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ULTRASONOGRAPHIC EVALUATION OF GESTATIONAL AGE BY CEREBELLAR MEASUREMENT

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ABSTRACT

With advent of ultrasound, fetal changes are efficiently depicted by ultrasonography with the evolving parameters as indicators of intrauterine growth. Another predictor for gestational age can be Transcerebellar diameter (TCD) along with other parameters A study was done on the pregnant women between 15 to 40 weeks who presented to our department for ultrasound examination over a period of one year. All pregnant women were evaluated with complete history, clinical examination and ultrasonography. The results of our study provide normative data of fetal cerbellar growth throughout gestation and demonstrate that the TCD remained unaffected by fetal growth retardation, whereas most biometric parameters measured sonographically were significantly affected by the overall growth retardation process. Estimation of gestational age by transcerebellar diameter correlated with the estimation of the gestational age by other multiple growth parameters.

INTRODUCTION

Increased diagnostic capability to identify multiple structural lesions within the fetus has many implications [1]. Early diagnosis of a congenital anomaly with a hopeless prognosis allows for termination of pregnancy. Detection of a less severe defect “or” late determination of severe malformation may alter the subsequent obstetrical course. Caesarean section may be indicated when continued intrauterine existence is detrimental to the fetal well being. Some malformation may be followed to a normal term delivery with subsequent extrauterine evaluation and therapy [2].

One of the commonest problems that an obstetrician faces frequently is the estimation of fetal maturity for the purpose of either prolonging pregnancy or when the termination of the pregnancy is being considered for such complications as pregnancy induced hypertension, diabetes and Rh diseases [3].

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The means that are widely accepted for estimating fetal maturity are:

1. Gestation age
2. Weight of the fetus

The maturity of the fetus is a pre-requisite for inducing labour especially in high risk pregnancy. It is rather difficult to assess accurate gestation age especially in our country, where most of the patients don’t have an accurate idea of the date of their last menstrual cycle. Attempts have therefore been made to assess the correct gestational age.

METHODOLOGY

This study of ultrasonographic estimation of gestational age by transcerebellar diameter in normal and intrauterine growth retarded pregnancies was conducted on 100 pregnant women (80 normal pregnancies and 20 IUGR pregnancies). These 100 women recruited into the study from routine antenatal clinic (OPD) and in patients admitted (IP) into Navodaya Medical College Hospital & Research Center, Raichur. A total number of 100 scans were performed between 15 and 40 weeks out of which 80

were in the group unassociated with any medical disorder and 20 were in the group of intra uterine growth retarded pregnancies.

Inclusion criteria

1. Normal pregnancies between 15 and 40 weeks of singleton pregnancies with known last menstrual period.
2. Clinically suspected intra uterine growth retardation.

Exclusion criteria

1. Multiple pregnancies
2. Congenital malformations
3. First trimester pregnancy.

Examination method

An informed consent from all the patients was taken and the patients were explained about the atraumatic nature and significant diagnostic importance of the procedure, which is being performed. Examination was performed with patient in the supine position. After taking a brief history, obstetrical examination was done; blood pressure was recorded in the recumbent position. Fundal height was measured in the supine position with empty bladder. An ultrasound examination was performed with the patient in the supine position and the synthetic ultragel was applied over the abdomen, to get a good acoustic coupling.

The ultrasound machine used for the study was a real time 2-D ultrasound unit, with a 3.5 and 5MHz convex cuvilinear transducer – Toshiba(Nemio) and Esoate with M and B mode for simultaneous imaging and calculating heart rates in the fetus. Images were recorded .

RESULTS

From the ultrasonic data obtained from normal pregnancies, analysis was done to correlate TCD with BPD, FL, AC and HC, which showed good correlation.

Table 1. Correlation of TCD with BPD, FL, AC and HC in normal pregnancies

Parameters Compared	R^2	p-value
TCD versus BPD	0.89	0.0001
TCD versus FL	0.94	0.0001
TCD versus AC	0.90	0.0001
TCD versus HC	0.90	0.0001

Table 2. Correlation of GA with BPD, FL, AC and HC in normal pregnancies

Parameters compared	R^2	p-value
GA vs BPD	0.98	0.0001
GA versus FL	0.97	0.0001
GA versus AC	0.99	0.0001
GA versus HC	0.98	0.0001
GA versus TCD	0.95	0.0001

In normal pregnancies, gestational age (GA) was correlated to various ultrasonic parameters including BPD, FL, AC, HC and TCD and a regression analysis were done. The analysis showed that the BPD was well correlated to GA (R^2 = 0.98) and the relationship was curvilinear, best described by a polynomial equation of the second order.

Nomograms showing mean BPD, FL, AC, HC and TCD measurements in millimeters at 5^{th}, 50^{th} and 95^{th} percentile for the corresponding gestational age was derived using ultrasonic data in normal pregnancies.

Table 3. Nomogram showing mean BPD (mm) measurements at 5^{th}, 50^{th} and 95^{th} percentile corresponding gestational age

GA	5^{th} Percentile	50^{th} Percentile	95^{th} Percentile
15^{th} week	32.00	32.00	32.00
16^{th} week	36.10	37.00	37.90
17^{th} week	37.20	39.00	40.90
18^{th} week	39.60	40.50	41.40
19^{th} week	42.00	42.00	42.00
20^{th} week	46.00	47.30	48.90
21^{st} week	49.20	50.50	51.90
22^{nd} week	54.20	55.50	56.90
23^{rd} week	50.60	57.00	60.80
24^{th} week	58.00	58.70	59.80
25^{th} week	60.20	62.50	66.30

26th week	65.00	65.00	65.00
27th week	66.10	67.00	67.90
28th week	68.60	71.80	74.60
29th week	73.20	75.30	77.70
30th week	72.00	73.50	74.90
31st week	78.10	78.50	79.00
32nd week	75.90	78.60	80.50
33rd week	73.80	78.80	82.00
34th week	83.30	85.50	87.80
35th week	86.10	86.50	87.00
36th week	86.40	88.60	90.00
37th week	86.60	90.30	93.00
38th week	88.00	88.00	88.00
39th week	92.00	94.00	98.80
40th week	93.10	94.00	94.90

Table 4. Nomogram showing mean FL(mm) measurements at 5th, 50th and 95th percentile for the corresponding gestational age

GA	5th Percentile	50th Percentile	95th Percentile
15th week	19.00	19.00	19.00
16th week	22.10	22.50	23.00
17th week	21.50	23.50	24.90
18th week	25.70	26.90	27.90
19th week	30.00	30.30	30.90
20th week	31.20	32.00	32.90
21st week	35.10	35.50	36.00
22nd week	35.20	36.50	37.90
23rd week	38.20	41.00	46.40
24th week	43.10	45.00	47.60
25th week	45.20	46.80	49.40
26th week	47.00	47.00	47.00
27th week	50.00	50.00	50.00
28th week	48.50	51.50	53.90
29th week	55.00	55.30	55.90
30th week	54.20	55.50	56.90
31st week	58.10	58.50	59.00
32nd week	61.50	61.90	62.40
33rd week	65.00	65.30	65.90
34th week	64.30	66.20	67.80
35th week	67.10	67.50	68.00
36th week	68.20	69.60	70.80
37th week	71.00	72.20	74.00
38th week	74.10	74.50	75.00
39th week	72.30	73.80	75.00
40th week	74.00	74.50	75.00

Table 5. Nomogram showing mean HC (mm) measurements at 5th, 50th and 95th percentile for the corresponding gestational age

GA	5th Percentile	50th Percentile	95th Percentile
15th week	104.00	104.00	104.00
16th week	118.20	120.00	121.80
17th week	130.60	137.00	142.00
18th week	146.30	149.70	152.50

19th week	162.00	162.30	162.90
20th week	167.20	173.80	180.00
21st week	183.70	190.00	196.30
22nd week	208.40	211.50	214.70
23rd week	202.00	212.60	218.80
24th week	213.50	217.70	221.60
25th week	228.30	238.00	249.10
26th week	260.00	260.00	260.00
27th week	251.70	257.50	263.40
28th week	266.60	271.30	277.00
29th week	280.10	281.00	281.90
30th week	280.80	283.30	285.70
31st week	281.50	285.50	289.60
32nd week	286.40	299.40	313.20
33rd week	291.40	313.30	336.90
34th week	303.80	312.30	321.30
35th week	315.30	317.50	319.80
36th week	317.60	321.40	326.00
37th week	322.40	332.90	341.20
38th week	343.50	347.50	351.60
39th week	331.30	337.80	344.50
40th week	334.00	342.50	351.10

Table 6. Nomogram showing means TCD (mm) measurements at 5th, 50th and 95th percentile for the corresponding gestational age

GA	5th Percentile	50th Percentile	95th Percentile
15th week	14.00	14.00	14.00
16th week	15.00	15.00	15.00
17th week	17.00	17.30	17.90
18th week	18.10	18.50	18.90
19th week	19.10	19.70	20.00
20th week	21.00	21.30	21.90
21st week	21.00	21.00	21.00
22nd week	23.10	23.50	24.00
23rd week	24.00	24.60	25.00
24th week	25.00	25.30	25.90
25th week	26.20	27.30	28.00
26th week	32.00	32.00	32.00
27th week	30.10	31.00	31.90
28th week	29.30	32.50	35.70
29th week	31.30	33.30	34.90
30th week	34.10	35.00	35.90
31st week	36.20	37.50	38.90
32nd week	36.80	39.00	41.60
33rd week	37.50	40.50	44.30
34th week	39.30	42.00	46.50
35th week	40.10	41.00	41.90
36th week	43.40	47.00	50.60
37th week	44.00	46.70	50.60
38th week	50.10	50.50	51.00
39th week	46.30	51.30	55.50
40th week	50.20	52.00	53.80

DISCUSSION

To be of practical value the screening test should be simple and acceptable to the patient and physician. It should have a high degree of sensitivity and low degree of false positive results. In our study we have scanned eighty uncomplicated pregnancies and twenty intra uterine growth retarded pregnant mothers between 15-40 weeks of gestation. The mean age group for normal pregnancy varies with in the range of 21.9 ± 3.18 yrs and 22.8 ± 3.38yrs in cases of IUGR. There is not much difference in the mean age between normal and IUGR.

Among the 80 patients with normal pregnancies 45 were primigravida, 18 were gravida-2, 15 were gravida-3 and 2 were gravida-4. Among 20 patients with IUGR pregnancies 11 were primigravida, 5 were gravida-2, 3 were gravida-3 and 1 was gravida-4. There was no statistically significant difference between the two groups in regard to parity (p=0.91).

In our study the sonographic visualization of the fetal cerebellum was present as early as 14 to 15 weeks of gestation. The characteristic image of the cerebellum by ultrasonography appears as two lobules on either side of the midline, located in the posterior cranial fossa. In all the examinations cerebellum was seen, however before the late third trimester measurements of the transverse cerebellar diameter are easier to perform. The transverse cerebellar diameter, biparietal diameter, femur length, abdominal circumference and head circumference were measured in all the cases to assess the gestational age of the fetus and an attempt was made to detect the correlation between all these parameters and gestational age. An attempt was also made to know correlation between TCD and other parameters. Nomograms for estimating the gestational age from the measured TCD, BPD, FL, AC and HC in normal pregnancies was done [5,6].

Stuart Campbell et al (1970) [2] first investigated to link the fetal BPD to the gestational age. In his study he has obtained sonar BPD measurements at each gestational age from a large number of normal gravidas in whom LMP was known. Using these data he defined the mean BPD values corresponding to each week of gestation.

He proposed that delivery occurred spontaneously with in ± 1 week of menstrual expected date of delivery and in 84% of the gravidas with uncertain dates, delivery occurred within ± 9 days of sonar expected date of delivery.

Sabbaga et al then defined the confidence limits of fetal age to the second and third trimester by BPD. In his study he further explained the relation existing between the BPD and duration of pregnancy and showed that prior to 26 weeks the BPD vary markedly around these values and are inaccurate indices of fetal age. The growth rates are faster in the earlier period of pregnancy, for example BPD grows by 3-4 mm per week, whereas after 30-week growth rate is 2mm per week. Therefore the more advanced the pregnancy the less reliable is the dating.

Hadlock et al [7] worked on elucidating the head shape changes. With the possibility of alteration for fetal head shape including dolichocephaly or brachycephaly, the criteria for acceptance of BPD for reflecting the gestational age may be wrong.

CONCLUSION

Fetal biparietal diameter, femur length, abdominal circumference and head circumference measurements of the fetus in normal pregnancies were comparable with transcerebellar diameter measurement between 15 and 40 weeks of gestation.

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CONFLICT OF INTEREST: Nil

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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