Original Article

Indian Journal of Anatomy
Volume 8 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/ija.2320.0022.8319.18

Correlation between Gestational Age and Head Circumference in Second Trimester

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Abstract

Introduction: In today's advanced medical world maternal child health care the important part of the healthcare system and important 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. Radiologically the period of gestation is grossly 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. Hence we proposed the present study to evaluate fetal Head Circumference for measuring the gestational age. *Materials and Methods:* The study Correlation between gestational age and head circumference in second trimester was carried out at Govt. Medical College and Hospital, Nanded, between July 2011 to July 2013 period. The study included 150 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:* Variation in fetal growth on the basis of Head Circumference during second trimester can be explained to the extent of 96.65%. The value of *R* is highly significant (Student's '*t*' test value = 149.10, $p < 0.0001$, highly significant) showing that there is statistically positive correlation between gestational age and Head Circumference. *Conclusion:* From the present study it is found that Head Circumference and gestational age are 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 results of present study were comparable with previous studies.

Keywords: Age; Fetal; Gestational age.

How to cite this article:
Varsha Pande, Vaishali Inamdar, Swapnil Patond. Correlation between Gestational Age and Head Circumference in Second Trimester. Indian J Anat. 2019;8(3):239-243.

Introduction

Beginning of human development start as oocyte from female which is fertilized by the sperm. Cell division, differentiation, growth transfigure the fertilized oocyte into a multicellular adult human being. Most of the changes occur during the early fetal and embryonic period, the development of which divided into pre and postnatal period. There are many changes that occur from the 3rd to 8th week called as embryonic development and changes occur from 9th week to birth into a recognizable human being called a fetus.[1]

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. Radiologically the period of gestation is grossly 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

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Received 15.06.2019 | **Accepted** 24.07.2019

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.[2]

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 like 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 uterus.

In any obstetrics case correct assessment of gestational age is keystone. Measurements and fetal characteristics are helpful in estimating fetal age. To determine the fetal age at the end of 1st trimester the crown rump length is method of choice because of negligible variation in the size of fetus during the 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 second trimester was carried out at Govt. Medical College and Hospital, Nanded, between July 2011 to July 2013 period. The study included 150 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 and uncomplicated pregnancy
4. Women having age between 18 and 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 calculated around the outer perimeter of the calvarium. 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 second trimester by Ultrasonography was carried out at Govt. Medical College and Hospital Nanded.

The collected data was tabulated according to weeks of menstrual cycle and were taken in centimeters.

Standard deviation of head circumference for each week was calculated. The mean of each parameter calculated statistical for each week. The completed

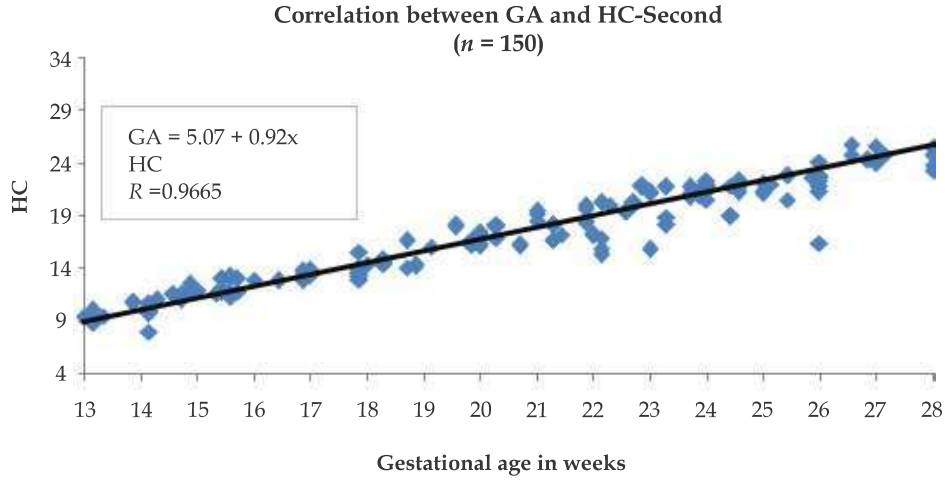
week considered as the week of gestation. For *e.g.*, 13th week refers to 13.00 to 13.86 weeks of menstrual age. 7 days = 1week, hence 1day = 0.14 weeks. Like this subsequently for each day.

Ultrasongraphic Head Circumference was measured in a total of 150 subjects. The observations of week wise mean values and standard deviation of fetal Head Circumference are shown in (**Table 1)**.

Table 1: Mean and Standard deviations of fetal Head Circumference

(Week wise).

Menstrual age in weeks	No. of cases	Mean	Standard deviation
13	8	9.67	0.78
14	11	10.72	1.24
15	10	12.18	0.76
16	7	13.20	0.44
17	12	13.73	0.66
18	9	14.67	0.76
19	7	16.84	0.82
20	11	16.97	0.70
21	10	18.38	0.97
22	12	19.23	1.94
23	10	20.11	1.93
24	10	21.15	1.29
25	8	21.88	0.88
26	12	22.75	2.41
27	4	24.65	0.73
28	9	24.78	1.64
	150		



Graph 1: Showing linear correlation between Gestational age and Head Circumference in second trimester (*n* = 150).

Regression output for 2nd trimester (13 to 28 weeks)

Constant	= 5.07
Standard error of Y ests	= 0.4787
Co-efficient Of determination (R)	= 0.9665
No. of observations	= 150
Degree of freedom	= 148
X co-efficients	= 0.902

Regression equation:

G.A. = 5.07 + 0.902 x HC

From the above equation it is clear that during the second trimester, for every 1*cm* increase in HC, the gestational age (GA) increases by 0.902 weeks.

As the value of *R* is 0.9665 the variation in fetal growth on the basis of Head Circumference during second trimester can be explained to the extent of 96.65%. The value of *R* is highly significant (Student's '*t*' test value = 149.10, $p < 0.0001$, highly significant) showing that there is statistically positive or strong positive correlation between gestational age and Head Circumference.

Discussion

Ultrasonography is key imaging technique in the assessment of fetal growth because of its low cost, availability, and without any adverse effects. Ultrasonography can detect the fine observations of the chorionic sac and its contents during the various stages of fetal and embryonic period. Along with this technique can also detect anomalies abnormality various presentations related fetus at a very early stage. Therefore various advances in Ultrasonography have made this technique a crucial tool for prenatal diagnosis which is a most reliable method for the growth of the fetus.[1]

It is observed that upper extremities almost reach to development by the end of 12th weeks, compare to lower extremities. Appearance of primary ossification centre for cranium and long bones develop by the end of 12 weeks. Various ossification centers can be observed during this period along with bones on Ultrasonography.

Fetal head, body and extremity measurements have been widely reported and found to be used in second and third trimester.[1]After 10th week of gestational period one can differentiate soft and hard tissues after which measurement of various parameters like head circumference other parameter can be done by Ultrasonography which can be recommended.[3]

Studies by Indian authors Vaidya[4] (1986), Khandeparkar[5] (1986), Ghamande[6] (1989), Rajan R[7] (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 150 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 2)** shows week wise averages of the measurements of the Head Circumference as studied by Rajan R *et al.*[7] (1991) compared with those calculated in the present study. The present study correlates with the above study**.**

In present study the measurements of Head Circumference are comparable with the findings of various Authors Scammon and Calkins and Kesari, Vare and Bhusari, shows that actual Head Circumference value for human fetuses is very close to value derived in the study.[9] (Shown in **Table 3)**.

Table 2: Showing comparison between week wise mean of the measurements of Head Circumference.

Gestational age	Rajan (1991)	Present study
13	9.1	9.67
14	9.7	10.72
15	11.5	12.18
16	12	13.2
17	13.3	13.73
18	14.3	14.67
19	15.6	16.84
20	16.8	16.97
21	17.5	18.38
22	18.8	19.23
23	19.4	20.11
24	20.5	21.15
25	22.4	21.88
26	23.5	22.75
27	24.1	24.65
28	25.3	24.78

Table 3: 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
16	11.79	12.30	11.76	13.26	13.20
20	16.68	18.50	17.69	17.13	16.97
24	21.01	24.80	20.69	21.20	21.15
28	24.96	26.30	25.18	26.47	24.78

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

HC	2nd Trimester
	G.A. = 5.07 + 0.902 × HC

(Shown in **Graph 1).**

Conclusion

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 collected data was arranged according to the menstrual weeks, by applying various statistical methods mean and standard deviation of the parameter for each week was calculated with software SYSTAT. Comparison of week wise mean value was done with studies done previously and represented in a tabular form and graphical representation of the results was done.

Finally, sonographically measured parameters during second 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 second trimester Head circumference is the sensitive parameter and results of present study was comparable with previous studies

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