Original Research Article

Correlation between Gestational Age and Head Circumference in Third Trimester

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Abstract

Introduction: In today's advanced medical world maternal child health care the important part of the health care system and import components is estimation fetal gestational age.

Gestational age is age of unborn baby, defined in weeks as beginning from first day of last menstrual period prior to conception. Trimester is period of three calendar months during a pregnancy. Clinically, the gestational period is divided into three trimesters. 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 other fetal parameters are useful Hence; we planned the present study to estimate fetal HC length for measuring the gestational age and compare it with other parameters.

Material and methods: The study Correlation between gestational age and head circumference in Third trimester was carried out at Govt. Medical College and Hospital, Nanded, between July 2011 to July 2013 period . The study included 132 pregnant women the data so collected was then subjected to statistical analysis by expert statistician with the help of SYSTAT Crainsoft version 12 software. Standard statistical methods, parametric methods were used for the evaluation and significance.

Results: As the value of R is 0.8612, the variation in fetal growth on the basis of Head Circumference during third trimester can be explained to the extent of 86.12%. The value of R is highly significant (Student's't' test value = 228.92, $p<0.0001$, very highly significant) showing that there is statistically highly Positive or strong positive association between gestational age and head Circumference

Conclusion: From the present study Head Circumference found to be statistically highly significant. The regression equations derived for growth parameter for estimating gestational age in a normally developing fetus, increase with gestational age, showed good correlation with gestational age. In Present study, Head circumference is the sensitive parameter and a result of present study was comparable with previous studies.

Keywords: *Fetal growth, Gestational age, head circumference, Third Trimester, Regression equation*

Introduction

Evaluation of age of an individual using various methods is required for medico legal purposes in both civil and criminal matters.[1, 2]

Human development is continuous process that begins when an oocyte from female is fertilized by a sperm. Cell division, programmed cell death, differentiation, growth and cell rearrangement transform the fertilized oocyte into a multicellular adult human being.[3]

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The most developmental changes occur during the embryonic and early fetal periods. The human development is divided into prenatal and postnatal period. There are many changes that occur from the 3rd to 8th week (calculated from the date of fertilization) called as embryonic development. Changes occur from 9th week to birth are meaningful because they signify that the embryo has developed into a recognizable human being called a fetus.4

Gestational age is age of unborn baby, defined in weeks as beginning from first day of last menstrual period prior to conception. Trimester is period of three calendar months during a pregnancy.[5] Clinically, the gestational period is divided into three trimesters. 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.

The parameters either singly or in combination useful in predicting the gestational age with fair degree of accuracy are Naegeles formula, Date of quickening, Palpation of fetal parts and Auscultation of fetal heart sound. [6]

The methods like physical examination, menstrual history, and laboratory methods have limitations in assessing fetal maturity, development and well being. At the same time Roentgenography likes procedures having hazards of invasive procedure or radiation compelled the research of safer, non-invasive and reliably predictive investigation modality, it was brought forth in the form of Ultrasonography. Added advantage of it being evaluation of multiple parameters in the same readings. Ultrasonography is non-ionising, non-invasive, safe and accurate method of objectively evaluating the fetal growth in utero.

Correct assessment of gestational age is a cornerstone of management of any obstetric case. Various calculation methods are used in the field of forensic medicine to determine age[7], measurement and external characteristics are useful for estimating fetal age. Crown rump length is the method of choice for estimating fetal age until the end of the first trimester because there is very little variability in fetal size during this period. In second and third trimester, fetus grows sufficiently in size; several structures can be identified and measured ultrasonographically.

Accurate knowledge of gestational age is a keystone in the obstetrical ability to successfully manage the antepartum care of the patient and is critically important in the interpretation of antenatal test and successful planning of appropriate therapy and interventions.

Materials and Methods

The study Correlation between gestational age and head circumference in Third trimester was carried out at Govt. Medical College and Hospital, Nanded, between July 2011 to July 2013 period . The study included 132 pregnant women. Who were selected on the following basis.

The subjects were females attending ANC clinic for Ultrasonography screening at Medical College and Hospital. Subjects of the study mainly include urban as well as rural areas in the vicinity.

Inclusion criteria:-

1. Women with known LMP
2. Women with regular menstrual cycle
3. Women with singleton &uncomplicated pregnancy
4. Women having age between 18-34 yrs

Exclusion criteria:-

1. Women with multiple pregnancies
2. Women with irregular menstrual cycles
3. Women having diabetes mellitus
4. Women with diseases like hypertension, chronic renal disease, heart diseases, iron deficiency anemia. Women having Fetus with congenital anomalies.

For collection of the data proper permission was obtained from ethical committee and radiology department.

1. In this study various particulars of the subjects like age, menstrual and obstetric history had been recorded in the Proforma.
2. The American Institute of Ultrasound in

Medicine recommendations were used for measurements of all the fetal parameters.[8]

3. The fetal Head Circumference (HC) was measured at the same level as that of the Biparietal Diameter (BPD) around the outer perimeter of the calvarium. This measurement is not affected by head shape. Interpretation of the measurements of fetal Head circumference was 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.

4. The data so collected was then subjected to statistical analysis by expert statistician with the help of SYSTAT Crainsoft version 12 software. Standard statistical methods, parametric methods were used for the evaluation and significance.

Results

The study of Correlation between gestational age and head circumference in Third trimester by Ultrasonography was carried out at Govt. Medical College & Hospital Nanded.

The data collected was formulated according to the menstrual weeks. All the observations of the fetal growth parameters were taken in centimeters.

Standard deviation of 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 = 1week, hence 1day = 0.14 weeks. Like this subsequently for each day.

Ultrasonographic Head Circumference was measured in a total of 132 subjects. The observations of week wise mean values and standard deviation of fetal Head Circumference are shown in table no.1

Table No. 1: Mean and Standard Deviations of Fetal Head Circumference (Week wise)

Menstrual age in weeks	No. of cases	Mean	Standard deviation
29	10	26.57	1.12
30	9	26.79	0.72
31	11	27.93	0.99
32	12	28.76	1.01
33	14	28.74	1.66
34	13	29.51	1.87
35	8	30.31	0.87
36	13	30.70	1.29
37	10	31.38	0.64
38	14	31.83	0.59
39	8	32.63	0.49
40	6	33.03	1.42
41	2	31.92	0.07
42	2	32.85	1.20
Total	132		

Regression output for 3rd trimester (29 to 42 weeks)

Constant = 3.82

Standard error of Y ests = 1.034

Coefficient Of determination (R) = 0.8612

No. of observations = 132

Degree of freedom = 130

X coefficients = 1.299

Regression equation:

G.A = 3.82 + 1.299 x HC

From the above equation it is clear that during the third trimester, for every 1cm increase in HC, the gestational age (G.A) increases by 1.299 weeks.

As the value of R is 0.8612, the variation in fetal growth on the basis of Head Circumference during third trimester can be explained to the extent of 86.12%. The value of R is highly significant (Student's't' test value = 228.92, $p<0.0001$, very highly significant) showing that there is statistically highly Positive or strong positive association between gestational age and head Circumference.

Discussion

Ultrasonography is primary imaging modality in the evaluation of fetus because of its wide availability, low cost, and lack of adverse effects. The chorionic sac and its contents may be visualized by Ultrasonography during the embryonic and fetal periods. Placental and fetal size, multiple fetuses, abnormalities of placental shape, and abnormal presentations can also be determined. Ultrasound examinations are also helpful for diagnosing abnormal pregnancies at a very early stage. Rapid advances in Ultrasonography have made this technique a major tool for prenatal diagnosis of fetal abnormalities. Thus Ultrasonography is a most reliable check on the growth of the fetus.[4]

By the end of 12 weeks, the upper limbs have almost reached their final relative lengths, but the lower limbs are still not so well developed and are slightly shorter than their final relative lengths. By the end of 12 weeks, primary ossification centers appear in the skeleton, especially in the cranium (skull) and long bones. By the 16 weeks the head is relatively small compared with that of the 12-week fetus and the lower limbs have lengthened. Ossification of the fetal skeleton is active during this period, and the bones are clearly visible on ultrasound images and determination age is also important medico legally because In India, the Consumer Protection Act (CPA) came into existence in 1986, which was enacted for better protection of the interests of consumers.[9]

Fetal head, body and extremity measurements have been widely reported and found to be used in second and third trimester[4].

The differentiation between hard and soft tissues of the embryo is possible after about 10th week of gestation when other parameters like Head circumference, Measurements of fetal parts during routine Ultrasonography screening have been recommended.[10]

Studies by Indian authors Vaidya[11] (1986), Khandeparkar[12] (1986), Ghamande[13] (1989), Rajan R[14] (1991) were reflection of the fetal growth parameters in a particular region of India. India being a multi racial country, regional differences in the growth pattern of fetal parameters is expected.

The present study is a cross sectional analysis of fetal growth parameters in 132 subjects was conducted considering the above views. Transabdominal sonography of these subjects was performed and the measurements of fetal growth parameters were recorded in a proforma and subjected to statistical analysis.

The table no. 2 Shows week wise averages of the measurements of the Head Circumference as studied by Rajan et al[14] (1991) compared with those calculated in the present study. The present study correlates with the study**.**

From the table no.3 it is clear that the measurements of Head Circumference in present study are comparable with the findings of Scammon & Calkins and Kesari, Vare (HC measured from aborted fetuses) and Bhusari (HC measured ultrasonographically) shows that actual Head Circumference value for human fetuses lie very close to sonar value derived in the study. [15]

Table no. 2: Table showing comparison between week wise mean of the measurements of head circumference

Gestational Age	Rajan(1991)	Present Study
29	26.1	26.57
30	27.1	26.79
31	28.2	27.93
32	28.5	28.76
33	28.8	28.74
34	29.2	29.51
35	30	30.31
36	30.9	30.7
37	31.3	31.38
38	31.5	31.83
39	32.1	32.63
40	32.9	33.03
41	-	31.92
42	-	32.85

Table no. 3: Table showing comparison between week wise mean of the measurements of Head circumference:

Gestational age in weeks	Scammon and Calkins (1929)	Vare (1976)	Kesari GV (1979)	Bhusari PA(2010)	Present study
32	28.59	29.50	28.98	29.42	28.76
36	31.99	31.80	30.31	31.67	30.70
40	35.19	35	32.98	32.76	33.85

The regression equations for the Head Circumference derived in the present study are as follows:

HC	3rd TRIMESTER
	G.A = 3.82 + 1.299 x HC

Summary and Conclusions

The present study by taking into consideration of Head circumference recorded. This cross-sectional study was carried out on ANC women with age group 18-34 yrs. This study was carried out during the period July 2011 to July 2013 in Govt. Medical College and Hospital Nanded. All the subjects had sound knowledge about their menstrual dates. Data was collected from these subjects with regards to fetal growth parameters and recorded in the proforma.

The data so collected was tabulated according to the menstrual weeks The statistical mean and standard deviation of each parameter for each week was calculated with statistical software SYSTAT version. Comparison of week wise mean value was done with studies done previously and represented in a tabular form & graphical representation of the results was done.

Finally, sonographically measured parameters during Third trimesters of pregnancy were subjected to statistical analysis by simple linear regression. The regression was done separately for each parameter and for each week.

1. Head Circumference is found to be statistically highly significant.

2. The regression equations derived for growth parameter for estimating gestational age in a normally developing fetus, increase with gestational age, showed good correlation with gestational age.

3. Assessment of gestational age helped in calculating the EDD (expected date of delivery) in all patients, thus improving the antepartum management. Gestational ages are fairly accurate predictors of fetal growth.

4. In Present study, In Third trimester Head circumference is the sensitive parameter and results of present study was comparable with previous studies

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