

The Degree of Ultrasonographic Amniotic Fluid Echogenicity for the Prediction Meconium Staining During Labor

Doğum Esnasında Mekonyumlu Amniyonun Öngörülmesinde Amniyon Sıvısının Ultrasonografik Ekojenisite Derecesi

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ABSTRACT Objective: The aim of this study is to evaluate the relationship between appearance of amniotic fluid on ultrasound and presence of meconium during labor. **Material and Methods:** This prospective study was conducted on 376 laboring women. The relationship between the degree of amniotic fluid echogenicity (normal, mild, intense) and degree of meconium stained amniotic fluid (clear, mild, thick) during labor was investigated. Positive and negative predictive values for determining meconium-staining amniotic fluid were evaluated using chi-square and Fisher's-exact tests. A value of $p<0.05$ was accepted as statistically significant. **Results:** The rate of echogenic amniotic fluid imaging on ultrasound was 44.4%. The consistency rate between the ultrasonography and amniotic fluid examination during/after labor was 51.1%, which was not statistically significant ($p=0.121$). However the negative predictive value of non-thick echogenicity was 84.3% in ruling out thick meconium-stained fluid, only when amniotic fluid index was normal ($p<0.05$). **Conclusion:** Ultrasonographic echogenicity of amniotic fluid is generally not a reliable method for predicting meconium-stained amniotic fluid. However in pregnancies with normal amniotic fluid, absence of thick echogenicity seems reliable for predicting the absence of thick meconium-stained amniotic fluid.

Key Words: Meconium; ultrasonography; amniotic fluid; labor, obstetric

ÖZET Amaç: Bu çalışmanın amacı, ultrasonografik muayenede saptanan ekojenik amniyotik sıvı görünümü ile doğum sırasında amniyotik sıvıdaki mekonyum varlığı arasındaki ilişkiyi araştırmaktır. **Gereç ve Yöntemler:** Prospektif bu çalışma doğum yapan 376 kadın üzerinde yapıldı. Amniyotik sıvının ekojenite derecesi ile (normal, orta derecede, yoğun) doğum sırasında mekonyum boyalı amniyotik sıvı derecesi (temiz, orta derecede mekonyumlu, koyu mekonyumlu) arasındaki ilişki araştırıldı. Mekonyum boyalı amniyotik sıvı varlığını belirlemede pozitif ve negatif belirleyici değer ki-kare ve Fisher's-exact testleri kullanılarak saptandı. P değerinin 0,05 altında olması anlamlı olarak kabul edildi. **Bulgular:** Ultrasonda saptanan ekojenik amniyotik sıvı görüntüsü oranı %44,4 idi. Ultrason bulguları ile doğum esnasında ya da sonrasında amniyon mayii muayenesi arasındaki uyum %51,1 olup anlamlı değildi ($p=0,121$). Bununla beraber ultrason muayenesindeki yoğun olmayan ekojenitenin doğum sırasında ya da sonrasında yoğun mekonyum boyalı amniyon mayisini dışladığı belirleyici değeri %84,3 olup anlamlı idi ($p<0,05$). Fakat bu sadece amniyon mayii indeksi normal olan olgularda geçerli idi. **Sonuç:** Amniyon mayisinin ultrasondaki ekojenik görüntüsü mekonyum boyalı amniyon mayii belirlemede genel olarak güvenilir bir yöntem değildir. Bununla beraber amniyon mayii indeksi normal olan gebelerde koyu ekojenitenin varlığı koyu mekonyum boyalı sıvı varlığını öngörmeye güvenilir görünmektedir.

Anahtar Kelimeler: Mekonyum; ultrasonografi; amniyotik sıvı; doğum, obstetrik

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The presence of meconium in the amniotic fluid (AF) during labour increases concerns considering fetal well-being and whether delivery will be able to be tolerated.¹ For detecting meconium before or

during labor, obstetricians seem to be willing to use ultrasonography (USG) since it is frequently utilized in pregnant women during labor, and it is non-invasive. In Turkey, USG is accepted as a non-invasive and cost-efficient method. While there are several studies on this topic in the literature, a relationship between an echogenic appearance and meconium has not been proven, and this appearance has usually been associated with vernix caseosa or blood.^{1,2}

With this consideration, the aim of this study is to evaluate the relationship between an echogenic AF appearance determined in USG before delivery and the presence of meconium-stained AF after delivery.

MATERIAL AND METHODS

Approval for the study was obtained from the local ethics committee (no 63). Three hundred and seventy-six pregnant women were examined, who presented to the delivery room of Batman Maternity and Pediatric Hospital between January 2014 - February 2015. USG examination was performed by a single physician (Y.Ç) using the same device (2-5 Mhz GE 3 CB probe, Logig 200, Solingen, Germany) on all women. Inclusion criteria were women with singleton pregnancies and with cephalic presentation at labor. Women that had undergone cesarean section (CS) were excluded as meconium-staining rates are generally low during CS and high at the second stage of labor ≥ 24 cm was considered polyhydramnios.³⁻⁶ The degree of echogenicity of AF on USG before labor and degree of meconium during labor were determined as follows. Placenta-like appearance was defined as thick, and that between was defined as mild echogenicity. AF was examined visually during delivery. It was evaluated as clear if meconium was completely absent, mild if thin meconium was present, and thick if thick meconium was present. Positive and negative predictive values for determining meconium-staining were calculated. The relationships between degree of AF echogenicity (normal, mild, intense) and degree of meconium-stained AF (clear, mild, thick) during labor, were investigated in the overall group and amniotic fluid index (AFI) sub groups.

Data were statistically evaluated using SPSS for Windows version 11.5 (Chicago Inc, IL, USA). Chi-square and Fisher's exact tests were used for comparisons. A p value <0.05 was considered as statistically significant.

RESULT

The study was conducted on 376 women with a mean age of 27.78 ± 6.51 years. All the deliveries were by the vaginal route, and average gestational age was 38.9 ± 1.89 weeks. The characteristics of the cases were given in Table 1. The consistency rate between the USG and AF examination results during/after labor was 51.1%, which was not statistically significant ($p=0.121$). When cases were examined in categories according to the amount of AF during USG examination, the consistency rate in groups with normal amniotic fluid, oligohydramnios and polyhydramnios was 51.8%, 49.2%, and 37.5% respectively ($p>0.05$) (Table 2). When mild and thick echogenities determined in USG were considered as a single group, the value of the echogenic image on USG in determining meconium was low in all groups and sub-groups according to the amount of AFI ($p>0.05$) (Table 3). When we considered normal and mild echogenity as a group, there was a significant relationship between thick echogenic USG image and presence of thick meconium-stained amniotic fluid in normal AFI group ($p<0.05$) (Table 4). This relationship was not evident in polihydramnios and oligohydramnios groups ($p>0.05$) (Table 4).

DISCUSSION

The results of this study have shown that the value of a mild or thick echogenic image or the echogenic image alone determined in the amniotic fluid as a result of USG examination is low in terms of determining meconium ($p>0.05$).

USG, which is used to monitor fetal status, is an easy to use and cost-efficient method in Turkey. Therefore, it is widely used in antenatal follow-up and during labor. The fact that it is easy to apply and cost efficient makes obstetricians quite willing to use it for the evaluation of fetal well-being and

TABLE 1: Characteristics of the study population.

| | | |
|---|----------------------|--------|
| Age mean±SD (min-max) (year) | 27.78±6.51 (14-46) | |
| Gestation age (mean±SD) (week) | 38.9±1.89 (27-41) | |
| Gravida (median (min.-max.)) | 3 (1-12) | |
| Systemic disease (n-%) | | |
| Hypertension | 4 | 1.1 |
| Diabetes | 2 | 0.5 |
| Cardiac diseases | 2 | 0.5 |
| AFI (n-%) | | |
| Normal | 301 | 80.1 |
| Oligohydroamnios | 67 | 17.8 |
| Polyhydroamnios | 8 | 2.1 |
| Ultrasonographic appearance of AF (n-%) | | |
| Normal echogenicity | 203 | 54.0 |
| Mild echogenicity | 113 | 30.1 |
| Thick echogenicity | 60 | 16.0 |
| Induction (n-%) | | |
| No | 234 | 62.24 |
| Yes | 142 | 37.76 |
| CE mean±SD (min.-max.) (cm) | 3.29±2.07 (0-10) | |
| Apgar 1' (median (min.-max.)) | 8 | (3-9) |
| Apgar 5' (median (min.-max.)) | 9 | (5-10) |
| Birth weight mean±SD (min.-max.) (gram) | 3273±445 (1400-4800) | |
| Appearance of AF after birth (n-%) | | |
| Clear | 322 | 85.6 |
| Mild | 9 | 2.4 |
| Thick | 45 | 12.0 |
| Stay in the hospital (n-%) | | |
| No | 343 | 91.2 |
| Yes | 33 | 8.8 |

AFI: Amniotic Fluid Index; CE: Physical examination of the cervix at the time of the entrance to delivery; SD: Standard deviation.

the capacity to tolerate labor. USG is beneficial for evaluating fetal position, cardiac rate, fetal growth, placental position, and the amount of AF. However, an abnormal USG appearance may sometimes result in false positive results and lead to unnecessary interventions.

In the literature, there are few studies that have examined the relationship between the presence of echogenic AF and meconium, and no evidence has been provided to support this relationship, as it has mainly been associated with vernix.^{7,8} Meconium-stained AF was first determined in USG by Benacerraf². Two pregnant women of 42 weeks were assessed by USG and the distribution of the echogenic images on different areas within the

uterus was evaluated. A significant difference was reported between the echogenic images associated with meconium and the umbilical cord. In contrast, some studies and case reports have suggested that the echogenic appearance is associated with vernix rather than meconium. DeVore and Platt argued that in pregnant women with an echogenic appearance, meconium was not present when membranes were ruptured and fetal status was good.⁹ In a retrospective study by Brown et al. it was reported that meconium was present in only 1 out of 19 patients, on whom echogenic appearance was determined, and vernix was present in the rest of the patients.¹⁰ The amniotic appearance was determined to be unreliable for the determination of meconium and it

TABLE 2: Individual value in detecting mild and thick echogenicity meconium.

| USG | Appearance of AF During Labor | | | Validity Index (%) | P |
|-------------------------|-------------------------------|---------------|----------------|--------------------|-------|
| | Clear n (%) | Mild n (%) | Thick n (%) | | |
| All cases | | | | | |
| Normal echogenicity | 179 (55.6) | 6 (66.7) | 18 (40.0) | 51.06 | 0.121 |
| Mild echogenicity | 97 (30.1) | 1 (11.1) | 15 (33.3) | | |
| Thick echogenicity | 46 (14.3) | 2 (22.2) | 12 (26.7) | | |
| NORMAL | | | | | |
| Normal echogenicity | 144 (56.9) | 6 (75.0) | 15 (54.8) | 51.82 | 0.041 |
| Mild echogenicity | 70 (27.7) | 0 (0.0) | 13 (32.5) | | |
| Thick echogenicity | 39 (15.4) | 2 (25.0) | 12 (30.0) | | |
| OLIGOHYDROAMNIOS | | | | | |
| Normal echogenicity | 32 (52.5) | 0 (0.0) | 3 (60.0) | 49.25 | 0.741 |
| Mild echogenicity | 24 (39.3) | 1 (100.0) | 2 (40.0) | | |
| Thick echogenicity | 5 (8.2) | 0 (0.0) | 0 (0.0) | | |
| POLYHYDROAMNIOS | | | | | |
| Normal echogenicity | 3 (37.5) | 0 (0.0) | 0 (0.0) | 37.50 | --- |
| Mild echogenicity | 3 (37.5) | 0 (0.0) | 0 (0.0) | | |
| Thick echogenicity | 2 (25.0) | 0 (0.0) | 0 (0.0) | | |

Chi-squared test; AF: Amniotic Fluid.

TABLE 3: Mild or thick value in detecting echogenicity meconium.

| USG | Appearance of AF During Labor | | Validity Index (%) | Spe. | Sen. | NPV | PPV | P |
|--------------------------|-------------------------------|---------------------|--------------------|-------|-------|--------|-------|----------|
| | Clear n (%) | Mild+Thick n (%) | | | | | | |
| Normal echogenicity | 179 (55.6) | 24 (44.4) | 55.59 | 55.60 | 55.60 | 88.18 | 17.34 | 0.128 * |
| Mild+thick echogenicity | 143 (44.4) | 30 (55.6) | | | | | | |
| NORMAL | | | | | | | | |
| Normal echogenicity | 144 (56.9) | 21 (43.8) | 56.81 | 56.90 | 56.20 | 87.27 | 19.85 | 0.093 * |
| Mild+ thick echogenicity | 109 (43.1) | 27 (56.2) | | | | | | |
| OLIGOHYDROAMNIOS | | | | | | | | |
| Normal echogenicity | 32 (52.5) | 3 (50.0) | 52.24 | 52.50 | 50.00 | 91.43 | 9.38 | 1.000 ** |
| Mild+thick echogenicity | 29 (47.5) | 3 (50.0) | | | | | | |
| POLYHYDROAMNIOS | | | | | | | | |
| Normal echogenicity | 3 (37.5) | 0 (0.0) | 37.50 | 37.5 | 0.00 | 100.00 | 0.00 | --- |

*: Chi-squared test, **: Fisher-Exact test; AF: Amniotic Fluid.

was not recommended for clinical use. In a study of 1100 pregnancies that were examined in the 38th week, an echogenic image was determined in only 1 case, who was then observed in a follow-up process until delivery and meconium was not determined.¹¹ In a review reported by Sepulveda, echogenic appearance was not associated with meconium, and the use of amniocentesis or amnioscopy was recommended to avoid false positive results and unnecessary inductions in such cases.⁷

The value of an echogenic appearance has also been found to be low in terms of determining meconium in prospective studies. Sherer et al. reported sensitivity as 100%, specificity 69%, positive predictive value 10% and negative predictive value as 100%.⁸ Mungen et al. evaluated 950 patients in a large series study, and determined echogenic amnion appearance in 7% of the patients.¹ It was reported from that study that echogenic appearance was not associated with meconium or materno-fetal negative re-

TABLE 4: Comparison of Clear+Mild and Thick echogenity.

| USG | Appearance of AF During Labor | | Validity Index (%) | Spe. | Sen. | NPV | PPV | P |
|-------------------------|-------------------------------|----------------|--------------------|------|------|------|------|---------|
| | Clear+Mild n (%) | Thick n (%) | | | | | | |
| NORMAL | | | | | | | | |
| Normal +Mild eko. | 220(88.7) | 28(11.3) | 77.1 | 88.7 | 22.6 | 84.3 | 30.0 | 0.027* |
| Thick eko. | 41(77.4) | 12(22.6) | | | | | | |
| OLİGOHYDROAMNIOS | | | | | | | | |
| Normal +Mild eko. | 57(91.9) | 5(8.1) | 85.1 | 91.9 | 0.0 | 91.9 | 0.0 | 1.000** |
| Thick eko. | 5(100.0) | 0(0.0) | | | | | | |
| POLİHYDROAMNIOS | | | | | | | | |
| Normal +Mild eko. | 5(100.0) | 0(0.0) | -- | -- | -- | -- | -- | -- |
| Thick eko. | 2(100.0) | 0(0.0) | | | | | | |

*: Chi-squared test, **: Fisher-Exact test.

sults. In the current study, all the cases with both diffuse and local invasion within the cavity were included. The degree of echogenity was accepted as normal echogenity if it was equal to the appearance in the umbilical cord, and intense echogenity if it had an appearance similar to that of the placenta. In the literature, there is no objective consensus with regard to grading, but this method adopted in the current study has been seen to be the main one used for grading. A strong feature of the current study is that all the cases were examined by a single physician, and were under the supervision of the same physician during the follow-up process. In addition, the same pediatrician examined all the newborns.

In our study, oligohydramnios and polyhydramnios groups were also evaluated. The rate of operative delivery or CS increases in pregnant women with oligohydramnios due to fetal distress or meconium.¹² In pregnant women with isolated polyhydramnios, while a relationship between fetal distress and negative neonatal results has not been determined, negative neonatal results may be seen particularly in those with fetal anomalies.¹³ Whether accompanied by fetal anomalies or not, the presence of an echogenic AF appearance may increase concerns about fetal distress or meconium in both groups. However, no relationship between echogenic appearance and meconium-stained AF was determined in either the oligohydramnios or the polyhydramnios groups in our study ($p>0.05$). We also divided the overall cases into two groups (normal+mild echogenity and thick echogenity).

We observed that there was significant correlation between thick echogenity and thick meconium-stained amniotic fluid ($p<0.05$). Nevertheless, this correlation was observed only in women with normal AF content, and positive predictive value was low. On the other hand, the negative predictive value was relatively good (84.3%). We conclude that absence of thick echogenity on USG in the absence of oligo/poly-hydramnios is strongly associated with non-stained AF during labor. Lack of any association in the oligo-polyhydramnios groups may be due to limited number of cases.

Echogenic appearance on USG causes concerns about the presence of meconium, and amniotomy, amniocentesis or birth induction may be conducted unnecessarily. From the results of our study and the limited literature support, the sensitivity of echogenic AF appearance was very low for determining meconium. However, according to these observations, echogenic appearance continues to worry obstetricians about the presence of meconium and unnecessary obstetric interventions are still prevalent. Prospective studies based on more extensive and detailed parameters are required to clarify these concerns about the relationship between echogenic US appearance and neonatal outcomes.

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