Amniotic Fluid Turbidity via Ultrasound before 34 Weeks of Pregnancy and Neonatal Outcomes

Wael Soliman Taha
Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Samir Khamis Galal
Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Sameh Mohammed Alshawaf Moghazy
Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt,
Samehshawwaf2015@gmail.com

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Wael S. Taha, Samir Khamis Galal, Sameh M. A. Moghazy *

Department of Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: Amniotic fluid (AF) is a multifaceted biofluid that indicates the fetal condition throughout evolution. Indirectly, the turbidity of AF is reflected in the echogenicity, which is determined by the particulate size, number, and distribution within the AF.

Aim and objectives: To find the relation among amniotic fluid turbidity before 34 weeks of pregnancy detected via ultrasound and neonatal outcomes.

Subjects and methods: This cross-sectional research was carried out on 100 pregnant women with gestational age before 34 weeks without any medical and obstetric complications at the Department of Gynecology and Obstetrics, El-Sayed Galal Hospital, Al-Azhar University, during the period from January 2022 to June 2023.

Results: There was a significantly lower AF brightness, BPD, FL, HC, AC, and BPP in the group who developed RD and needed NICU admission than the group without RD. No significant variation was found among groups regarding maternal age, BMI, GA at assessment, maternal EBW, birth weight, AFI, and APGAR score at 1stand 5th min. ROC curve analysis revealed that at cutoff point 16.5, AF brightness levels have a sensitivity of 91.4% and specificity of 93.3% for predicting NICU admission/RD in neonates.

Conclusion: Measuring the brightness of the amniotic fluid using ultrasonography may be a simple and objective way to determine whether or not a newborn has neonatal RDS. Gestational age was substantially associated with AF brightness and neonatal outcome in the present analysis.

Keywords: Amniotic Fluid Turbidity, Ultrasound, Pregnancy, Neonatal Outcomes

1. Introduction

The ultimate goals of antepartum monitoring programs are improvements in perinatal outcomes, reductions in intrauterine fetal death, and reductions in maternal and neonatal morbidity and mortality. [1]

Amniotic fluid (AF) is a multifaceted biofluid that provides insight into the health of the developing fetus. Liquid that is usually clear to pale yellow that surrounds a developing fetus in the amniotic sac. Many different components from the mother and the developing baby make it into AF. The pH and specific gravity of the AF vary from 1.0069 to 1.008 on average, depending on the gestational age. Previously assumed to only supply the fetus with the necessary space for mobility and growth, amniotic fluid is today recognized as a highly sophisticated and dynamic system that can be used as a data point to assess fetal well-being. [2,3]

Due to the prevalence of amniotic fluid anomalies (about seven percent of all pregnancies), measuring amniotic fluid is now standard practice. Ultrasound is the most simple, straightforward, familiar, non-invasive, and cost-effective method for routine obstetric scanning . [4]

Evaluation of the amniotic fluid index, subjective assessment, and measurement of the sole deepest vertical pocket are the three methods that can be utilized to determine the amount of amniotic fluid during a routine ultrasound scan. Visualizing amniotic fluid compartments during an ultrasound is subjective .[5]

Sonographic estimation of amniotic fluid volume (AFV) is an important aspect of antenatal testing because it can help determine the health of the fetus. [6]

The turbidity of AF is indirectly represented by the echogenicity, which is determined by the particle size, number, and distribution within AF. This may result in detecting echogenic particles by ultrasound, also called AF sediment, or the appearance of a uniformly echogenic AF. An example of "sludge" is a compacted mass of particulate matter. Around four percent of those with AF have this type of particulate matter detected by ultrasound in the first and second trimesters .[7]

The objective of the work was to find a relation between amniotic fluid turbidity detected via ultrasound before 34 weeks of pregnancy and neonatal outcomes.

2. Patients and methods

This cross-sectional trial was conducted at the Department of Gynecology and Obstetrics, El-Sayed Galal Hospital, Al-Azhar University, from January 2022 to June 2023. One hundred pregnant women were involved in the research, all of whom had ultrasonographic evidence of echogenic fluid and were enrolled before 34 weeks of gestation.

Sample Size(n):

This study is based on the study carried out by MISGANA et al. The sample size was measured utilizing Epi Info STATCALC, considering the following assumptions: The study utilized a 95% two-sided confidence level and a power of 80%, with a margin of error of 5%. The ultimate maximum sample size extracted from the Epi-Info output was 85. Therefore, the sample size was augmented to include 100 cases to account for any drop out throughout the follow-up period .[8]

$$\left(\frac{Z_{a/2} + Z_B}{P_1 - P_2} \right)^2 (p_1 q_1 + p_2 q_2)$$

Takazawa & Morita [9]

n = sample size

Z a/2 (The crucial number that demarcates the center 95% of the Z distribution)

ZB (The crucial number that demarcates the center 20% of the Z distribution)

p1 = prevalence in NICU group

p2 = prevalence in the No NICU group.

q = 1-p

Inclusion criteria: Patients who were sure of their last menstrual period (LMP). Singleton pregnancy, Gestational age ≤ 34 weeks of pregnancy, and Amniotic fluid index (AFI) between 8 and 15 cm. Ultrasound documented echogenic liquor (turbid amniotic fluid).

Exclusion criteria: Multiple gestation, Gestational age > 34 weeks, any congenital anomaly in the fetus, Oligohydramnios or polyhydramnios, fetal hydrops, and Preterm prelabour rupture of membranes (PPROM). Any medical or obstetric complication of pregnancy

2.1.Method

All participants were subjected to Complete history taking (Personal, Present, Medical, Past Surgical, Menstrual, LMP, and obstetrics history), Physical examinations (General, Abdominal, Abdominal obstetric, vaginal, and pelvic examination), and Investigational Studies (Routine laboratory and Radiological investigation).

Abdominal ultrasonographic examinations (before 34 weeks) by Ge Volson p8: The abdominal ultrasonographic examinations performed before 34 weeks of pregnancy involved a 3.5-5 MHz transabdominal probe. These examinations aimed to assess various aspects of fetal well-being and development. These were the parameters typically evaluated during these ultrasounds (Fetal et al. including: (Biparietal Diameter (BPD), Abdominal Circumference (AC), Femur Length (FL), Head Circumference (HC), Fetal Weight Estimation, and Amniotic fluid index.

Amniotic fluid index: The AFI evaluates the quantity of amniotic fluid surrounding the fetus during pregnancy. It is calculated by dividing the maternal abdomen into four quadrants and measuring the maximum vertical diameter of amniotic fluid in each quadrant, excluding the cord or fetal extremities. The individual measurements are then summed to obtain the AFI. In the context of AFI values, the cutoff of ≤ 5 cm is commonly used to define Oligohydramnios, which refers to a decreased amount of amniotic fluid. Values above and below the 5 to 24 cm normal range can indicate abnormal conditions: Oligohydramnios, Normal AFI Range, and Hydramnios (Polyhydramnios).

Presence of amniotic fluid echogenicities: The level of significance between echogenic liquor before 34 weeks of pregnancy (for vernix caseosa and meconium) and neonatal outcomes were evaluated (birth weight, APGAR score, NICU admission, neonatal morbidity, stillbirth, neonatal deaths was calculated. The presence of amniotic fluid echogenicities, specifically echogenic liquor, referred to the detection of increased density or

brightness within the amniotic fluid during an ultrasound examination. Echogenicities can be caused by various factors, including vernix caseosa (a waxy substance covering the fetus) and meconium (fetal bowel movements). They evaluated the significance of echogenic liquor before 34 weeks of pregnancy, and its relationship with neonatal outcomes involved assessing parameters such as birth weight, APGAR score, NICU admission, neonatal morbidity, stillbirth, and neonatal deaths. These factors were Birth Weight, APGAR Score, NICU Admission, Neonatal Morbidity, Stillbirth, and Neonatal Deaths.

2.2.Ethical Consideration

The ethics committee at the department of obstetrics and gynecology in the faculty of medicine at Al-Azhar University gave its blessing to conduct the study. After outlining the objectives and methodology of the study and obtaining the participants' informed consent prior to recruitment, all participants were enrolled in the research. The information was confidential.

3. Results

Table 1. Comparison of clinical data regarding neonatal outcome

	NICU/RD (N = 30)		NO NICU/RD (N = 70)		TEST OF SIG.	
	Mean	SD	Mean	SD	t	P value
AGE (YEARS)	25.67	4.27	27.10	3.96	-1.572	0.122
BMI	24.77	2.71	25.41	2.03	-1.174	0.247
GA AT ASSESSMENT (WEEKS)	32.10	1.44	32.08	1.21	-0.047	0.962
GA AT BIRTH (WEEKS)	5.20	.96	5.90	.05	3.243	.002

SD: standard deviation. t: independent student t test

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.001: Highly significant

There was no significant variance was found among groups regarding maternal age, BMI and GA at assessment (P > 0.05).

Table 2. Comparison of echocardiographic data among the examined groups

	NICU/RD (N = 30)		NO NICU/RD (N = 70)		TEST OF SIG.	
	Mean	SD	Mean	SD	t	P value
EBW (GM)	2397.47	267.59	2359.8	262.37	0.649	0.519
BIRTH WEIGHT (GM)	2965.33	272.07	2927.34	260.659	0.648	0.520
AF BRIGHTNESS	10.70	4.40	22.0143	5.58075	-10.842	0.0001
AFI	12.93	1.60	12.7571	1.1476	0.547	0.587

Table 2 demonstrated significant lower AF brightness in the group who develop RD and need NICU admission than the group without RD (P < 0.05). While no significant disparity was found amongst groups concerning maternal EBW, birth weight and AFI (P > 0.05).

Table 3. Comparison of fetal US parameters amongst the examined groups

	NICU/RD (N = 30)		NO NICU/RD (N = 70)		TEST OF SIG.	
	Mean	SD	Mean	SD	T	P value
BPD	63.47	6.85	68.3571	4.905	-3.542	0.001
FL	38.70	7.21	43.2	6.02074	-3.001	0.004
HC	31.53	1.04	33.8143	1.14579	-9.733	0.000
AC	32.73	0.78	34.9286	1.2663	-10.532	0.000
BPP	8.67	0.48	8.4714	0.58288	1.745	0.086

Table 3 showed statistically significant lower BPD, FL, HC, AC, BPP in the group who develop RD and need NICU admission than the group without RD.

Table 4. Comparison of APGAR score among the studied groups

	NICU/RD		NO NICU/RD		TEST OF SIG.	
	(N = 30)		(N = 70)		t	P value
	Mean	SD	Mean	SD		
APGAR AT 1ST MIN	7.00	0.37	7.0857	0.40799	-1.026	0.309
APGAR AT 5TH MIN	8.17	0.46	8.1429	0.45954	0.237	0.814

Table 4 showed no significant distinction was found among groups concerning APGAR score at 1st & 5th min.

Table 5. Correlation between AF brightness levels with clinical and sonographic parameters of the studied groups (N = 100)

	AF BRIGHTNESS LEVELS	
	r	P value
GA AT BIRTH (WEEKS)	0.316	0.001
BIRTH WEIGHT	0.015	0.886
EBW	0.036	0.722
BPD	0.424	0.00001
FL	0.373	0.00001
AFI	-0.045	0.659
HC	0.766	0.00001
AC	0.781	0.00001
BPP	-0.169	0.094

Table 5 showed significant positive correlation between AF brightness levels with gestational age, BPD, FL, AC, HC of the studied groups.

Table 6. Sensitivity, specificity of AF brightness levels for prediction of NICU admission/RD in neonates

CUTOFF POINT	AREA UNDER CURVE	STD. ERRORA	SENSTIVITY%	SPECIFICITY%	ASYMPTOTIC 95% CONFIDENCE INTERVAL	
					Lower Bound	Upper Bound
≤16.5	0.977	0.01	91.40%	93.30%	0.951	1.000

This table and following figure showed that at cutoff point 16.5 AF brightness levels had sensitivity of 91.4% and specificity of 93.3% for predicting NICU admission/RD in neonates.
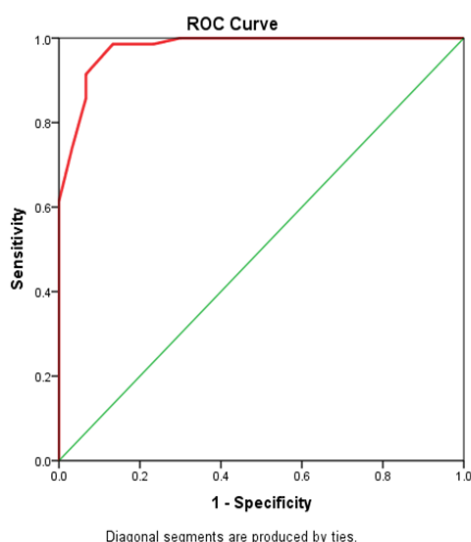

Figure 1. ROC curve for AF brightness levels for prediction of NICU admission/RD in neonates.

4. Discussion

To assess the factors associated with fetal outcome, a comparison between neonates with RD admitted to the NICU and those without RD was performed. The results showed a statistically significant lower GA at birth in the group who developed RD and needed NICU admission than those without RD. No statistically significant variance was found between groups regarding maternal age, BMI, and GA at assessment.

In concordance with the current trial, EL-Omda et al. showed that the incidence of RDS among 300 pregnancies was 47 (15.6%). There was a significant difference in gestational age between the neonates with respiratory distress syndrome (RDS) and non-RDS groups (P value=0.0005). However, there was no significant difference in maternal age .[10]

The current study showed no significant association between fetal outcome and estimated birth weight (EBW) or birth weight.

In agreement with the current research, Stylianou-Riga et al. showed no significant difference in birth weight between neonates with and without RDS .[11]

Contrary to the present investigation, Matsumoto et al. demonstrated that the RDS neonates had significantly lighter birth weights (p = 0.00029) than the control group (without RDS) (12). Also, EL-Omda et al. showed a significant distinction between the RDS group and the non-RDS group regarding birth weight; the disagreement may be due to the difference in sample size and mean gestational age .[10]

Regarding amniotic fluid (AF) brightness, the current study showed that neonates with poor outcomes (RDS/NICU) have significantly lower AF brightness compared to the non-RDS group (p=0.0001).

In concordance with the current study, Matsumoto et al. showed that Significantly lower than that of the control group (26.3 ± 16.3), the amniotic fluid brightness value in the RDS/TTN (respiratory distress syndrome/transient tachypnea of the neonate) group (16.2 ± 13.5) was analyzed (p = 0.020) .[12]

The current study found no association between amniotic fluid index (AFI) and fetal outcome (p=0.587).

In accordance with the present research, Günay et al. revealed no significant association between AFI, RDS, and NICU stay .[13]

In contrast, Bhagat and Chawla revealed a significant association between AFI and admission to the NICU; the disagreement may be due to the difference in mean GA .[14]

Regarding the association between fetal US parameters and fetal outcome, the current study showed that statistically significantly lower BPD, FL, HC, AC, and BPP were found in those who developed RD and needed NICU admission than those without RD (P < 0.05).

Consistent with the present investigation, EL-Omda et al. found that the values of fetal biometric parameters such as BPD, FL, and AC were significantly lower in the RDS group than in the non-RDS group .[10]

The recent trial showed no significant distinction among groups regarding APGAR score at 1st and 5th min (P > 0.05).

Contrary to the current study, Buyuk et al. revealed that neonates with RDS have a significantly higher number of neonates with APGAR<7 at 1 and 5 minutes .[15]

Regarding the correlation between AF brightness levels and sonographic parameters, the study showed a significant positive correlation between AF brightness levels with gestational age, BPD, FL, AC, and HC of the studied groups.

With increasing gestational age, the amniotic fluid gets turbid, and the amniotic fluid's brightness increases. Sebum, the primary component of vernix, is secreted by the fetal sebaceous glands, which rapidly increase in activity, size, and number after the third trimester of pregnancy. When the fetal skin comes into contact with the pulmonary surfactant secreted by alveolar type II epithelial cells, vernix separates from the skin surface. Increased turbidity in the amniotic fluid is caused by micelles formed from the detached vernix and pulmonary surfactant that have diffused into the fluid .[12]

To test the prognostic accuracy of AF brightness levels in predicting NICU admission/RD in neonates, ROC curve analysis was performed. It revealed that at cutoff point 16.5, AF brightness levels have a sensitivity of 91.4% and a specificity of 93.3%.

Our results were supported by Ram& Ram, who revealed that when predicting RDS in 123 different women, an echogenic amniotic fluid particle size (AFPS) of less than 3.8 millimeters exhibited a sensitivity of 85.74% and a positive predictive value of 66.67%. AFPS acts as a sonological marker for fetal lung maturity and labor .[16]

5. *Conclusion*

The quantitative value of the amniotic fluid brightness as measured by ultrasonography might provide an easy and objective criterion for determining whether or not a newborn has RDS.

This study revealed that gestational age was significantly correlated with AF brightness and neonatal outcome..

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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