DETERMINATION OF FOETAL MATURITY BY SONOGRAPHIC ASSESSMENT OF EPIPHYSEAL CENTRES AND ITS CORRELATION WITH PULMONIC MATURITY

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SUMMARY

Sixty pregnant women with normal, singleton pregnancy with known L.M.P., and with gestational age of 36 weeks or more were selected from Antenatal Clinic. Ultrasound examination was performed and lower femoral and upper tibial epiphyses were identified and measured in axial plane. The mean values of diameters of epiphyses at each week of gestation were calculated. Amniocentesis was performed on the same day as ultrasound examination and amniotic fluid studied for the Bubble stability test (BST). The values of distal femoral epiphyses and proximal Tibial epiphyses were then correlated with B.S.T. A lower femoral epiphyses of more than 5 mm and proximal tibial epiphyses diameter of more than 3 mm were found to be highly predictive of pulmonic maturity as determined by B.S.T.

INTRODUCTION

An accurate assessment of foetal maturity in utero is required for optimal management of high risk pregnancies. The precise sonographic estimation of foetal gestational age in third trimester is not currently possible, since fetal growth in B.P.D, abdominal circumference and limb length measurement displays great individual heterogenicity after 28 weeks of gestation. Therefore, non-invasive methods for determining pulmonary maturity using alternative indices less dependent on somatic growth would be desirable. Recent study by Goldstein et al (1988) exploits far more accurate axial sonographic plane to identify the precise dimensions of lower limb ossification centres and offers a more reproducible method of analysis. Measurement of high amplitude echo from epiphyseal ossification centres by U.S.G. is a non-invasive technique for evaluation of the foetus. This present study was undertaken to (i) investigate the reliability of intra-uterine visualization and size of epiphyseal centres about the foetal knee and (ii) to correlate these centres with fetal maturity as

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estimated by BST on amniocentesis.

MATERIAL AND METHOD

The study was conducted in the department of Obstetrics and Gynaecology and the department of Radiology of LNJPN Hospital associated with Maulana Azad Medical College. A total of sixty patients were selected from ANC. The criteria for selection were -

(1) Pregnancy of 36 weeks or more

(2) Known L.M.P.

(3) Absence of any complication of pregnancy

(4) Absence of any maternal illness

(5) Singleton pregnancy

The routine followed in all patients was History taking, Laboratory investigations, Clinical examinations, Ultrasonography and Aminocentesis.

Methodology of epiphyseal centres localization and measurement:

Femur was located by method described by O'Brien et al (1981). The lower end was visualized and femoral epiphyseal centre located as a separate echogenic area. Measurements were obtained from outer to outer margins. Care was taken not to mistake the echogenic material within the intercondylar notch for the distal femoral epiphysis Similarly the proximal Tibial epiphyses was identified by visualizing proximal tibia and locating the echogenic epiphyseal centre adjacent to the head of the tibia.

Patients were excluded if proper measurement could not be obtained because of foetal position or if foetal anomalies were present. Three readings within a variation of 1 mm were taken and mean of 3 readings were taken as diameter of the centre.

Amniocentesis was performed and Bubble Stability Test was done and results were divided in groups as described by Schlueter et al (1979). The patients were followed up and neonates were assessed clinically according to Ballard Scoring (1984).

OBSERVATIONS:

TABLE I

Mean diameter and D F E (mm) and P T E (mm) at each week of gestation

Gestation Age by L.M.P.	No. of Cases	Mean D.F.	± S.D.	Mean P.T.E.	± S.D.
35 Weeks	7	5.2	0.98	1.46	1.4
37 Weeks	13	5.7	0.62	3.1	1.8
38 Weeks	10	5.86	0.67	3.5	1.97
39 Weeks	17	6.01	0.92	4.6	1.51
40 Weeks	12	6.4	0.98	5.15	1.8
41 Weeks	1	6.8	0	6.3	0

From Table-I : It is evident that mean diameter of D F E increases from 5.2 ± 0.98 mm at 36 weeks to 6.8 mm ± 0 mm at 41 weeks. P T E also shows a progressive increase from 1.46 ± 1.4 mm at 36 weeks to 6.3 mm ± O mm at 41 weeks of gestation.

DFE - Distal Femoral Epiphyses
PTE - Proximal Tibial Epiphyses

TABLE - II

Distribution of (+) & (-) B S T (Bubble Stability Tex) at each weeks of gestation

Gestational Age by L.M.P.	Total No. of Cases	B.S.T. + No. of Cases	%	B.S.T. - No. of Cases	%
36 Weeks	7	0	0	7	100
37 Weeks	13	8	61.5	5	38.5
38 Weeks	10	9	90	1	10.0
39 Weeks	17	17	100	0	0
40 Weeks	12	12	100	0	0
41 Weeks	1	1	100	0	0
Total	60	47		13	

Among the seven patients at 36 weeks, all the patients (100%) had negative B.S.T. At 37 Weeks of gestation, 8 out of 13 (61.5%) had positive B.S.T. whereas positivity of B.S.T. from 90 - 100% 38 Weeks onwards.

Of the total 60 patients in this study, 44 had normal vaginal delivery and 16 had C.S. All thew neonates were term according to Ballard scoring and none of them had any evidence of B.D.S.

TABLE III

Correlation of the diameter of D F E (mm) with B S T

D.F.E. (mm)	Total No. of Cases	B.S.T. + No. of cases	%	B.S.T. - No. of cases	%
0-3	0	0	0	0	0
3.1-4	2	0	0	2	100
4.1-5	5	2	40	3	60
5.1-6	26	20	76.93	6	23.07
6.1-7	22	20	90.9	2	9.1
7.1-9	5	5	100	0	0
Total	60	47		13	

X^2 = 38.05 P<0.001

The correlation of the diameters of D F E & B S T was found to be highly significant.

TABLE IV

Correlation of diameter of P T E (mm) with B S T

P T E	Total No. of cases	BST + No. of cases	%	BST - No. of cases	%
Not localised	6	0	0	6	
1-3	12	5	41.6	7	
3.1-4	4	3	75.6	1	
5.1-6	11	11	100	0	
6.1-7	6	6	100	0	
7.1-8	0	0	0	0	
Total	60	46	14		

$X^2 = 23.83$ P<0.001

The correlation of diameters of P T E with B S T was found to be highly significant (P<0.001).

Thus, the 60 patients in the study were divided in two groups on the basis of diameter measurement for D F E and P T E.

	D F E	P T E
Gr. 1 Diameter	0-5 mm	0-3mm
Gr.2	5.1-9mm	3.1-8mm

TABLE V

Correlation of Gr. 1 and Gr. 2 with B S T

Gr.	D.F.E. Diameter	No. of Cases	B.S.T. +	B.S.T. -	P.T.E Diameter	No. of Cases	B.S.T. +	B.S.T. -
1	0-5 mm	7	2	5	0 - 3	18	5	13
2.	5.1-9 mm	53	45	8	3.1 - 7	42	41	1
		60	47	13	60	46	14	

$X^2 = 9.43$ P<0.005 $X^2 = 32.32$ P<0.001

From Table V, it is evident that diameter of D F E of more than 5 mm and that of P T E of more than 3 mm is highly predictive of pulmonic maturity.

DISCUSSIONS

Various workers have attempted to correlate the Ultrasonic epiphyseal centres with gestational age and a few have attempted to correlate it with lung maturity.

Chinn et al (1984) used the presence of a distal femoral epiphyses to indicate a gestational age > 33 weeks and this method according to them was 95% sensitive, 95% specific and accurate overall in 95% of a selected cohort of 61 cases. In the same cohort, they postulated that the presence of P T E was highly predictive (95%) of a gestational age > 35 weeks. Their study was based on a 'all or none' observation. The epiphyseal ossification centres is either present or absent. They did not attempt to measure the size of the centres and did not correlate it with indices of pulmonary maturity, which ensures less of R D S (Respiratory Distress Syndrome) in the newborn.

Another study by Mahony et al (1985) concluded that the age of a foetus without an identifiable D F E is most likely to be < 34 weeks. They also concluded that D F E size increases linearly with gestational age and that the gestational age of a foetus whose D F E measures 7 mm is most likely 37 weeks.

Goldstein et al (1988) reported that the mean gestational age of imaging D F E was 34 weeks and that of P T E as 38 weeks. They reported D F E measuring 3 mm was associated with gestational age 37 weeks in 85% foetus and P T E of 1 or 2 mm was associated with gestational age of 36 weeks in 88% fetuses whereas P T E 3 mm was associated with a gestational age of 38 weeks in 94% foetuses.

Khalil and Tabsh (1984) and Goldstein et al (1988) attempted to correlate tthe ultrasonic epiphyseal centres maturity using Lecithin-Sphingomyelin ratio as base line test. Khalil and Tabsh (1984) reported that patients with a D F E of more than or equal to 5 mm and P T E greater than or equal to 3 mm provide predictibility in 95% patients. The conclusion of the present study are also similar ie., D F E of more than 5 mm and P T E of 3 mm or more are highly predictive of pulmonary in maturity in normal pregnant women. Goldstein et al (1988) reported that in uncomplicated pregnancies a D F E mm in axial plane or sonographic identification of a P T E of any dimension correlated highly with pulmonary maturity ($P<0.002$). The lower values quoted by Goldstein et al could be attributed to ultrasound scanner of different tissue velocity and better resolution power being used.

CONCLUSION

The ultrasonic identification and measurement of D F E and P T E is a new and promising parameter for pulmonic maturity. This parameter is highly sensitive, noninvasive and free of errors which arise due to biologic variation in growth of the foetus.

ABBREVIATIONS

B S T	-	Bubble Stability Test
B P D	-	Bi Parietal Diameter
FL	-	Femur Length
D F E	-	Distal Femoral Epihysis
P T E	-	Proximal Tibial Epiphysis
L M P	-	Last Menstrual Period

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