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CORRELATION BETWEEN ULTRASONOGRAPHY MEASURED TRANSCEREBELLAR DIAMETER OF FOETUS WITH GESTATIONAL AGE

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ABSTRACT

Introduction: knowledge of foetal age and growth is essential in management of all pregnancies. Ultrasound dating of pregnancy provides more accurate estimation of gestational age than by menstrual history. The transverse cerebellar diameter (TCD) is reliable parameter for estimating gestational age.

Methods: This prospective observational study was conducted in 300 pregnant women. Ultrasound examination for TCD and gestation age was done between 15-40 weeks of gestation. TCD was measured in transverse view of foetal intracranium. Statistical analysis was performed using suitable tests.

Results: Mean TCD at 15 weeks was 15.13±0.68mm and at 40 weeks was 44.74±2.9mm. Centiles for TCD for each GA were derived. There was significant correlation between TCD and menstrual gestational age. This study shows linear relationship between TCD and gestational age.

Conclusion: TCD is reliable method of gestational age determination

KEYWORDS : transverse cerebellar diameter(TCD), gestational age(GA), ultrasound, cerebellum, regression equation

INTRODUCTION:

Objective knowledge of the gestational age is essential in management of all pregnancies particularly for the management of high risk pregnancies, elective planned induction of labour and elective caesarean for previous caesarean section deliveries and to distinguish pre-term from term infants. Determination of foetal growth is crucial in planning pregnancy management, especially for low birth-weight infants. In addition, post-maturity problems may arise when mothers are not aware of last menstrual period (LMP).

Traditionally, the gestational age of the foetus is determined from the date of the last menstrual period. Many women can't accurately recall their date of last menstrual period. Even when the date of last menstrual period can be recalled reliably, the gestational age so determined is not always reliable. This may be because of irregular cycles, lactation, recent use of hormonal contraceptives, intrauterine devices, bleeding in first trimesters, hormone therapy etc. Therefore ultrasound provides a more accurate estimation of gestational age than by menstrual history.

Cerebellum is not liable to change in its form by extrinsic pressure and its size correlates with gestational age(GA). Transverse cerebellar diameter (TCD) can predict GA especially in cases where there is variation of foetal head shape such as dolichocephaly and brachycephaly. The transverse cerebellar diameter (TCD) is a reliable parameter for estimating gestational age.

It is therefore important to study the correlation between foetal TCD and gestational age. So, this study was planned to evaluate the role of foetal transcerebellar diameter in predicting gestational age.

AIMS AND OBJECTIVES:

1. To derive normograms for estimating the gestational age of the fetus from the ultrasonography measured transcerebellar diameter
2. To assess the correlation between transverse cerebellar diameter and gestational age.

MATERIAL AND METHOD

This prospective observational study was performed on 300 patients who came for ultrasonography in Department of Radiology and Imaging, Grant Government Medical College and JJ group of hospitals, Mumbai, from November 2016 to April 2017.
Written informed consent was taken from the patients.

Inclusion criteria:

(a) Normal singleton pregnancies of 15 to 40 weeks gestation with known last menstrual period.

Exclusion criteria:

1. Unknown or inaccurate date of last menstrual period.
2. Irregular menstrual cycles.
3. Oligohydramnios.
4. Polyhydramnios.
5. Diabetic mother.
6. Pregnancy induced hypertension.
7. Pre eclampsia.
8. Dolichocephalic skull.
9. Multiple gestation.
10. Fetal chromosomal abnormalities.
11. Intrauterine growth restriction.
12. Any other known maternal and foetal abnormality.

The measurements were obtained with commercially available, curvilinear array real time, B-mode ultrasound (SonoSite, S-ICU), equipped with a 3.5 MHz transducer.

During each ultrasound examination bi-parietal diameter(BPD),head circumference (HC), femur length(FL), abdominal circumference (AC), transverse cerebellar diameter (TCD) were measured.

TCD measurement method: Transverse views of the fetal intracranial anatomy were obtained. Using the horizontal plane of the foetal head, the landmark of the thalami and cavum septum pellucidum were identified in the midline. The transducer was slightly rotated caudally to bring the characteristic “butterfly” appearance of the cerebellum into view. TCD was then measured as the widest diameter across both hemispheres in outer-to-outer fashion . Averaging of at least three measurements were taken.

Statistical analysis:

All the measurements were analysed using the Statistical Package for the Social Sciences (SPSS).

Mean and standard deviation of TCD was determined at each week of gestation. TCD Normograms were derived by taking 5th, 50th and 95th percentiles. Statistical analysis was performed using Student's 't' test, Analysis of Variance (ANOVA), Pearson's Correlation, Regression analysis wherever applicable. A "P" value of <0.05 was considered to be statistically significant.

OBSERVATION AND RESULT:

There were singleton 300 foetuses that met inclusion criteria for this study. TCD measurements for gestational ages from 15 to 40 weeks were done.

Collected data was converted into variables which were analysed by Statistical package for social sciences (SPSS).

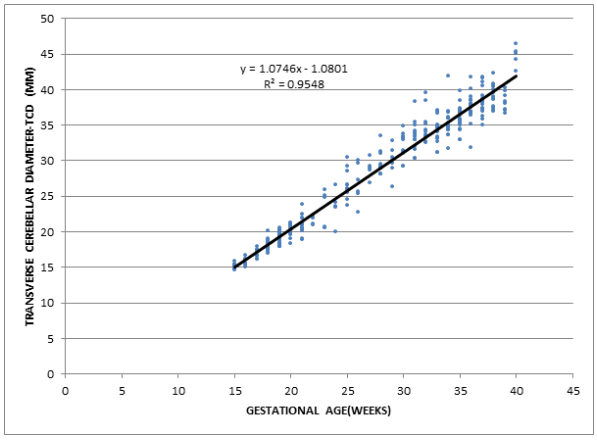
Table 1: Mean Transverse cerebellar diameter –TCD(mm) ,standard deviation(SD), TCD percentiles (5th, 50th and 95th) relative to gestational age (weeks).

GA by LMP (week)	frequency (N)	mean TCD (mm)	SD	variance	SE of mean	TCD percentiles (mm)		
						5th percentile	50th percentile	95th percentile
15	10	15.13	0.34	0.117	0.108	14.6	15.05	15.8
16	7	15.85	0.58	0.34	0.22	15	16.1	16.7
17	8	16.93	0.67	0.45	0.23	16.1	16.9	18
18	18	18.32	0.7	0.49	0.16	17	18.5	20.1
19	21	19.17	0.86	0.75	0.18	18	19.4	20.3
20	14	20.13	0.82	0.67	0.21	18.3	20.15	21.2
21	14	20.99	1.29	1.67	0.34	18.9	20.95	23.8
22	5	21.74	0.65	0.43	0.29	21	21.9	22.4
23	5	23.4	2.58	6.7	1.15	20.5	24.8	25.9
24	5	23.56	2.35	5.55	1.05	20	23.6	26.6
25	12	26.55	1.94	3.77	0.56	23.7	26	30.5
26	6	26.81	2.75	7.61	1.12	22.8	26.5	30
27	5	28.9	1.39	1.93	0.62	26.9	28.9	30.8
28	11	29.64	1.65	2.72	0.49	28.2	29	33.5
29	7	29.95	2	4.02	0.75	26.4	30	32.8
30	11	32.14	1.87	3.52	0.56	29.2	33	34.9
31	13	33.4	2.14	4.61	0.59	30.4	33.4	38.3
32	12	34.67	2.24	5.02	0.64	32.6	33.85	39.6
33	17	34.23	1.72	2.97	0.41	31.2	34.2	37.1
34	16	35.37	2.17	4.75	0.54	31.7	35	41.9
35	21	36.02	1.64	2.71	0.35	33	35.8	38.5
36	19	37.5	1.98	3.94	0.45	31.9	37.8	41.8
37	17	38.35	1.99	3.97	0.48	35	38.2	41.8
38	13	39.16	1.64	2.7	0.45	37	39	42.3
39	8	38.32	1.32	1.75	0.46	36.7	38.15	40.2
40	5	44.74	1.45	2.1	0.64	42.6	45.1	46.5

Table 1 shows the mean TCD values and standard deviation at gestational ages 15 – 40 weeks. The mean TCD at 15 weeks was 15.13±0.68mm, mean TCD at 40 weeks was 44.74±2.9mm. Table 1 shows centiles for TCD for each GA. There was significant correlation between TCD and menstrual gestational age ($r = 0.9771$; $p < 0.00001$).

Regression analysis was done for Trans-Cerebellar Diameter and Gestation Age. Formula obtained was $y = 1.0746x – 1.0801$

Graphical representation of collected data between Gestation Age and Transverse Cerebellar Diameter shows linear relationship [Graph 1].



Graph 1: Relationship between TCD and gestational age

DISCUSSION:

Accurate estimation of GA is an important part of antenatal care. Obstetric ultrasound examination is very useful in achieving this. Routinely assessed parameters for GA estimation include biparietal diameter(BPD), head circumference(HC), abdominal circumference(AC) and femur length (FL). Transverse cerebellar diameter (TCD) is an emerging parameter found to be more accurate in predicting GA than the routine parameters.

In this study, foetal biometric parameters were estimated at GA between 15– 40 weeks.

The TCD values in this study ranged from 14.6 mm to 46.5 mm. The graph of TCD versus GA demonstrated a linear relationship with positive correlation ($r = 0.9771$; $p < 0.0001$). This relationship of foetal cerebellar growth and gestational age is statistically significant. Similar observations were obtained in other studies and their results are also comparable to our study as shown in the Table 2.

Mikovic and Markovic et al[1] studied the growth of fetal cerebellum in normal pregnancy between 20 and 40 weeks and proposed that TCD can be practically applied in cases where it is difficult or impossible to measure BPD or in cases where it is unsuitable because of the expressed moulding of the head.

Guan et al [2] generated a nomogram for TCD with respect to gestational age and compared fetal TCD, BPD, HC, AC and FL measurements by ultrasound. Correlation coefficient between the birth weight and their parameters were studied and concluded that the function of the TCD in the evaluation of fetal growth and development is better than any other parameter.

Reece EA et al [3] and Goldstein I et al [4] in their study concluded that there was no significant difference between growth of the transverse cerebellar diameter in the appropriately grown and growth restricted children. These data confirm the relative preservation of normal cerebellar growth in growth restricted foetuses.

Table 2: Comparison of present study with previous studies for relationship between TCD and gestational age.

Study	Correlation Coefficient (r)	R2	P value
Present study	0.9771	0.9548	<0.00001
Goldstein I et al 1987 [5]	_	0.948	<0.001
Guan et al 1992 [2]	0.996	_	<0.0005
Vinkesteijn ASM et al 2000 [6]	_	0.96	<0.0001
Goel P et al 2010 [7]	0.991	_	<0.0001

CONCLUSION:

In this study, the relationship was established between TCD and gestational age between 15-40 weeks. This study shows linear relationship between gestational age and TCD. So, transcerebellar diameter is a reliable method of gestational age determination between 15-40 weeks of gestation.

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