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Assessment of Fetal Lung Maturity by Ultrasonography.

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ABSTRACT

Background: Pulmonary function is one of the important factor on which survival of the preterm born baby depends. It is also plays important in the management of patients in modern obstetrics. In our country, main patient load comes from poorly educated community, so majority of mothers are not able to provide the required menstrual history. On other hand clinically determined gestational age of the fetus can be interpreted wrongly due to pathological conditions associated with pregnancy such as diabetes and IUGR. **Methods:** This study will help us to determine the utility of ultrasound in assessing the fetal lung maturity. The standard test for the assessment of fetal pulmonary function i.e. amniocentesis. It is invasive, can be performed by trained persons, costly and may have complications. Ultrasound being a widely used routine obstetric scanning tool, it is non-invasive and cost effective. **Results:** In the study, ultrasound parameters used were Biparietal diameter (BPD), Placental grading, epiphyseal centers of the lower limb and Free were floating particles in the amniotic fluid. These parameters with compared with Shake test performed on the amniotic fluid. **Conclusion**: The study showed the fetal lung maturity assessed by the ultrasound parameters was useful. BPD being most helpful among them followed by Epiphyseal centers of lower limb, Placenta and free floating particles in the amniotic fluid.

Keywords: Fetal lung maturity; Ultrasonography; Biparietal diameter; Placenta; Epiphyseal centers of lower limb; Free floating particles in the amniotic fluid.

INTRODUCTION

Fetal lung maturity is the key factor for the survival of prematurely delivered newborn baby.[1]
Knowledge of the fetal lung maturity is helpful to make the decision of continuation or termination of pregnancy.[1]

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Methods of determination of fetal lung maturity are:[2]

1. Clinical methods:
   - Menstrual history & Last menstrual period(LMP)
   - Per abdomen examination
   - Date of quickening
2. Ancillary methods:
   - Amniocentesis[3]
   - Radiography
   - Ultrasonography

Clinical methods have drawbacks. In many cases patients do not know the exact LMP or date of quickening. Per abdominal examinations can also give erroneous results in cases such as polyhydrominos or multiple gestation or IUGR.
Amniocentesis is an invasive technique. Biochemical indicators like lecithin, sphingomyelin, phosphatidyl choline are measured in amniotic fluid to determine the fetal lung maturity.
Few amniotic fluid tests used to determine the fetal lung maturity are:[4]

- Lecithin to sphingomyelinratio(L/S ratio)
- Phosphatidyl glycerol levels in amniotic fluid
- DPPC (Dipalmitoylphosphatidyl choline)levels in amniotic fluid
- Fluorescence polarization of amniotic fluid.
- Optical density of amniotic fluid at 650 nm
- Shake test

Of the above-mentioned tests, Lecithin to sphinomyelin ratio is considered accurate but as amniocentesis is an invasive test, has dangerous complications and can only be done by expertise and is costly. Shake test has an accuracy comparative with L/S ratio. It is a bed side test & cost effective, easy to perform.

Radiation hazards to fetus are proved hence the use of X-rays in determination of lung maturity is not done now a days.

Ultrasound is the gold standard for antenatal screening of fetus. Ultrasonic findings used as predictors of fetal lung maturity are:[5]

- Placental grading[6,7]:

Grade III maturation of placenta indicates the fetal lung maturity

- Bi-parietal diameter(BPD)[8]:

BPD >90 mm ~ 40 weeks also indicates fetal lung maturity.

- Lower limb epiphyseal centers[9]:

Distal femoral epiphysis (DFE) and proximal tibial epiphysis (PTE) appearance is an indicator of fetal lung maturity.

Antenatal detection of DFE and PTE and their size is seen to correlate with amniotic fluid L/S ratio.

- Appearance of free floating particles in the amniotic fluid is also one of the indicators of fetal lung maturity on ultrasound[10].

Comparative study of fetal lung maturity assessed by amniotic fluid parameters and ultrasound parameters is done. This study will help in assessing the accuracy of ultrasound parameters in detecting the lung maturity of the fetus.

Aims and Objectives

- To assess the fetal lung maturity using ultrasound parameters:
  1. Placental grading
  2. Biparietal diameter.
  3. Measurements of lower limb epiphysis: DFE and PTE
  4. Free floating particles in the amniotic fluid on ultrasound.
- Role of above Ultrasound indicators in detecting the fetal lung maturity.

MATERIALS AND METHODS

100 pregnant preterm or term patients were selected randomly.

Ultrasound of these patients was done in the Department of Radio-diagnosis. The ultrasound findings were correlated with the amniotic fluid test for fetal lung maturity –Shake test.

Ultrasound machine Mindray Diagnostic Ultrasound System-BC7 with 3.5 Hz convex transducer was used.

Methods

1. Radiological investigation– Ultrasonography
2. Laboratory investigation –Shake test of the amniotic fluid

Technique

(A) Ultrasound Findings:

i. **Placenta** :Grannum's classification of placental grading was used.

ii. **Biparietal diameter(BPD)** :Fetal skull is measured in the axial section where clear midline echo of the thalamus is evident along with septum pellucidum with the help of calipers from outer table to the inner table of the skull.

iii. **Epiphyseal centers**: Lower limbs of the fetus are screened and measurements of distal femoral epiphysis and proximal tibial epiphysis are measured with calipers.

iv. **Free-floating particles in amniotic fluid**: Linear densities in the amniotic fluid are noted.

(B) Shake Test :

Amniotic fluid is obtained by performing artificial rupture of membranes with syringe to prevent the contamination of the amniotic fluid.

The amniotic fluid sample is taken in 5 test tubes i.e. 1ml, 0.8ml, 0.75 ml, 0.5 ml and 0.2 ml and diluted by normal saline so that the volume becomes 1ml in each testtube. 1 ml ethanol 95% is added in each test tube .All the test tubes are capped. Test tubes are shacked vigorously for 15 seconds and then placed vertically for 15 minutes. At the end of 15 minutes, the result is interpreted by presence of air bubble at the meniscus.

RESULTS

Table 1: Correlation of placental grades with shake test

Placental Grade	No. of Cases	Shake Test	
		Positive	Negative
0	2	0	2
I	30	17	13
II	22	19	4
III	46	44	2

Table 2: Distribution of placental grades by gestation

Gestational age (weeks)	No. of cases	Placental grades			
		0	I	II	III
<37 weeks	52	2	26	7	17
≥37 weeks	48	1	6	13	28

Table 3: Biparietal diameter as a predictor of fetal lung maturity as compared with Shake test.

BPD(mm)	No of cases	Positive shake test

<78	8	0(0 %)
>78	3	1(33.33%)
>80	1	0(0%)
>82	8	6(75%)
>84	8	7(87.5%)
>86	18	18(100%)
>88	14	11(78.5%)
>90	31	31(100%)
>92	9	9(100%)

Table 4: Correlation of diameters of the distal femoral and proximal tibial epiphysis with shake test

Epiphysis	Diameter(mm)	No. of cases	Shake test	
			Positive	Negative
Distal femoral epiphysis	0-2	14	6(42.8%)	8 (57.1%)
	3-4	16	11(68.7%)	5 (31.2%)
	5-7	70	68(97.1%)	2 (2.85%)
Proximal tibial epiphysis	0-2	14	4(28.5%)	10(71.4%)
	3-4	23	19(82.6%)	4(17.3%)
	5-7	63	62(98.4%)	1(1.5%)

Table 5: Correlation of free floating particles in amniotic fluid with shake test

	Shake test positive	Shake test negative	Total
FFP present	55	3	58
FFP absent	30	12	42
Total	85	15	100

Figure 1: Ultrasound image showing Grade III placenta.

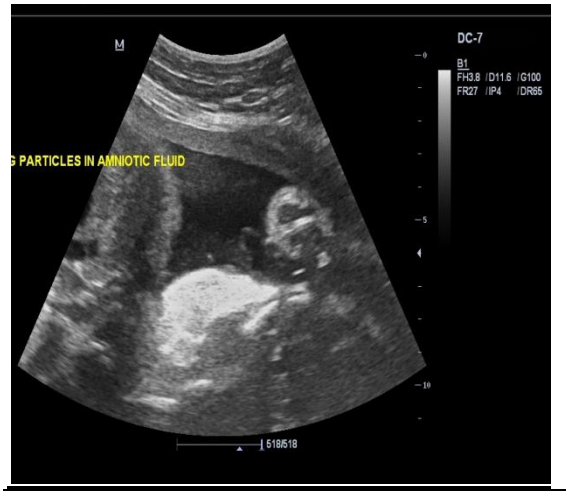

Figure 2: Ultrasound image with free floating particles in the amniotic fluid.

DISCUSSION

Biochemical tests used as fetal lung maturity predictors are discussed above. Shake test, among the biochemical test was performed in this study, as it is cost effective, easy to perform and have accuracy near to accuracy of L/S ratio.

Ultrasound Parameters:

1. Placental Grading:

Out of 100 patients, two Grade 0 placentas were noted and both of them showed negative shake tests, suggesting Grade 0 placenta predicts 0% of fetal lung maturity. 17 out of 30 Grade I placentas are shake test positive. 19 of 22 and 44 of 46 Grade II and Grade III maturity placentas respectively shows fetal lung maturity.

Predictivity of fetal lung maturity on the basis of placental grades is –

Grade 0 0 %
Grade I 56.6 %
Grade II 86.3 %
Grade III 95.6 %

2. Biparietal diameter(BPD):

Out of 100, 40 cases show BPD ≥ 90 mm. All of these 40 cases were positive shake test.

Rest 60 cases with BPD < 90 mm, 43 cases were shake test positive. This suggests 100 % correlation between BPD > 90 mm and fetal lung maturity.

3. Epiphyseal centers of lower limb :

Out of 100 cases 70 cases were having distal femoral epiphysis ≥ 5mm, 68 cases out of these 70 were shake test positive. Hence 97 % patients with DFE ≥ 5mm shows fetal lung maturity.

Proximal tibial epiphysis ≥ 5mm was present in 63 cases, 62 of them showed positive shake test.

That means 98.4 % cases with PTE ≥ 5mm show correlation with fetal lung maturity.

4. Free floating particles in amniotic fluid:

Free floating particles appear in amniotic fluid in late third trimester. Out of 100 patients, 58 patients showed presence of free-floating particles. The average gestational age of the patients with free-floating particles is 38 weeks 3 days. 55 patients out of 58 i.e. 94 % show positive shake test.

CONCLUSION

The study was undertaken to assess the ultrasonographic parameters to determine the fetal lung maturity as compared to the shake test.

The ultrasonographic parameters BPD, placental grades, Lower limb epiphyseal centers and free-floating particle in the amniotic fluid were taken into considerations. These parameters then were correlated with the shake test.

The study included 100 cases conclusions of the study are:

1. 95.6 % of Grade III maturity placenta shows fetal lung maturity.
2. All cases with BPD ≥ 90 mm show fetal lung maturity.
3. 94 % of cases with free-floating particles show fetal lung maturity.
4. 97 % of DFE ≥ 5 mm cases shows fetal lung maturity.
5. 98.4 % of PTE ≥ 5 mm cases shows fetal lung maturity.

Hence, this study concludes that when we use Ultrasound parameters in assessing the fetal lung maturity the following USG parameters are useful in descending order: BPD≥ 90 mm (100%),
PTE ≥ 5mm (98.4 %),DFE ≥ 5mm (97 %),Grade III maturity placenta (95.6 %) and free floating particles in the amniotic fluid (94%).

REFERENCES

1. Blackburn S.Maternal, Fetal, & Neonatal Physiology: A Clinical Perspective. Elsevier Health Sciences. 2007:336.
2. Misra O, Prabhu S, Singh S. Nelson Essentials of Pediatrics: First South Asia Edition. Elsevier Health Sciences.2016.
3. Misra R.Ian Donald's Practical Obstetric Problem, 6/e.2006.48
4. Misra R.Ian Donald's Practical Obstetric Problem, 6/e.2006.135-45
5. Beck A, Araujo Júnior E, Leslie A, Camano L, Moron A. Assessment of fetal lung maturity by ultrasound. J Matern Fetal Neonatal Med. 2015;28(6):617-22.
6. Fisher C. Placental aging monitored by Grey scale echography. Am. J. OBGY. 1976;143:941-43.
7. Grannum P. The ultrasonic changes in the maturing placenta and their relation to fetal pulmonic maturity. Am. J. OBGY. 1979; 133:915-22.
8. Lee. Ultrasonic determination of fetal maturity at repeat caesarean section. Obst.Gynaecol. 1971;38:294.
9. Mahony B. Epiphyseal ossification centers in the assessment of fetal maturity: Sonographic correlation with the amniocentesis lung profile. OBGY Survey. 1987;142:26-27.
10. Gross T. Sonographically detected free floating particles in amniotic fluid predict a mature lecithin-sphingomyelin ratio. J. Clin. Ultrasound. 1985; 13:405-09.

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