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Original Research

Fetal Transcerebellar Diameter (TCD): A Better Sonological Parameter For The Estimation Of Fetal Gestational Age (FGA) In Normal Pregnancy

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Abstract

Background: Proper management of pregnancies requires the knowledge of expected date of delivery and more so in cases of high risk pregnancies to avoid complications. Traditionally last menstrual period (LMP) has been used to determine approximate gestational age (GA). However, with the advent of newer technologies like Ultrasonography (USG) different Ultrasonographic measurements are now routinely used for gestational age estimation.

Materials & methods: In 273 cases of normal pregnancy Biparietal diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), Femur Length (FL) and Transverse Cerebellar Diameter (TCD) were measured. From the above measured parameters gestational age was measured using Hadlock tables. TCD was compared with BPD, HC, AC, and FL.

Results: Results showed that of all parameters, TCD has best correlation with gestational age. The relationship for each correlation was curvilinear. This relationship was best described with quadratic and linear equations

Conclusion: TCD is a better parameter for gestational age assessment compared to other parameters due to its less susceptibility to variations due to the different parameters.

Key words: Gestational Age, Transcerebellar Diameter, Ultrasonographic Parameters

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INTRODUCTION

Knowledge of the expected date of delivery is essential in the management of all pregnancies particularly those which require active management like high risk pregnancies (pregnancy induced hypertension, diabetes, RH Incompatibility etc), fetal distress and for planned labour induction and to decide the method of termination.[1]

Most commonly used method to estimate the gestational age is menstrual history (*LMP*).[2] This estimation assumes that conception occurs on day 14 of the cycle. The average duration of pregnancy is 266 days from conception and 280 days from the date of last menstrual period in a woman with 28 days cycle. The 95% confidence interval of menstrual dates is -27 to +9 days. The Nagele's rule: In women with regular cycles and certain LMP, the EDD is calculated by adding 7 days to the first day of the LMP and adding 9months. Estimation of Gestational age by LMP has several limitations such as: many women do not recall the first day of last menstrual period. LMP may also be misleading due to oligomenorrhoea, abnormal bleeding events or use of oral contraceptives, becoming pregnant during first ovulatory cycle after a recent delivery, ovulation very early or very late in the menstrual cycle[3] etc. Due to these limitations of LMP, presently the most effective way to date the pregnancy is by the use of ultrasound. Accurate assessment of gestational age of fetus, major congenital anomalies, fetal growth, well being and maturity all have become possible due to the availability of ultrasound.

Several Sonographically derived fetal parameters are used to date pregnancies those include Biparietal diameter (BPD), Head circumference (HC),Abdominal circumference (AC) and femur length (FL).[4] However, the variability of these parameters increases with increasing age due to factors like fetal skull moulding, deeply engaged head, hydrocephalus, microcephalus etc.[5] Due to these limitations of the conventionally used parameters, new parameters like Transverse cerebellar diameter (TCD) measurement can be used to estimate the fetal gestational age more accurately in cases where the LMP aren't exactly known, in cases of IUGR as TCD is minimally affected by the fetal growth and the changes associated with increasing gestational age than the conventional parameters (BPD, HC, AC, FL).[6,7] Also it is consistently superior in estimating gestational age in both singleton and twingestation.[8-16]

Methodology

A prospective Cross sectional observational study of pregnant women between 15-40 weeks of gestation attending Department of Obstetrics &Gynaecology of L.D. Hospital, an associated hospital of GMC Srinagar was conducted over a period of 2 years.

Inclusion criteria

Pregnancies of 15-40 weeks gestation with known last menstrual period (LMP)

Exclusion criteria

Congenital malformations involving cerebellum
Dandy Walker malformation
Dandy Walker variant
Vermian hypoplasia
Chiari malformations

For each patient included in the study BPD, HC, AC, FL and TCD were measured by using a 3-5 MHz curvilinear transducer of Mindray DC-70 EXPUSG machine. From the above measured parameters gestational age was measured using Hadlock tables. TCD was compared with BPD, HC, AC, and FL. 273 cases of normal pregnancies were studied.

Methodology for measurement of various parameters:

Transcerebellar Diameter (TCD): TCD was measured by obtaining the cerebellar view by rotating the transducer in the axial plane centred on the thalamus to show the cerebellar hemispheres. This view shows the cerebellum, the cisterna magna and the cavum septum pellucidi. The cerebellum characteristically appears as two lobules on either side of midline in the posterior cranial fossa. The widest diameter of the cerebellum was measured. Three measurements were taken in millimetres and their average was recorded in data sheet for further data analysis.[17]

Biparietal Diameter (BPD): Measurement taken from trans-axial sonograms of fetal head at the level of paired thalami and cavum septum pellucidum. The BPD was measured from the outer edge of the cranium nearest the transducer to the inner edge of the cranium farthest from the transducer.[18]

Femur Length (FL); Measurement was taken from greater trochanter to the lateral condyle.[19]

Head Circumference (HC); Measurement taken as the outer perimeter of the cranium made on the same transaxial image of the fetal head as used for measuring BPD.

Abdominal Circumference (AC); Measured as outer perimeter of the fetal abdomen on transverse scan at the level of the stomach and intrahepatic portion of the umbilical vein

Last Menstrual Period (LMP); Gestational age has been traditionally estimated from date of LMP assuming conception on day 14 of menstrual cycle in a woman with regular cycles of 28 days. Also, assuming the average duration of pregnancy as 266 days from conception and 280 days from date of LMP. Regression analysis was used to compare TCD with BPD, HC, AC and FL in normal pregnancy. Nomograms were derived by taking 5th, 50th and 95th percentile values in normal pregnancies.

Statistical Analysis; Data was collected using clinical record forms. Data was analysed using SPSS statistical software and subjected to various tests like "student t test", "regression analysis" and "P values" and" correlation coefficients" where ever needed.

Ethical Issues; Study was approved by the institutional ethics committee.

OBSERVATIONS & RESULTS

In this study 273 cases of normal pregnancy were studied. Age distribution of normal pregnancies was 19 to 45 years with mean age of 29.1 years. For the 273 normal pregnancy patients initially all the parameters i.e. TCD, BPD, AC, FL and HC were measured ultrasonographically in millimeters and correlated with GA (derived from LMP) using regression analysis. The analysis showed that of all parameters TCD shows best correlation with gestational age. The relationship for each correlation was curvilinear. This relationship was best described with quadratic and linear equations as shown in tables 1-3.

Table1:Table showing correlation of GA with BPD,HC,AC,FLandTCD in normal pregnancies		
Parameters Compared	R^2	P value
GA Vs BPD	0.975	0.0001
GA Vs HC	0.964	0.0001
GA Vs AC	0.977	0.0001
GA Vs FL	0.974	0.0006
GA Vs TCD	0.980	0.0001
GA Vs Comp	0.984	0.0001

Table 2: Table showing correlation of TCD with BPD, HC, AC and FL in normal pregnancies		
Parameters Compared	R^2	P Value
TCD Vs BPD	0.970	0.0001
TCD Vs HC	0.959	0.0001
TCD Vs AC	0.971	0.0001
TCD Vs FL	0.970	0.0001
TCD Vs Comp GA	0.980	0.0001

Table 3: Table showing correlation of LMP with BPD, HC, AC, FL, Comp, and TCD in normal pregnancies		
Parameters Compared	R^2	P Value
LMP Vs BPD	0.975	0.0001
LMP Vs HC	0.964	0.0001
LMP Vs AC	0.976	0.0001
LMP Vs FL	0.973	0.0001
LMP Vs Comp GA	0.983	0.0001
LMP Vs TCD	0.990	0.0001

By using the ultrasonographically derived data, nomogram was derived for TCD in case of normal pregnancies. The nomogram showed mean measurement in millimeter (mm) for TCD at 5th, 50th and 95th percentile for the corresponding gestational age. (Table 4)

Table4: Nomogram showing mean TCD (mm) measurement sat 5^{th}, 50^{th} and95^{th} percentile for the corresponding gestational age.			
GA in weeks	5^{th}percentile	50^{th}percentile	95^{th}percentile
15	14	16	18
16	14	17	18
17	16	18	20
18	16	18	21
19	18	19	22
20	18	20	24
21	19	22	24
22	20	23	26
23	21	24	28
24	22	26	30
25	23	27	31
26	24	29	33
27	26	30	35
28	27	32	37
29	28	34	39
30	29	36	41
31	31	38	44
32	32	40	46

33	34	42	48
34	36	44	51
35	38	46	54
36	39	48	56
37	40	50	59
38	42	52	62
39	44	54	65
40	47	56	68

DISCUSSION

Accurate gestational dating is of paramount importance and cornerstone for management of pregnancies especially those with fetuses who have growth disturbances (IUGR fetuses). In 1966 Scott and Usher reported that the death rate was nearly 8 times higher than in total study population when birth weight was below the 10th percentile.[20] Among the various clinical criteria LMP preceded by normal cycle is known to best correlate with the gestational age but it is not reliable when a woman is not sure about her last menstrual period. Ultrasonography is routinely used for dating of pregnancy. The biometric parameters used for gestational age assessment are BPD, HC, AC and FL.[21-23] However each of these parameters have their own limitations. The variability in predicting gestational age with these parameters goes on increasing as the pregnancy advances.[5,24,25] TCD is a unique parameter for estimating the gestational age of fetus. In this study 273 normal pregnant patients with known LMP were scanned between 15 to 40 weeks of gestation. In each patient BPD, HC, AC, FL and TCD were measured ultrasonographically. The gestational age derived from LMP was then correlated with each of the measured parameters. Nomogram was established which shows mean TCD values at 5th, 50thand 95th percentiles for the corresponding gestational age. The nomogram can be used for assessing the fetal gestational age when LMP is not known and to asses any deviation from normal growth. In this study it was noted that early sonographic visualization of cerebellum occurred as early as 14 weeks. On ultrasonography the characteristic image of cerebellum appears as two lobules on either side of midline in the posterior cranial fossa .Mcleary et al studied the measurement of transcerebellar diameter with ultrasonography in 225 normal fetuses ranging from 15 to 39 weeks of gestational age and found it to closely correlate with BPD. They proposed that the transcerebellar diameter may be useful in estimating fetal age, particularly in breech presentation where extrinsic pressure may deform the skull and decrease the biparietal diameter.[11]Similar results were found in this study. There was good correlation between BPD and TCD (R2 = 0.970, p value = 0.0001). Therefore TCD may be preferred over BPD in assessing gestational age of fetuses in circumstances where head is deformed e.g. as in moulding or dolicocephaly. Reece et al prospectively studied ultrasonography of 371 normal pregnant women, with gestational ages ranging from 13 weeks to 40 weeks. They found curvilinear relationships between the transverse diameter of the cerebellum and the gestational age (R2 = 0.948; P = 0.001), the biparietal diameter (R2 = 0.956; P = 0.0001), and the head circumference (R2=0.969; P = 0.0001). A nomogram of cerebellar measurements estimating gestational age was generated. They concluded that throughout pregnancy normative cerebellar measurements allows for estimation of gestational age that is independent of the shape of fetal head.[12]The result of this study is in concurrence with the above observation. In the present study there was good correlation between TCD and gestational age. (R2 = 0.990, p value = 0.0001). Also good correlation was found between TCD and BPD (R2 = 0.986, p value = 0.0001) and between TCD and HC (R2 = 0.959, p value = 0.0001). In this study TCD nomogram was established from ultrasonographically measured data which can be used for estimating the gestational age of fetus. Smith et al demonstrated that the fetal cerebellum can be visualized with ultrasound throughout the second trimester. Nomograms of transcerebellar diameter measurements against gestational age showed good correlation, and narrow confidence limits.[13]The present study also showed similar results. It was noticed that early visualization of cerebellum by ultrasonography occurred as early as 14 weeks. Good visualization was seen in each case; however, measurements were easier to perform in second and early third trimester. There was good correlation between gestational age and TCD (R2 = 0.990, p value =0.0001). Guan B found curvilinear relationship between TCD and gestational age (R2 = 0.99624, p value less than 0.0005). He concluded that the function of the TCD in the evaluation of fetal growth and development is better than any other parameter.[14]

Similar results were obtained in present study. We noticed curvilinear relationship between TCD and gestational age (R2 = 0.986, p value =0.001).The potential importance of TCD in predicting gestational age in normal pregnancies has thus been stated.

CONCLUSION

TCD is a better parameter for gestational age assessment compared to other parameters due to its less susceptibility to variations due to the different parameters.

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