ORIGINAL RESEARCH PAPER

Radiology

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

A Study of Transcerebellar Diameter in Foetus as an Additional Marker for Estimation of Gestational Age

KEYWORDS: Antenatal sonography, Transcerebellar diameter, Gestational age, Growth retardation.

Sreenivasa chowdary.J
Dept of Radiology, Siddhartha Medical College, Vijayawada, India

Chandrasekhar kondragunta
Dept of Radiology, Dr.PSIMS & RF, Gannavaram, Vijayawada, India

Kuldeep kumar.Ch
Dept of Radiology, Dr.PSIMS & RF, Gannavaram, Vijayawada, India

Raghu Teja.S
Dept of Radiology, Dr.PSIMS & RF, Gannavaram, Vijayawada, India

ABSTRACT *Gestational age in pregnant women with known last menstrual period is commonly assessed by ultrasonographic examination using parameters like biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). Lack of information about the last menstrual period is a common problem faced due to uneducated pregnant women. Transcerebellar diameter (TCD) has been proposed for assessment as an additional reliable parameter to estimate the foetal gestational age. It has an important role also in cases of growth retardation. In our study, we describe the usefulness and reliability of transcerebellar diameter assessment in comparison to the routinely used parameters viz. BPD, HC, AC and FL in estimating the gestational age of the foetus and to establish a nomogram in our population.*

INTRODUCTION

One of the common problems that an obstetrician frequently faces is the estimation of foetal maturity, either for the purpose of prolonging pregnancy or for the termination of pregnancy in the presence of complications like severe pregnancy induced hypertension, diabetes mellitus and Rh incompatibility. The means that are widely used for assessing foetal maturity include estimation of gestational age and foetal weight. Foetal maturity is a pre requisite for inducing labour, especially in high risk pregnancies. It is rather difficult to assess gestational age accurately, especially in developing/under developed countries, as most of the patients will not have an accurate idea of the date of their last menstrual period.

Commonly used parameters for assessing the gestational age include crown rump length (early pregnancy), biparietal diameter, head, abdominal circumferences and femur length. Out of these, biparietal diameter is more reliable in the first trimester and femur length in the third trimester. But these parameters can either overestimate or underestimate gestational age in certain conditions like foetal skull abnormalities, skeletal dysplasia's and growth retardation.

Transcerebellar diameter measurement is a concept of assessing the foetal gestational age after 14 weeks when the cerebellum starts developing. Literature has been generated about the utility of transcerebellar diameter in assessing the gestational age as the development of cerebellum is not affected by factors like abnormal foetal skull or blood supply. Also it is found to be more reliable in normal pregnant women with unknown last menstrual period.

Hence this study is done on pregnant women who are referred for ultrasound examination to evaluate the role of transcerebellar diameter in relation to the commonly used foetal parameters for gestational age assessment.

REVIEW OF LITERATURE:-

Cerebellum can be visualized as early as from 9 to 10 weeks, it is peanut shaped with a central constriction denoting the Vermis and flared ends representing two cerebellar hemispheres[1]. Growth of cerebellum is rapid in second trimester and has a linear relationship with gestational age[2]. Its location in posterior fossa surrounded by the dense petrous ridges of occipital bone makes it more resistant to deformation by extrinsic pressure[3].

A brief overview of various grades of cerebellum through gestation:

1) Grade I cerebellum: -
Cerebellar hemispheres appear as two cystic globes on either side of the midline. It is seen predominantly up to 27 weeks of gestational age[4]. They appear as a pair of eyeglasses and are homogeneously hypo echoic. The Vermis is not yet developed.

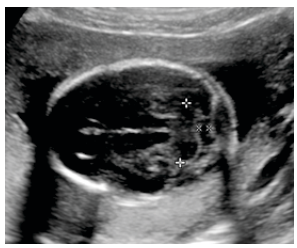

Fig 1: Ultrasonographic image of the fetal head (20weeks gestation) showing grade I cerebellum indicated by markers (+).Cisterna magna (retrocerebellar space) is indicated by x markers.

2) Grade II cerebellum:-
Seen predominantly from 28-32 wks, shows vermis more prominently and it appears as an echogenic rectangular tissue connecting the two hemispheres, which gives the cerebellum dumbbell shape. It is of intermediate echogenicity, the margins being echogenic and shows ground glass appearance.

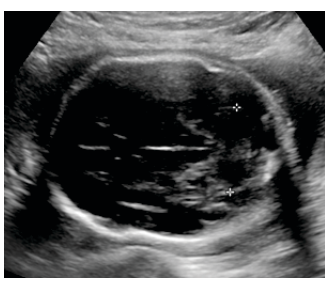

Fig 2.Ultrasonographic image of foetal head (28weeks gestation) showing dumbbell shaped grade II cerebellum indicated by markers (+).

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3) **Grade III cerebellum**:-
Seen after 32-33 wks of gestation, the appearance of cerebellum changes to that of a triangular or fan shaped structure. The tissue in the central portion of the hemisphere shows similar echogenicity to that of the margins. Consequently, the cerebellum looks more like solid tissue than cyst and homogeneously echogenic.

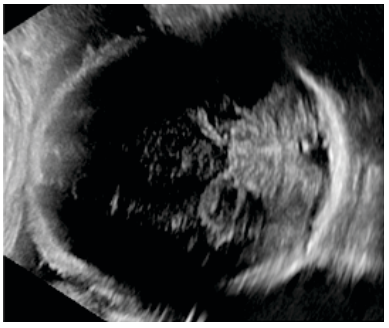

Fig 3 : Ultrasonographic image of the foetal head in third trimester (35weeks) showing grade III cerebellum as triangular or fan shaped echogenic structure.

MATERIAL AND METHODS

A total of 300 pregnant women referred from obstetric department of our institute for over 3 yrs period (2013 to 2016) were included in the study. This also included 100 pregnant women, who did not know their Last Menstrual Period.

The ultrasound machines used for the study were real time 2-D ultrasound units, with 3.5 and 5MHz convex transducers – Philips HD15 and G.E logic 400 M.D. After the initial survey with the ultrasound transducer, routine fetal parameters were obtained in each patient. A cross section of fetal head parallel and slightly above the canthomeatal line showing the falx, thalamus and cavum septum pellucidum was first obtained. Then by slightly rotating the transducer below the thalamic plane by an angle of thirty degrees, a plane was obtained that demonstrated the contents of the posterior fossa, which includes the characteristic butterfly like appearance of the cerebellum. The cisterna magna is seen posterior to the cerebellum.

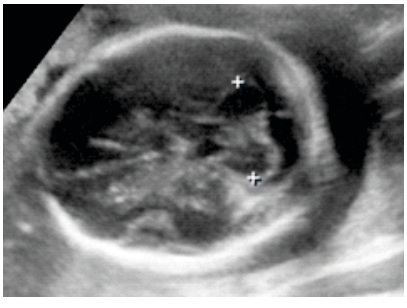

Fig 4 : Ultrasonographic image of the fetal head (25weeks gestation) showing posterior fossa with cerebellum indicated by markers (+). TCD measurement is taken from outer to outer margin of cerebellum.

In our series, statistical software [5] namely SPSS 11.0 and System 8.0 were used for the analysis of the data and Microsoft word and excel have been used to generate graphs, tables etc. The measured values were analyzed statistically using SPSS 7.5 statistical package for windows. Analysis of variance has been used to find the significant association of TCD grades with BPD, AC, FL, and HC. Correlation and regression analysis has been used to find the relationship between study parameters. Student 't' test was used to compare age of the patients with normal pregnancies. One-way analysis of variance (ANOVA) was used to compare parity distribution between the two groups. The ultrasonic parameters TCD, BPD, FL, AC and HC are compared with GA by regression analysis. TCD was compared with BPD, FL, AC and HC using statistics of normal pregnancy groups. Nomograms were derived by taking 5th and 95th percentile values in normal pregnancies. Measurements were compared with the nomograms and analysed by Fischer's exact test with P <0.05 taken as significant.

RESULTS

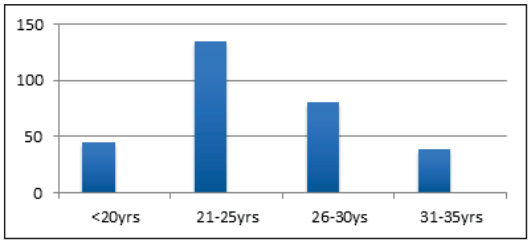

Fig 5: Column chart showing distribution of cases by age.

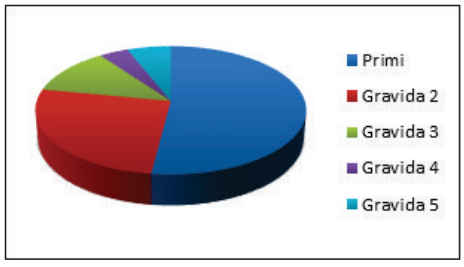

Fig 6: Pie chart showing distribution of cases by Gravida status.

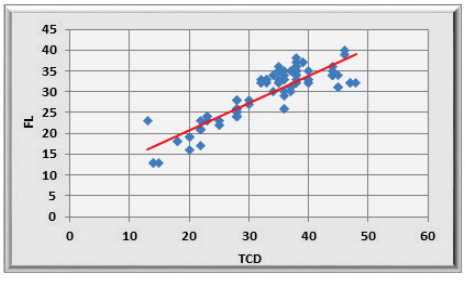

Figure 7: Chart showing the correlation between TCD and FL.

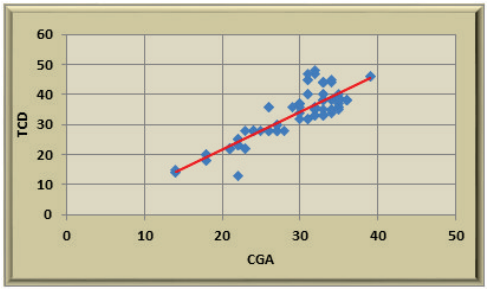

Figure 8: Chart showing regression analysis of predicting Correct Gestational Age (CGA) by TCD.

Table 1: Mean Pattern of BPD, HC, AC and FL in relation to grades of TCD

Gestational Age(weeks)	5th – 95th percentiles				
Gestational age(weeks)	BPD (mm)	HC (mm)	AC (mm)	FL (mm)	TCD (mm)
13-21	22-48	88-190	71-184	11-37	13-21
21-25	51-63	202-254	163-219	39-47	21-26

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25-29	66-69	240-250	208-277	48-53	27-35
30-34	73-84	278-306	229-301	57-66	31-36
33-35	70-97	302-348	300-353	67-78	33-35

Table 3: showing accuracy of various Fetal Biometric Ultrasonographic parameters in predicting gestational age.

S. No	Parameters	% Accuracy
1.	Biparietal Diameter (BPD)	94.4%
2.	Head Circumference (HC)	95.1%
3.	Abdominal Circumference (AC)	95.3%
4.	Femoral length (FL)	96.5%
5.	Trans cerebellar diameter (TCD)	96.7%

DISCUSSION

In this prospective study of 300 normal pregnant ladies, the sonographic visualization of the foetal 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. Transverse Cerebellar Diameter is measured from the outer margin of one cerebellar hemisphere to the outer margin of the other cerebellar hemisphere, including both the hemispheres and the vermis.

The transcerebellar diameter, biparietal diameter, head circumference, abdominal circumference and femoral length were measured in all the cases to assess the gestational age of the foetus and an attempt was made to detect the correlation between all these parameters and gestational age.

Nomograms for estimating the gestational age from the measured TCD, BPD, FL, AC and HC in normal pregnancy were done. In our study we have found a good correlation between TCD v/s BPD, HC, FL, AC & CGA in concordance to various studies done by Richard D. McLeary et al[6], Israel Goldstein et al[7], Winston A. Campbell et al[8], priestly et al[9]. In our study we found that there is a good correlation between TCD and gestational age ($R^2 = 0.947$) further confirming that given in the literature.

There is uncertainty in the estimation of gestational age, which is amplified in cases of foetal growth retardation leading to difficulty in determining whether foetus is truly growth retarded. To solve this dilemma, estimation of gestational age by transcerebellar diameter has been found to be of much advantage (10).

Failure to demonstrate a normal cerebellum could indicate congenital cerebellar disorders like Cerebellar hypoplasias, Dandy Walker spectrum and Arnold Chiari malformations.

CONCLUSION:

Biparietal diameter, head circumference, abdominal circumference and femur length measurements of the foetus in normal pregnancies were comparable with transcerebellar diameter measurement. Estimation of gestational age by transcerebellar diameter correlated with the estimation of the gestational age by multiple growth parameters. On ultrasonography it is measured in mm which correlates with the gestational age in weeks.

Transcerebellar diameter is also a better parameter for gestational age assessment due to its easily identifiable landmarks and relative resistance to alterations. It can be used as a single growth parameter to predict the gestational age, especially in pregnant women with unknown last menstrual period. In addition, as observed by various studies, we would like to conclude that transcerebellar diameter should be included in the routine measurements for the estimation of gestational age and the failure to demonstrate a normal cerebellum should raise the suspicion for congenital malformations.

Acknowledgements

Our sincere thanks to Head of the Radiology dept.: Professor Chander.

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