A COMPARATIVE ANALYSIS OF ESTABLISHED VERSUS NEWER STANDARD ANATOMICAL PARAMETERS FOR FETAL AGE DETERMINATION-AN ULTRASOUND STUDY

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Abstract

Title- A comparative analysis of established versus newer Standard Anatomical parameters for fetal age determination – An Ultrasound study

Objective- The objective of the study was to determine the growth of fetus in different trimesters with the help of fetal parameters and see the extent of disparity of individual parameters to be still acceptable for incorporation into the composite age estimate.

Background- The anatomical plane chosen for measurement of various fetal parameters was obtained by placing the transducer over abdomen in the midsaggital section. The fetal head was then looked for the lie of the fetus. Then the transducer was placed in the parasaggital plane to define other fetal parts. Each examination was performed after the routine antenatal check up by the obstetrician prior to the scan. The patients were explained about the procedure and its purpose, prior to scanning. Patient was placed supine and the area between the pubic symphysis and umbilicus was exposed, the ultrasound jelly was applied to the skin and transducers head. The jelly serves to make better contact between the skin surface and the transducer, making the passage of ultrasonic waves easier.

Subjects-The Study was conducted in 200 normal pregnant females between 13th to 39th weeks of gestation.

Methods- All examinations were performed by using a Gray scale real time machine (Sonosite Micromaxx M Turbo) employing a 3-5 MHz convex transducer.

Result-The correlation coefficient was +0.994, +0.989, + 0.965, +0.938 and 0.976 which is statistically highly significant.

Conclusion and Discussion- Gestational age (BPD, HC, AC, FL) predicted by sonography were lower than GA (LMP) in each week of both trimesters. Its variability also increased as the pregnancy advanced.

Keywords- Gestational age (Biparietal diameter, Head Circumference, Abdominal Circumference, femur length, Foot length)

INTRODUCTION

"*Fetal development is a continuous process* that begins when an **oocyte** (ovum) from a female is fertilized by a **sperm** (spermatozoon) from a male. Cell division, cell migration, programmed cell death, differentiation, growth, and cell rearrangement transform the fertilized oocyte, a highly specialized, totipotent cell – a **zygote** – into a multicellular human being. (1, 2)

Before the advent of sonography, menstrual age was established by the patient's menstrual history, corroborated, preferably during early pregnancy, by physical examination of uterine size, and confirmed in the postnatal period by physical examination of the neonate. All three of these parameters alone or in combination were notoriously inaccurate, but the menstrual history could be especially misleading for a number of reasons.(3,4) First, many women may not accurately recall the 1st day of the last normal menstrual period (LMP), particularly if they are not trying to conceive. So also some women commonly misunderstand the question posed and report the last day instead of the 1st day of their last period. (5, 6, 7) Fetal biometry is a methodology devoted to the measurement of several parts of fetal anatomy and their

growth**.** Fetal growth is defined as the time dependent changes in body dimensions that occur throughout the pregnancy. The real-time ultrasound scanners have given a number of ultrasonic biometric parameters to determine gestational age. (8, 9, 10)

Gestational age is defined as the duration of the pregnancy calculated from first day of last normal menstrual period (LMP). It is about 280 days from LMP (Jukic AM et al 2013). Fetal biometry is of great interest in obstetrical practice. In addition, fetal biometry distinguishes the normal from abnormal fetal structures. (11, 12) Prenatal measurement of fetal parameters and estimated size and weights vary among different populations, depending upon their racial, demographic characteristics and nutrition (Whitworth M et al 2010). It is therefore important that fetal biometry be performed for local population and local charts of normal biometry be constructed and followed for these populations and ethnic groups. (13, 14, 15)

Materials and method- The present study entitled "A Comparative Analysis of Established versus Newer Standard Anatomical Parameters for Fetal Age Determination – An Ultrasound Study"has been conducted upon 200 normal pregnant females between 13th to 39th weeks of gestation, referred from antenatal clinics towards department of Radio diagnosis, S.N. Medical College and Care Diagnostic Centre, Agra for Ultrasonography to determine fetal Gestational Age.

1. Ultrasonography machine: Sonosite Micromaxx M Turbo (Image-01).
2. Aqua saline jelly like *ultragel*
3. Single coated sonographic films
4. Convex Probe Frequency (3-5) MHz (Image-02)

ABBREVIATIONS USED:

1. Head Circumference (HC)
2. Abdominal Circumference (AC)
3. Last Menstrual Period (LMP)
4. Gestational Age (GA)
5. Femur Length(FL)
6. Foot Length (FOL)
7. Biparital Circumference (BPC)

Inclusion and Exclusion Criterion- Normal and Healthy Subjects and Subjects of North Indian Origin are the Inclusion criterion. Subjects with history of trauma and affected limbs are the Exclusion criterion.

Image-01

Image-02 Convex probe Frequency

Result- Table No.01 Distribution of women according to maternal age in 2nd and 3rd trimesters

Age group (In yrs)	Trimester		Total
	II	III	
18-23	44(44%)	32(32%)	76(38%)
124-29	45(45%)	50(50%)	95(47.5%)
>30	11(11%)	18(18%)	29(14.5%)

Total	**100(100%)**	**100(100%)**	**200(100%)**

Table No. 02 Comparison of mean Head Circumference of present study with Hadlock's finding according to Gestational Age (Last Menstrual Period) in 2nd trimester

GA according to LMP (in weeks)	Present Study (in mm)	Hadlock (in mm)	% difference
13	81	82	-1.23
14	89	97	-8.98
15	103.38	116	-12.21
16	118.75	124	-4.42
17	134.40	138	-2.68
18	143	151	-5.59
19	147.75	164	-1.099
20	165.14	177	-7.18
21	183.50	189	-3.00
22	189.36	201	-6.14
23	199.89	213	-6.56
24	210.50	224	-6.41
25	231.85	234	-1.37
26	233.80	246	-5.22
27	243.83	256	-4.99
28	252.83	266	-5.21

Table No. 03 Distribution of difference of mean Gestational Age according to Last Menstrual Period and Head Circumference in 3rd trimester

Mean GA according to LMP (in weeks)	Mean GA according to HC	% difference
29	27.80	-4.14
30	29.43	-1.90
31	29.93	-3.45
32	31.00	-3.13
33	32.10	-2.73
34	32.17	-5.38
35	33.85	-3.29
36	33.82	-6.06
37	34.79	-5.97
38	34.71	-8.66
39	35.94	-7.85

Table No. 04 Correlation between Gestational Age and Bi Parietal Diameter, Head Circumference, Abdominal Circumference, Femur Length & Foot Length

Correlation	r-value	p-value	Significance
GA v/s BPD	0.994	< .001	HS*
GA v/s HC	0.989	< .001	HS*
GA v/s AC	0.965	< .001	HS*
GA v/s FL	0.938	< .001	HS*
GA v/s FoL	0.976	< .001	HS*

Table no. 01 shows the distribution of cases in 2nd and 3rd trimesters according to maternal age group. Maximum no. of cases (95 i.e. 47.5%) were in 24-29yrs age group and minimum no. of cases (29 i.e. 14.5%) were found in age group ≥ 30 yrs. This observation depicts marriage and conceiving trend at middle age in study sample size. This may be due to increasing literacy rates and social awareness in Agra region.

Table no. 02 shows distribution of difference of mean GA according to LMP and HC in 2nd trimester. % difference varies from -0.56% to -6.55% in 2nd trimester.

Table no. 03 shows distribution of difference of mean GA according to LMP and HC in 3rd trimester. % difference varies from - -1.9% to -8.66% in 3rd trimester. Observations shows trend that MGA (HC) is lower than MGA (LMP) in all weeks of both trimester

Table no.04 there is a high degree of positive correlation between Gestational Age and Bi Parietal Diameter, Head Circumference, Abdominal Circumference, Femur Length and Foot Length. The correlation coefficient was +0.994, +0.989, + 0.965, +0.938 and 0.976 which is statistically highly significant i.e. P < .001. As the BPD, HC, AC, FL and FoL increase, GA also increases.

DISCUSSION-

In 2nd trimester Gestational Age (Head Circumference) varied from +1 to +2 weeks in 8% cases and from -1 to -3 weeks in 54% cases. Whereas in 3rd trimester Gestational Age (Head Circumference) varied from +1 to +2 weeks in 10% cases and from -1 to -4 weeks in 75% cases. Bensen et al (1991) demonstrated variability in predicting Gestational Age from Head Circumference reaches to peak approximately ±3.8 weeks in late 3rd trimester. W. Akhtar et al (2011) found a linear growth pattern for head circumference for all gestational weeks with most rapid growth in 15th week for head circumference.

Our findings also correlated with S. Campbell, S.L Warsof et al (1985) study which demonstrated that Bi Parietal Diameter measurements were significantly more accurate to predict gestational age before 36 weeks. Ultrasonography measurement of Bi Parietal Diameter was found to be the best single dating parameter as the Bi-Parietal Diameter growth in first half of 2nd trimester is quite uniform and not much altered by genetic and environmental factors that may create variation in size in latter stages of pregnancy.

In 2nd trimester Gestational Age (Femur Length) was similar to Gestational Age (Last Menstrual Period) in 28% cases with variability of ±1 week in 54% cases. In 3rd trimester Gestational Age (Femur Length) was similar to Gestational Age (Last Menstrual Period) in 21% cases with variability of ±1 week in 36% cases. Accuracy of Femur Length to predict Gestational Age had decreased from 28% to 21% in 3rd trimester. In 2nd trimester Gestational Age (Femur Length) varied from +1 to +2 weeks in 9% cases and from -1 to -2 weeks in 63% cases. Whereas in 3rd trimester GA (FL) varied from +1 to +2 weeks in 8% cases and from -1 to -7 weeks in 71% cases.

W.Akhtar et al (2012) found a linear growth of abdominal circumference from 16 weeks gestational age till the end. The abdominal size appeared to be larger in comparison to other studies (Shahida et al 2010).

In present study, accuracy of Gestational Age (Abdominal Circumference) was 22% in 2nd trimester and 28% in 3rd trimester. This shows that Abdominal Circumference is least accurate parameters to determine Gestational Age among all parameters. Our study was thus, not in agreement with W. Akhtar et al (2011).

Foot Length values (in mm) in present study were lower than Joshi's nomogram in each week of both trimesters. Maximum difference observed was 1.33 mm (7%) in 2nd trimester which increased to 2 mm (3.28%) in 3rd trimester. Smaller measurement and slow growth rate of FL were found in present study as compared to Joshi's nomogram.

Conclusion-

I. Gestational age (BPD, HC, AC, FL) predicted by sonography were lower than GA (LMP) in each week of both trimesters. Its variability also increased as the pregnancy advanced.
II. Mean measurements of Fetal Biometric parameters (BPD, HC, AC, FL) were found lower than western monograms in each week of both trimesters. Also difference (in measurement) increased as the pregnancy advanced to late 3rd trimester .This was because of slower growth rate of all fetal parameters compared to western normogram in both 102 trimesters, more so in 3rd trimester.
III. Ultrasonography as a method to determine fetal gestation age was found to be a reliable, accurate and safe imaging modality in modern era.
IV. Our present study also revealed that the use of multiple fetal parameters results in greater accuracy for gestational age determination.

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