



Research Article

Role of Ultrasound in Antenatal Detection of Echogenic Amniotic Fluid and Pregnancy Outcome

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Abstract

Background: Ultrasound is a valuable tool for evaluating fetal problems throughout pregnancy. Amniotic fluid anomalies have been associated with unfavorable maternal, fetal, and obstetrical outcomes. **Objective:** To determine the effect of echogenic amniotic fluid during term pregnancy on the presence of meconium stain liquor and pregnancy outcome. **Methods:** A cross-sectional study was conducted on 1080 term pregnant women who visited Al-Elwiya Maternity Teaching Hospital from May 1st, 2021, to May 1st, 2023. Ultrasound was used to analyze echogenic amniotic fluid and turbid liquor. The liquor state was tested either after an artificial membrane rupture in the vaginal delivery trial or during a cesarean section. **Results:** Echogenic amniotic fluid or turbid liquor was detected in 120 cases, while clear liquor was found in 960. Meconium-stained amniotic fluid was discovered in 39 of the 120 instances with turbid liquor, whereas bloody liquor was found in four. In contrast, clear fluid with vernix caseosa was identified in 55 cases, while just 22 cases had clear liquor. Clear liquor was found in 640 of the 960 cases, vernix caseosa liquor in 200, and meconium-staining liquor in only 120 cases. **Conclusions:** Presence of echogenic amniotic fluid or turbid liquor increases the chance of meconium-stained liquor, but it could also be caused by vernix caseosa. Other indicators, such as fetal movement and the non-stress test, should be used to determine the manner of delivery.

Keywords: Echogenic amniotic fluid, Meconium-stained amniotic fluid, Term pregnancy, Vernix caseosa, Ultrasonography.

دور الموجات فوق الصوتية في الكشف قبل الولادة عن السائل الأمنيوسي المنشأ ونتائج الحمل

الخلاصة

الخلفية: الموجات فوق الصوتية هي أداة قيمة لتقييم مشاكل الجنين طوال فترة الحمل. ارتبطت تشوهات السائل الأمنيوسي بنتائج غير مواتية للأم والجنين والتوليد. **الهدف:** تحديد تأثير السائل الأمنيوسي المنشأ أثناء فترة الحمل على وجود سائل صبيغة العقي ونتائج الحمل. **الطريقة:** أجريت دراسة مقطعية مستعرضة على 1080 امرأة حامل في مستشفى العلية التعليمي للولادة في الفترة من 1 مايو 2021 إلى 1 مايو 2023. تم استخدام الموجات فوق الصوتية لتحليل السائل الأمنيوسي المنشأ والسائل العكرة. تم اختبار حالة السائل إما بعد تمزق الغشاء الاصطناعي في تجربة الولادة المهبلية أو أثناء العملية القيصرية. **النتائج:** تم الكشف عن السائل الأمنيوسي المنشأ أو السائل العكرة في 120 حالة، بينما تم العثور على السائل الصافي في 960. تم اكتشاف السائل الأمنيوسي المصبوغ بالعقي في 39 من أصل 120 حالة مع السائل العكرة، في حين تم العثور على السائل الدموي في أربعة. في المقابل، تم تحديد السائل الصافي مع vernix caseosa في 55 حالة، في حين أن 22 حالة فقط لديها سائل صاف. تم العثور على السائل الصافي في 640 من أصل 960 حالة، وسائل vernix caseosa في 200، وسائل تلطيخ العقي في 120 حالة فقط. **الاستنتاجات:** يزيد وجود السائل الأمنيوسي المنشأ أو السائل العكرة من فرصة حدوث السائل الملطخة بالعقي، ولكن يمكن أن يكون سببها أيضا vernix caseosa. يجب استخدام مؤشرات أخرى مثل حركة الجنين واختبار عدم الإجهاد، لتحديد طريقة الولادة.

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INTRODUCTION

Amniotic fluid (AF) is the liquid that surrounds the fetus in the amniotic sac and is usually clear to pale yellow in color. Amniotic fluid is composed of numerous materials, and its composition alters with gestational age [1]. Since many years, evaluation of AF has continued to be a vital part of obstetrical checkups, fetal evaluations, and fetal health surveillance [2]. Amniotic fluid assessment by ultrasound (U/S) is very useful in obstetric care, and it

has become a necessary aspect of pregnancy follow-up [3]. The presence of echogenic AF on sonography is not common, and its clinical significance is not well established. It happens due to numerous echogenic particles. 1 Very echogenic AF has been linked with vernix caseosa, meconium, or blood [4]. Fetal sebaceous glands in the third trimester produce some of the complex material known as vernix caseosa. 5 Vernix caseosa in AF is a normal finding, whereas meconium may indicate fetal distress. Blood in the AF might also be of clinical concern, indicating intra-

amniotic hemorrhage [6]. Meconium-stained AF means meconium passage in the antenatal or labor period by a fetus in utero [7]. Meconium is made up of water (up to 95%), while the remaining (up to 15%) involve mucus, gastric secretions, bile salts, lanugo, vernix, blood, pancreatic enzymes, squamous cells, and free fatty acids [8]. Meconium-stained AF badly predicts fetal outcomes, with noticeable perinatal morbidity and mortality. Meconium-stained AF was associated with a higher rate of caesarean section (CS) and adverse fetal outcomes, including birth asphyxia, neonatal sepsis, and neonatal intensive care unit admissions (NICU), compared to clear AF [9]. Before 37 weeks of gestation, meconium passage is less common and increases gradually with increased gestational age [10]. The rate of meconium-stained AF varies from 12 to 20%, with a higher rate in underdeveloped countries [11]. Some congenital diseases are associated with particulate matter in the AF, including harlequin ichthyosis and epidermolysis bullosa letalis [1].

METHODS

Study design and sample selection

A cross-sectional study was conducted in the Al-Elwiya Maternity Teaching Hospital in Baghdad from May 1st, 2021 to May 1st, 2023. The local institutional research ethics committee authorized the study protocol, and the participants provided informed consent prior to enrollment. During this time, 1080 pregnant women in their third trimester who visited the obstetrical consultant department were included in the study. All were evaluated by taking a full history (general and obstetrical), performing a general and obstetrical examination, and sending them for investigations (complete blood count, midstream urine examination, blood sugar, renal function test, and liver function test as appropriate) and an ultrasound examination to assess fetal viability, gestational age, fetal wellbeing, congenital anomalies, placental localization, AF index, and AF turbidity. Two radiology specialists performed U/S using a convex transducer at 3.5 MHz (Braun, UK). The study factors included maternal age, parity, gestational age, antepartum and intrapartum features, as well as pregnancy outcome (method of delivery, admission to a neonatal critical care unit, and early infant death).

Inclusion criteria

Singleton living pregnancies, term pregnancy from 37 completed weeks to 42 completed weeks of gestation depending on sure last menstrual period and/or early U/S, pregnancy with intact fetal membranes, and U/S showing turbid or echogenic AF.

Exclusion criteria

Fetus with major congenital anomaly, patients with frank rupture of membranes, twin pregnancy, preterm pregnancy, presence of other comorbidities, placenta previa, placental abruption, and intrauterine growth restriction.

Interventions and outcome measurements

Labor was attended by the researcher, and the AF condition were observed during artificial rupture of membrane in cases of vaginal delivery (VD), and during CS. The measured neonatal outcomes include: Apgar score, congenital anomalies, admission to the NICU and early neonatal death was assessed.

Statistical analysis

The data were entered to computer and analyzed using Statistical Package for Social Sciences (SPSS) version 25. The data presented as mean±standard deviation (SD) and ranges. Categorical data presented by frequencies and percentages. The difference between percentages of categorical data was tested using Chi-square test or Fisher Exact test whenever applicable. Sensitivity, specificity, accuracy, positive and negative predictive values of U/S in diagnosis of amniotic fluid were calculated. A level of *p*-value less than 0.05 was considered significant.

RESULTS

A cohort of 1080 term singleton expectant women who were admitted to the labor unit participated in this study. For the evaluation of AF, ultrasound (U/S) imaging was performed on all women. The women under study had a mean age of 27.03±5.84 years. Parity and gravidity were, respectively, 1.14±1.52 and 2.13±1.53. The weight of the neonate at birth was 3,584±362 g, whereas the gestational age at delivery was 39.27±1.34 weeks. The findings are presented in Table 1.

Table 1: Socio-demographic characteristics of the study sample

Variables	mean ± SD	Range
Maternal Age (year)	27.03±5.84	17–39
Gravidity	2.13±1.53	1–8
Parity	1.14±1.52	0–7
Gestational Age (week)	39.27±1.24	37–41
Birth Weight (g)	3584±362	2100–4500

Echogenic AF was identified in 120 women during U/S assessment of AF; the remaining 960 women had non-echogenic AF; thus, the incidence of sonographically echogenic AF was 11.1%. The findings are illustrated in Figure 1.

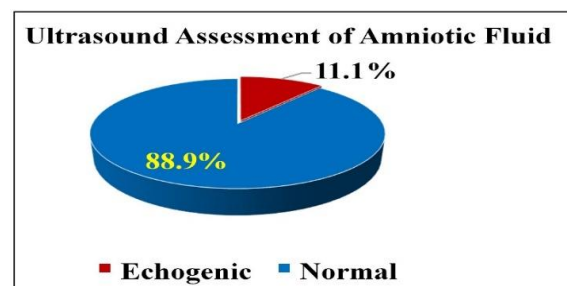


Figure 1: Distribution of the study sample according to echogenicity of AF.

A total of 55 cases (45.7%) of women with echogenic AF who had their AF assessed at delivery exhibited vernix caseosa, 39 cases (32.5%) contained

meconium, 4 cases (3.3%) contained blood, and 22 cases (18.3%) contained clear fluid. Out of the 960 women who presented with non-echogenic AF, 640 were deemed clear (66.7%), while 200 had vernix (20.8%) and 120 had meconium (12.5%). The findings are illustrated in Figure 2.

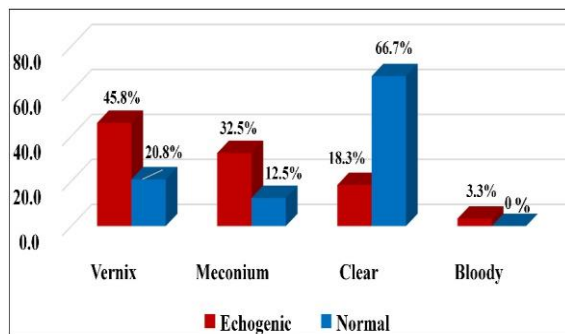


Figure 2: Distribution of the studied women according to assessment of amniotic fluid at delivery.

Table 2: Distribution of study sample according to characteristics of amniotic fluid and assessment at delivery

Variables	Amniotic Fluid at Delivery		Total (n=1080)	p-value
	Echogenic (n=120)	Normal (n=960)		
Turbid				
Yes	98(81.7)	320(33.3)	418(38.7)	<0.001
No	22(18.3)	640(66.7)	662(61.3)	
Meconium-stained				
Yes	39(32.5)	120(12.5)	159(14.7)	<0.001
No	81(67.5)	840(87.5)	921(85.3)	
With vernix caseosa				
Yes	55(45.9)	200(20.8)	255(23.6)	<0.001
No	65(44.1)	760(79.2)	825(76.4)	
Blood				
Yes	4	0	4	<0.001
No	116	960	1076	
Clear				
Yes	22(18.3)	640(66.7)	662(61.3)	<0.001
No	98(81.7)	320(33.3)	418(38.7)	
NICU Admission				
Yes	12(10.0)	31(3.2)	43(3.9)	<0.001
No	108(90.0)	929(96.8)	1037(96.1)	
Mode of delivery				
NVD	60	452(47.1)	512(47.4)	0.04
CS	60	508 (52.9)	568(52.6)	

Values are presented as frequency (%). Significant difference between percentages using Chi-square test at $p < 0.05$ level.

In terms of diagnosing amniotic fluid, the U/S results indicated that the method was 76.9% accurate, 23.4% sensitive, 96.7% specific, and 81.7% positive predictive, with a negative predictive value of 66.7%. The findings are presented in Table 3.

Table 3: Sensitivity, specificity, and accuracy of ultrasound in diagnosis of amniotic fluid

Ultrasound Diagnosis	On labor diagnosis		Total
	Turbid	Normal	
Echogenic	98	22	120
Non-echogenic	320	640	960
Total	418	662	1080

DISCUSSION

Only a few papers about echogenic AF have been published in the medical literature; these are primarily case reports or investigations with tiny sample sizes. Insufficient information was provided by

The frequencies of turbid AF in echogenic AF were significantly different from those in non-echogenic AF, according to this study ($p < 0.001$). In comparison to women without echogenic AF, the incidence rates of amniotic fluid containing vernix, blood, and meconium were significantly higher in women with echogenic AF ($p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively). Conversely, women with echogenic AF had a considerably lower incidence of distinct AF than those with non-echogenic AF ($p < 0.001$). In terms of NICU admission, twelve infants (10%) of those whose mothers had echogenic AF required NICU admission, compared to thirty-one infants (3.2%) whose mothers had non-echogenic AF; this difference was significantly statistically significant ($p < 0.001$). In relation to mode of delivery, 74 (61.7%) women with non-echogenic AF had Caesarian section (CS), whereas 461 (48%) women with echogenic AF had normal vaginal delivery (NVD) and 499 (52%) had cs. The findings are presented in Table 2.

Karamustafaoglu Balci and Goynumer [12] about the relationship between echogenic AF and pregnancy outcomes. The density, quantity, and turbidity of free-floating materials in AF are all determined by AF echogenicity [13,14]. According to this study, the average age of the study participants was 27.03 ± 5.84 years, and their average parity and gravidity were 1.14 ± 1.52 and 2.13 ± 1.53 , respectively. These results are in agreement with those of Goynumer and Karamustafaoglu Balci [12]. Similar to the results of Meda *et al.* [2], the mean birth weight was 3584 ± 362 g and the mean gestational age at delivery was 39.27 ± 1.34 weeks. According to the current investigation, echogenic AF was present in 11.1% of the study population. This finding contrasts with that of Karamustafaoglu Balci and Goynumer [12] and Shrestha *et al.* [15], who reported rates of 3.2% and 0.5%, respectively. These discrepancies could be ascribed to variations in the populations under study, sample sizes, or inter-examiner variability. In the

current study, vernix caseosa was identified in 45.8% of women with echogenic AF, meconium in 32.5%, blood in 3.3%, and clear fluid in 18.3% of women. On the other hand, clear fluid was present in 66.7% of women with non-echogenic AF, meconium in 12.5%, and vernix in 20.8% of cases. These findings diverge from those reported by Buyuk *et al.* [16] and Shrestha *et al.* [15]. These discrepancies could be ascribed to variations in the populations under study, sample sizes, or inter-examiner variability. The results of this investigation demonstrated a strong correlation between meconium and the echogenicity of AF. This finding is different from that of Buyuk *et al.* [16] and Müngen *et al.* [13], but it is similar to that of Karamustafaoglu Balci and Goynumer [12]. Obstetricians appear to be willing to use ultrasonography to identify meconium before or during labor because it is a non-invasive method that is commonly used on pregnant women during labor [17]. Meconium-stained AF is considered a dangerous condition and is found in 5% to 20% of instances during childbirth. It has been connected to bleeding in the AF when heme products are present, the expulsion of fetal intestinal material (meconium), or both. Gallo *et al.* [18] report that the frequency of green-stained atrial fibrillation (AF) rises directly with gestational age, peaking at roughly 27% in post-term gestation. Echogenicity of AF and vernix were found to be significantly correlated in the current investigation; this conclusion is consistent with that of Buyuk *et al.* [16]. The present investigation demonstrated a noteworthy correlation between the echogenicity of AF and blood; yet, the investigator was unable to locate any literature addressing analogous or dissimilar findings in this context. According to the current investigation, admission to a neonatal intensive care unit (NICU) was linked to the echogenicity of AF. This result differs from that of Müngen *et al.* [13] but is comparable to that of Shrestha *et al.* [15]. According to the current study, the route of delivery and the echogenicity of AF were related, with the echogenic AF group having significantly higher CS. This result is in line with the findings of Buyuk *et al.* [16] and Shrestha *et al.* [15], who discovered that the route of delivery was related to the presence of meconium without examining AF echogenicity. According to the results of the current investigation, the use of U/S in the diagnosis of AF had low sensitivity (23.4%), high specificity (96.7%), moderate accuracy (76.9%), and positive and negative predictive values of 81.7% and 66.7%, respectively. These results show that echogenic AF has low sensitivity, which is in line with studies by Karamustafaoglu Balci and Goynumer [12], Meda *et al.* [2], and Panicker *et al.* [19].

Conclusion

The presence of echogenic amniotic fluid or turbid liquor raises suspicion about the presence of meconium-stained liquor, but it can still be due to vernix caseosa, so other parameters like fetal

movement and a non-stress test should be used to decide the mode of delivery.

Conflict of interests

No conflict of interests was declared by the author.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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