Original Article

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Ultrasonographic Evaluation of Fetal Gestational Age in Different Trimesters from Various Anatomical Biometric Parameters

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Abstract

Introduction: Ultrasound has become the essential tool of modern obstetric practice. Ultrasound dating along with LMP provides more accurate gestational age assessment than menstrual dating alone. Aim: To estimate gestational age in second & third trimesters using ultrasonographic imaging, by fetal biometry parameters i.e Femur Length (FL) and Humerus Length (HL). *Materials and Methods:* The present study was carried out in 100 normal pregnant women with singleton uncomplicated pregnancy, with the known last menstrual period (LMP). *Results:* FL was found to be more reliable parameter as compared to HL in both second and third trimester of pregnancy. *Conclusion:* HL can also be used one of the reliable parameter next to femur length in assessing gestational age.

Keywords: Gestational Age **(**GA); LMP; Femur Length (FL); Humerus Length (HL).

Introduction

Determination of age of an unborn baby is known as the gestational age, defined in weeks as beginning from first day of last menstrual period (LMP) prior to conception [1]. Trimester is period of three calendar months during a pregnancy. Estimation of gestational age and thereby forecasting expected date of delivery (EDD) is not only concern of the individual but it is invaluable in the diagnosis of intrauterine growth retardation of fetus and obstetric planning. But significant number of females (20-30%) either fails to remember LMP or report inaccurately. The matter becomes complicated when conception occurs during lactational amenorrhoea or soon following withdrawal of contraceptive pills in which ovulation may be delayed for 4-6 weeks [2].

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Ultrasonography is non-ionising, non-invasive, safe and accurate method of objectively evaluating the fetal growth in utero. Ultrasound has become the essential tool of modern obstetric practice. Doopler ultrasound has become crucial for making management decisions in some high risk settings [3]. Added advantage of it being evaluation of multiple parameters in one procedure.

The real-time ultrasound scanners have given a number of ultrasonic biometric parameters to determine gestational age. The most commonly used fetal biometric parameters are head circumference (HC) [4], abdominal circumference (AC) [5] and femur length (FL) [6] to determine gestational age, fetal weight & growth in different trimester. In cases where LMP or fundal height does not agree with dates, then this anatomical biometric parameter are valuable in estimating the gestational age of fetus [7].

The present study was undertaken in the second & third trimesters with the help of sonographic measurement of two fetal biometric parameters (i.e. FL and HL) in the local population of Indore region of Madhya Pradesh & to compare these values with western normograms.The study also aimed to find out the predictive accuracy of gestational age determined by ultrasongraphy (USG) with menstrual age determined by the LMP method in local population.

Aims

To record various fetal biometry parameters like Femur Length (FL) and Humerus Length (HL). To estimate gestational age in second & third trimesters using ultrasonographic imaging.

Objectives

1. To assess fetal growth.
2. To observe mean growth rate pattern of the fetus.

Materials & Methods

The study "Ultrasonographic evaluation of fetal gestational age in different trimesters from various anatomical biometric parameters." was carried out in 100 pregnant women.

The subjects were females attending ANC clinic for ultrasonographic screening at CHL hospital of indore. Subjects of the study mainly include urban as well as rural areas in the vicinity.

Inclusion Criteria

i. Women with known LMP.
ii. Women with regular menstrual cycle.
iii. Women with singleton pregnancy.
iv. Women with uncomplicated pregnancy

Exclusion Criteria

i. Women with multiple pregnancies.
ii. Women with irregular menstrual cycles.
iii. Women with diseases like hypertension, chronic renal disease, heart diseases and diabetes mellitus.
iv. Women having Foetus with congenital anomalies.

The subjects were informed regarding the nature and purpose of the study. For collection of the Data proper permission was obtained from ethical committee and fetal medicine department. The subjects were given prior appointment in morning hours and were screened under guidance of sonologist throughout the study.

In this study various particulars of the subjects like age, menstrual and Obstetric history had been recorded in the Performa. (Annexure II). The routinely used Ultrasonography Machine in the obstetric practice, i.e Sequina L & T with 3-5 MHz macro convex probe was used.

Subject was asked to lie in supine position on the ultrasound screening table with her abdomen exposed. To ensure an airless contact between the tissue and the transducer probe Sonogel, a mineral jelly was applied all over the abdominal surface.

a. Diphyseal length of Femur (FL) can be reliably used after 14 weeks of gestational age. The long axis of the femoral shaft is most accurately measured with the beam of insonation being perpendicular to the shaft, excluding the distal femoral epiphysis [8].

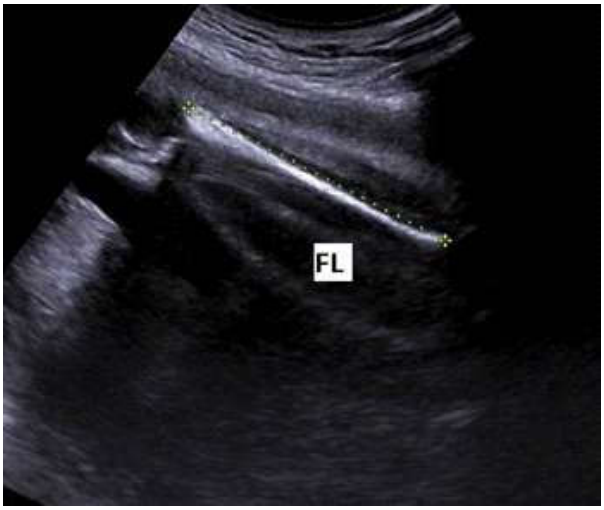

Fig. 1:

b. The fetal Arm (humerus) length technique: After visualizing the heart, the transducer is moved to image the scapular spine which is dorsal to the humerus head. The full length of the humerus was then obtained in a plane as close as possible to right angles of the ultrasound beam. A straight measurement was made from the center of one end of the diaphysis to the other, disregarding any curvature [9].

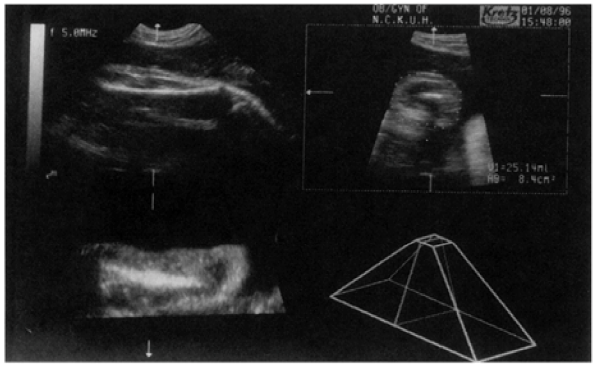

Fig. 2:

Interpretation of the measurements of Femur length and Humerus length were done with the help of computer assembled along with the Ultrasound machine. Date of ultrasonography of subject is recorded and Gestational age of the fetus in terms of weeks was calculated from last menstrual period in the Proforma.

Results

The present study was carried out in a Private Hospital of Indore on a total of 100 pregnant females.The data collected was formulated according to the menstrual weeks from 13 to 42 weeks. All the observations of the fetal growth parameters were taken in centimeters. Standard deviation of each parameter for each week was calculated. Similarly the statistical mean of each parameter for each week was calculated. The weeks of gestation were defined as completed week. For e.g. 13th week refers to 13.00 to 13.86 weeks of menstrual age. 7 days = 1 week, hence 1day = 0.14 weeks. Like this subsequently for each day.

The mean, SD of femur length was 5.76 and 1.2 and range is 3.04–8.8 and mean & SD of humerus length was 4.92 and 1.0 and the range is 3.0–7.6. (Table 1).

Frequency distribution of gestational age were, gestational age of 29 subjects was between 15 to 20 weeks, GA of 21 subjects was between 21–25 weeks, GA of 19 subjects was between 26 to30 weeks, GA of 20 subjects was between 31-35 weeks, whereas GA of 11 subjects was between 36-40 weeks (Table 2).

Simple Linear Regression

Simple linear regression analysis of the observations was done for estimating gestational age from the measurements of Femur length and Humerus length.

Simple linear regression for the observations from the Femur Length.

Regression equation for total cases (15-40 weeks)

G.A = 8.02+ 3.56 x FL

From the above equation it is clear that, for every 1cm increase in FL, the gestational age (G.A) increases by 3.56 weeks.

Coefficient Of determination (R) = 0.9516

The value of R is highly significant $p<0.0001$ showing that there is statistically highly positive association between Gestational age and Femur Length.

Simple linear regression for the observations from the Humerus Length.

Regression equation for total cases (15-40 weeks)

G.A = 7.89+ 3.02 x HL

From the above equation it is clear that, for every 1cm increase in HL, the gestational age (G.A) increases by 3.02 weeks.

Coefficient Of determination (R) = 0.9285

The value of R is highly significant $p<0.0001$ showing that there is statistically highly positive association between Gestational age and Humerus Length.

Discussion

Researchers from Anatomical background in the past worked on the correct estimation of gestational age by measuring different anatomical biometric parameters by Ultrasound. So, here also by using two anatomical biometric parameter (i.e FL & HL)

Table 1: Ultrasonic Biometric Parameters

Parameters	N	Minimum	Maximum	Mean	Std. deviation
Femur length (cm)	100	3.04	8.8	5.76	1.2
Humerus length (cm)	100	3	7.6	4.92	1.0

Table 2: Frequency distribution of Gestational age

GA in weeks	Frequency	Percent
15-20 weeks	29	29
21-25 weeks	21	21
26-30 weeks	19	19
31-35 weeks	20	20
36 -40 weeks	11	11

to determine gestational age using ultrasonography, we found that each parameter increases as age advances from second trimester to third trimester & also found to be statistically significant.

These finding were supported by Hadlock [10] et al. but were in contrast to Sumit [7] et al . Hadlock [11] et al. stated that a combination of multiple fetal parameters (HC, AC, FL) provided age estimates that were significantly better (p=0.05) than alone using single parameter. In fact Hohler [12] found that the measurement of more than one parameter, in a sense, prevents over-reliance on any single measurement which by itself might mislead the clinician. Therefore it proves that the estimate using the mean fetal gestation period is accurate as well as precise than single measurement.

Hadlock [13] et al. stated that the regression equation developed from white middle class population appeared to be applicable to the populations of racial & socioeconomic groups. Ruvolo [14] et al. found no statistically significant difference in FL versus gestational age in racially mixed population of Blacks, Asians & Caucasians while Present study shows that FL is reliable parameter in determining the gestational age & also it is statistically significant.

Yeo [15] et al. conducted a study on Chinese, Malaysian & Indian population which showed that fetal FL of Chinese and Malaysian, are apparently shorter than Indian FL. Lai [16] & Yeo demonstrated Slightly smaller FL- more pronounced over the course of gestation in Asians compared with white fetuses. Patre [6] et al. found that in the management of the patient with premature labour, to accurately predict GA , FL can be used in conjunction with HL Supported by Tahmasebpour [17] AR et al. Thus proving the existence of similarities & differences in ultrasound measurement of FL & HL in different ethnic groups.

Anatomical dimension of fetus vary according to the race, nutritional status, build & geographic location of the origin of the parents. As the growth trend of our fetuses increases, all fetal biometric parameters predict precise gestational age, more so as pregnancy advances.

Sonographic measurement of the ossified shaft humerus is possible after the 12th week of gestation. Humerus is difficult to define accurately, because of its proximity to the chest wall &its apparent continuity with the scapula & clavicle. The relationship between HL & GA has been studied by only few workers [9]. They stated that HL is also a useful parameter for assessing GA. In present study, the coefficient of correlation was found to highly significant & shows that with increase in GA & HL also increases. Hence it can be used to asses GA.HL recorded in present correlated well with the normograms suggested by Jeanty [18] (1983).

Conclusion

The present study describes the use of two fetal biometric parameter (FL and HL) to determine the accurate gestational age in the population of Indore region of M.P. Present analysis reveals that fetal anthropometric parameters significantly differ among different population groups due to racial, genetic & ethnic regions. Therefore biometric curves of one population may overestimate gestational age when used for other racial or ethnic groups. Also accurate determination of gestational age is required for many aspects of antenatal care. Clinical history may have value in determining gestational age. Thus a need for large-scale study at national level Indian population to generate population –specific tables & regression equations for more precise reporting of gestational age by sonography on the basis of various fetal biometric parameters.

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