

Comparison of Fetal Intestinal Maturity with Amniotic Fluid Pulmonary Maturity Tests

FETAL İNTESTİNAL MATÜRİTENİN, AMNİYOTİK SIVI AKCİĞER MATÜRİTE TESTLERİYLE KARŞILAŞTIRILMASI

Erdal YERMEZ*, Bülent URAN**, İsmail TEKER**, Nurettin DEMİR**, Deniz EGELİ***

* Clinic of Obstetrics and Gynecology, SSK Hospital, Manisa,

** Department of Perinatology, SSK Ege Maternity Teaching Hospital, Izmir,

*** Department of Biochemistry, SSK Tepecik Teaching Hospital, Izmir, TURKEY

Summary

Objective: To assess ultrasonographic fetal intestinal maturity as a non-invasive pulmonary maturity investigation and to compare with pulmonary maturity tests of amniotic fluid of high risk pregnant women.

Method: Fetal intestinal parameters were evaluated ultrasonographically in pregnancies who would be delivered within 72 hours. Tap test and TDx FLM test for pulmonary maturity evaluation were applied in amniotic fluids of these patients.

Results: In the prediction of respiratory distress syndrome (RDS), colonic diameter greater than 10 mm showed high specificity (%91) and high negative predictive value (%91) and colonic ecogenity smaller than grade 3 indicated high sensitivity (%100).

Conclusions: The prediction of pulmonary maturity by ultrasonographic colonic markers is superior to invasive diagnostic procedures.

Key Words: Pulmonary maturity, Respiratory distress syndrome, Ultrasonography, Fetal intestine, Amniocentesis

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Özet

Amaç: Yüksek riskli gebelerde fetal akciğer matüritesinin araştırılması amacıyla, non-invaziv bir yöntem olan fetal intestinlerin ultrasonografik görünümünün; amniyotik sıvı akciğer matürite testleriyle karşılaştırılması.

Metod: Fetal intestinal parametrelerin ultrasonografik olarak değerlendirilmesini takip eden ilk 72 saat içinde doğumu gerçekleştiren gebeler çalışma kapsamına alındı. Amniyotik sıvıda, akciğer matüritesini belirlemek amacıyla Tap testi ve TDx-FLM testi bu gebelerde yapıldı.

Bulgular: Respiratuar distress sendromunun (RDS) tespitinde; fetal kolon diametri 10mm.nin üstünde olan olgularda yüksek spesifisite (%91), yüksek prediktif negatif değer (%91) ve kolonik ekojenite grade 3'den küçük olgularda yüksek sensitivite (%100) belirlenmiştir.

Sonuç: Fetal akciğer matüritesinin belirlenmesinde, ultrasonografik kolonik markerlerin değerlendirilmesi, invaziv diagnostik prosedürlerden daha üstündür.

Anahtar Kelimeler: Akciğer matüritesi, Respiratuar distress sendromu, Ultrasonografi, Fetal intestin, Amniosentez

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Laboratory estimation of fetal lung maturity is sometimes indicated when a preterm delivery is anticipated because of complications of pregnancy. Another common indication for testing is the need to interrupt pregnancy in patients with unreliable estimation of gestational age.

The advent of obstetric ultrasound has significantly improved our evaluation of fetal growth and behavior. The primary function of ultrasound in obstetrics is the estimation of gestational age. But the precise sonographic estimation of gestational age after 28 weeks is not possible because of great variation of standard biometric findings (1).

With the advent of advanced sonographic imaging anatomic definition of the fetal gastrointestinal tract is now possible. It was claimed that intestinal growth and function should develop independently of fetal skeletal and somatic

growth and therefore may provide an alternate indicator of fetal gestational age and pulmonary maturity (2,3). We were not able to find any study which compares the efficiency of ultrasonic evidence of fetal intestinal maturity with that of amniotic fluid (AF) fetal pulmonary maturity tests for the prediction of neonatal respiratory distress syndrome (RDS).

The purpose of this prospective study was to compare the sonographic appearance and behavior of the fetal intestine with AF pulmonary maturity tests in a population of high risk pregnant women as a method of evaluating fetal lung maturity.

Materials and Methods

The research was performed at SSK Ege Maternity Hospital Izmir- Turkey, from October 1993 to February

1996. Indications for assessment of fetal lung maturity included elective cesarean delivery, elective induction, preterm labor, pregnancy-induced hypertension, and fetal growth retardation. Conditions possibly affecting the development of fetal pulmonary maturity such as premature rupture of membranes, diabetic pregnancy, proven fetal anomaly and third trimester vaginal bleeding were excluded.

A prospective study was carried out on high risk pregnant women who had been hospitalized in the perinatology department. Patients were included if gestational age based on last menstrual period was available and confirmed by ultrasound examination in the second trimester.

Patients were excluded if delivery had occurred later than 72 hours of AF and ultrasonographic evaluation. Cases that were administered corticosteroids for the acceleration of fetal lung maturation were also excluded.

All the sonographic evaluation was performed with a Toshiba SSA 270 A using a 3.75 MHz convex array transducer. Each sonographic analysis included assessment of the BPD, head perimeter, femoral bone, and abdominal circumference. The transverse colon diameter was obtained by visualizing the fetal abdomen in the sagittal plane, identifying the fetal bladder, and altering the transducer location to visualize the colon in its maximal cross section. The transverse colon diameter was measured from outer to outer margins. The presence of characteristic colonic haustra was also noted.

The echogenicity of the colon was assessed and graded in comparison with bladder and liver echogenicity. Grade 1: The colonic contents are echo free in appearance. The echogenicity is identical to that of the bladder. Grade 2: Low intermediate. The echogenicity is more dense than bladder but much lower than liver. Grade 3: High intermediate. The colonic contents are echo dense, but echogenicity is lower than the liver. Grade 4: The echogenicity of colonic contents is equal to that of the liver.

The nature of small intestinal peristalsis was also assessed and noted.

We analyzed AF samples from these women for the evaluation of pulmonary maturity. TDx-FLM assay were performed in the biochemical laboratory of SSK Tepecik Hospital. Tap test were performed by one of the investigators who was unaware of the patient's ultrasonographic findings. The tap procedure and its evaluation were done according to Socol's definition(4).

The TDx-FLM test used an Abbot TDx automated fluorescence polarization instrument (TDx analyzer; Abbot Laboratories) and Abbot's TDx-FLM assay kit. The surfactant-albumin ratio of at least 70 mg/g were used as criteria to predict adequate fetal pulmonary maturity.

The same pediatrician unaware of the results of the lung maturity tests diagnosed the presence of RDS. The criteria used to diagnose RDS were physical evidence of respiratory distress (tachypnea, retractions, grunting, cyanosis in room air and x-ray confirmation), and supplemental oxygen requirement for more than 24 hours.

The sensitivity, specificity, and positive and negative predictive values of the two lung maturity tests and that of the intestinal markers were calculated by conventional formulas.

We used the following definitions in the data analysis: Negative test=test indicating absence of RDS (mature test); positive test; test result indicating presence of RDS (immature test); sensitivity= proportion of immature tests among infants with RDS; specificity= proportion of mature tests among infants without RDS; positive predictive value= proportion of infants with RDS among all patients with immature tests; negative predictive value= proportion of infants without RDS among all patients with mature tests.

Results

The study was conducted in 120 patients. The results of 21 patients were excluded from the investigation because of delayed delivery or steroid administration. RDS was not observed in 72 patients while some form of respiratory distress was determined in 27 babies. Some characteristics of these babies are shown in Table 1. No cases of RDS were seen when the gestational age was 37 weeks or more.

Table 2 presents the sensitivity, specificity, and positive and negative predictive values of TDx-FML, tap test, colonic diameter, colonic echogenicity, presence of haustra, and small bowel peristalsis in patients who delivered within 72 hours of providing the AF sample. The sensitivity and negative predictive values of colonic echogenicity were better than those of the TDx-FLM and tap test. The specificity of the intestinal markers other than colonic echogenicity were better than that of the AF test.

Table 1. Some characteristics of babies in RDS and non-RDS groups

	RDS	Non-RDS
Case number	27(%27)	72 (%73)
Gest age at birth(week)	33.3±1.1	36.4±2.7
Birthweight (g)	1817±224	3085±480
1 minute Apgar	4.6±2.4	8.2±1.1
Surfactan/Albumin (mg/g)	58.7±51	95.6±59.7
Colonic diameter (mm)	8.4±2	12.2±1.5
Colonic ecogenicity (median)	1	3

Table 2. Diagnostic parameters (%) of TDx-FLM, TAP test, colonic diameter, colonic ecogenicity, presence of haustra, and small bowel peristalsism in patients who delivered within 72 hours of providing the AF sample. (NPV: Negative predictive value, PPV: Positive predictive value)

PARAMETER	SENSITIVITY	SPECIFICITY	NPV	PPV
Haustra	11	100	100	75
Diameter of colon	78	91	78	91
Colonic ecogenicity	100	62,5	50	100
Peristaltism	22	96	67	77
TAP	55	71	42	81
TDx-FLM	78	58	41	87

Comments

A large number of tests of fetal maturity that have been developed over the years allowed the direct assessment of lung surfactant in the amniotic fluid.

Tests of fetal maturity have always concentrated on the fetal lung because the greatest risk to the immature neonate is the development of RDS, arising as a result of surfactant deficiency (5).

The currently available fetal well-being tests have increased clinician's ability to determine more precisely the fetal condition. An assessment of fetal weight, activity, heart rate patterns or amniotic fluid volume may indicate that the fetus is deteriorating strengthen the need to deliver even in the presence of lung immaturity.

Unfortunately many amniotic fluid tests in current use are unreliable when amniotic fluid is contaminated and many take time and sophistication to perform.

Amniocentesis is also an invasive procedure with a small, but significant morbidity rate. If fetal maturity can be predicted unquestionably, then the risk of morbidity to the fetus and mother from amniocentesis can be eliminated.

The intraluminal changes in echogenicity appeared to reflect the progressive increase in volume of meconium and a decrease in water content in the colon during the third trimester. Goldstein et al noted the abrupt sonographic appearance of haustra at 30 weeks' gestation (2). With a stepwise linear logistic regression analysis, they found that gestational ages could be ascertained with a high probability with the use of a combination of the proximal humeral epiphysis and colonic grades (6). There appears to be a high degree of correlation between the maximal transverse diameter and gestational age.

In normal pregnancy, the four stages of fetal intestinal maturity described here can be easily distinguished and reproduced with fewer interobserver differences. The grading system of intestinal maturity was well adjusted with the biparietal diameter (3).

The recently introduced TDx-FLM assay (Abbott Laboratories, North Chicago, IL) provides a quantitative,

rapid and automated measurement of the amniotic fluid surfactant-to-albumin ratio. The TDx-FLM test has a better sensitivity and negative value than the lecithin-sphingomyelin ratio (L/S) (7). The phosphatidylglycerol (PG) test has a predictive ability similar to that of the TDx-FLM assay (8).

The TDx-FLM assay performs similarly to the L/S and PG tests in the prediction of RDS. It has been claimed that the efficiency of tap test was also comparable with phospholipid profile in detecting of pulmonary maturity (4,9). In common obstetric practice, clinicians are requesting several of these AF tests for fetal lung maturity evaluation. But this approach is time consuming, requires extra laboratory staff, yields conflicting results and is costly for patients and the hospital (10). To use laboratory tests and personnel most effectively, efforts may be directed toward noninvasive and less time consuming methods.

Our study is the first report that compares fetal intestinal parameters with amniotic fluid maturity markers and with the status of newborn babies.

In this preliminary study, we showed that as the colonic ecogenicity approaches that of the liver, the incidence of fetal maturity increases. Colonic diameter smaller than 10 mm provides predictability of RDS in 78% of patients which is equal to that of TDx-FLM. This study also indicates that non-invasive ultrasonographic markers of intestinal maturity are better predictors of pulmonary maturity than AF tests. The presence of colonic haustral development and small bowel peristalsism were not good predictors of RDS because of low sensitivity. These findings suggest that colonic echogenicity and diameter are powerful predictors of fetal lung maturity and could be used instead of AF maturity markers.

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Yazışma Adresi: Dr.Erdal YERMEZ

SSK Hastanesi

Kadın Hastalıkları ve Doğum Kliniği, MANİSA