the 6 following criteria[6,18] –

1. Preterm infant (< 37 weeks)
2. Respiratory rate 260/min within 4 hours of birth.
3. Intercostal recession and substernal retraction.
4. Grunting
5. Cyanosis in room air and
6. X-ray chest compatible with RDS.

For all infants suspected to have RDS, complete blood count, blood film, IT ratio, and blood culture were done to exclude early-onset neonatal sepsis. Gestational age was assessed from a menstrual history of the mother, USG of pregnancy profile report (optional), and was confirmed by an expanded New Ballard Scoring system.

Statistical Analysis: All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. The differences between groups were analyzed by the chi-square (X2) test and Fisher's exact test. A p-value <0.05 was considered as significant. Statistical analysis was performed by using SPSS 16 (Statistical Package for Social Sciences) for Windows version 10. The study was approved by the Ethical Review Committee of Bangabandhu Sheikh Mujib Medical University & Dhaka Medical College Hospital.

Results:

Table I: Characteristics of our study neonates (n= 60)

Characteristics	Mean±SD	Range (Min-Max)
Gestational age (weeks)	34.2±3.2	(27-42)
Birth weight (gm)	1890.2±710.6	(800-4090)
APGAR Score at birth	8.2±1.4	(1-9)
	Number (Percentage)	
Male	38(63.3%)	
Preterm	30(50%)	
Caesarean Section	33(55%)	
SGA	15(25%)	
H/O maternal DM	10(16.6%)	
H/O leaking membrane	9(15%)	
H/O preeclampsia of mother	32(53.3%)	
H/O antenatal corticosteroids	13(21.6%)	

Table I shows the mean gestational age was 34.2±3.2 weeks, birth weight was 1890.2±710.6 gm, and APGAR score was 8.2±1.4 at birth. Among all neonates, males were 63.3%, preterm (50%), delivered by LUCS (55%), SGA (25%), had H/O maternal DM (16.6%), H/O leaking membrane (15%), H/O preeclampsia of mother (53.3%) and H/O receiving antenatal corticosteroids (21.6%).

Table II: Characteristics of Preterm neonate with and without RDS (n=30)

Characteristics	RDS (n=11)	Non-RDS (n=19)	P-value
Gestational age (weeks)	30.1±1.3	32.8±2.6	[a]0.0015[S]
Birth weight (gm)	1489.3±352.1	1780.2+433.7	[a]0.0495[S]
APGAR Score at birth	6.2±2.2	7.9±1.98	[a]0.036[S]
Male	8(72.7%)	9(47.3%)	[b]0.166[NS]
Caesarean Section	7(63.6%	9(47.3%)	[b]0.389[NS]
SGA	3(27.2%)	8(42.1%)	[b]0.341[NS]
H/O maternal DM	4(36.3%)	2(10.5%)	[b]0.110[NS]
H/O leaking membrane	1(9%)	3(15.7%)	[b]0.530[NS]
H/O preeclampsia of mother	3(27.2%)	15(78.9%)	[b]0.001[S]
H/O antenatal corticosteroids	2(18.1%)	6(31.5%)	[b]0.362[NS]

Table II shows gestational age and birthweight were significantly different between RDS and non-RDS groups. However other parameters were not significantly different except the APGAR score at birth and H/O preeclampsia of the mother.

Table Ill: Results of single-step gastric aspirate shake test and development of RDS in neonate according to gestational age

	Term(n=30)		Preterm (n=30)		P -value
	n	%	n	%	
Shake test					
Positive	25	83.3	14	46.6	0.01s
Intermediate	2	6.6	4	13.3	
Negative	3	10	12	40.0	
RDS					
Positive	0	0.0	11	36.6	0.001s
Negative	30	100.0	19	**63.3**	

Table III shows that shake test results and development of RDS were significantly different in the Term and Preterm groups. The shake test shows positive results in 83.3% & 46.6% of neonates in term & preterm groups respectively.

Table IV: Result of shake test (n=60)

	RDS		Other respiratory distress		No respiratory distress		Total	
All neonates (n=60)	n	%	n	%	n	%	n	%
Negative	9	60.0	4	26.6	2	13.3	15	100
Intermediate	2	33.3	2	33.3	2	33.3	6	100
Positive	0	0.0	6	15.3	33	84.6	39	100
Preterm (n=30)								
Negative	9	75.0	3	25.0	0	0.0	12	100
Intermediate	2	50.0	2	50.0	0	0.0	4	100
Positive	0	0.0	5	35.7	9	64.3	14	100
Term (n=30)								
Negative	0	0.0	1	33.3	2	66.7	3	100
Intermediate	0	0.0	0	0.0	2	100.0	2	100
Positive	0	0.0	1	4.0	24	96.0	25	100

The table shows that among all neonates, shake test positive resultants had 0% RDS, among the intermediate resultants, 33.3% developed RDS, and among negative resultants, 60% developed RDS. But in the case of preterm neonates, it was 0%, 50%, and 75%, respectively. No term neonates developed RDS.

Table V: Relation between gastric aspirate shake test and RDS in predicting lung maturity in studied neonates (n=60)

Gastric aspirate shake test	RDS		Total
	Disease positive	Disease negative	
Positive	**0**	**39**	**39**
Others (Intermediate +Negative)	**11**	**10**	**21**
Total	**11**	**49**	**60**

Table V shows that none of the 39 shake test-positive neonates developed RDS in our study. Other (Intermediate and negative) neonates developed 11 cases of RDS out of 21.

Discussion:

This study confirms the usefulness of a single-step gastric aspirate shake test for assessing pulmonary maturity at birth. This study reveals no term neonate-developed RDS. A similar observation has been made by other studies[6,18]. Among term neonates, 83.3% of them were shake test positive in contrast to 46.6% in preterm neonates which is statistically significant (p-value 0.01). On the contrary preterm babies were 40.0% shake test negative in contrast to 10.0% in term neonates which is also statistically significant (p-value 0.01). Among term neonates only 3 presented with a shake test negative but they did not develop RDS. Only 2 neonates in the term group developed respiratory distress (one transient tachypnoea of a newborn and another neonate in the term group showed meconium aspiration syndrome). Only intermediate result in gastric aspirate shake test none of them developed RDS or other respiratory distress. Parekh et al, and Teeratakulpisarn et al also showed similar observations[6,26]. On the other hand, 40.0% in the preterm group showed shake test negative, 13.3% intermediate, and 46.6% positive. No neonates with positive shake test developed RDS (mentioned earlier) but 2 patients developed early onset neonatal sepsis and 3 patients developed TTN. Among neonates with intermediate results, all 4 developed respiratory distress (2 developed RDS and another 2 early onset neonatal sepsis). Out of 12 negative shake tests, baby 9 developed RDS, 1 developed transient tachypnea of the newborn, and 2 developed early onset neonatal sepsis. In contrast, 75% of shake test-negative neonates developed RDS, and 25% did not develop RDS in the preterm group. A similar observation was also found by Arya, Skelton, and Transwell[14,18,27]. This false negative gastric aspirate shake test in neonates (shake test negative but did not develop RDS) may be due to over-dilution of surfactant by excessive gastric juice in the stomach[18]. Serial gastric aspirate shake test may reduce such false negative results[14]. This same explanation is also applicable for term neonates with false negative gastric aspirate shake tests. In the preterm neonate group, it was difficult to predict the outcome from intermediate results as 50% of intermediate resultants (2 out of 4) developed RDS, and 50% did not develop. This observation is similarly found in Parekh and Chaudhari studies[6,19]. Repeat gastric aspirate shake test may resolve this difficulty both in term and preterm groups. To predict RDS, it might be best to regard an intermediate test result as negative in the preterm group[19].

Conclusion and recommendations:

In our study, we found that no term neonates developed RDS. Gastric aspirate shake test-positive neonates also had not developed RDS in both term and preterm groups. Respiratory distress syndrome was correctly predicted in 9(75%) out of 12 preterm babies with a negative shake test and 2 (50%) babies out of 4 preterm babies with an intermediate result developed RD. Our findings also found

that this extremely simple, inexpensive, quick, reproducible, and non-invasive but useful test can help to decide whether the neonate needs NICU admission for ventilation or not, and early referral from a low-facility hospital would be possible. So further study with a prospective and longitudinal study design including a larger sample size needs to be done to validate the findings of our study.

Conflict of Interest: None.

Ethical approval: The study was approved by the Institutional Ethics Committee.

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