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RESEARCH ARTICLE

A clinical study on correlation of fetal kidney length with gestational age in third trimester of pregnancy

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ABSTRACT

Objectives: To study the correlation between fetal kidney length on ultrasonography (USG) and gestational age as well as validated with different biometric parameters of pregnant women presenting third trimester. **Methodology:** A cross-sectional study was performed among100 antenatal mothers of singleton pregnancies and parity who visited gynaecology and obstetrics OPD at IPGME&R & SSKM Hospital during the period of January 2019 to August 2020. The measurements of USG for foetal kidney length (FKL) and correlation with last menstrual period gestational age and other biometric indices viz. BPD, HC, AC and FL were evaluated. **Results:** The mean age of patients was 27.12± 4.12 years was obtained. The mean± SD values were recorded for POG by LMP (35.73 ± 3.71 days), POG by DS (35.19 ± 3.46 days), MKL (38.08± 3.76 mm), BPD (33.75± 2.60 mm), AC (33.38± 2.18 mm), FL (34.03 ± 2.40 mm), weight (233.93± 692.46 mm), HC (317.04± 23.67 mm), and AUA (33.88± 2.45 days) among patients. The values of Pearson correlation coefficient (r) were observed significantly (p = 0.03 and 0.020) positive correlation between POG by LMP and DS vs MKL while BPD, AC, weight, and AUA were observed significantly (p = 0.009, p = 0.001, p = 0.007 and p = 0.037) positive correlation (0.260, 0.339, 0.195, 0.267, 0.092 and 0.209) except FL and HC did not show significant (p = 0.052 and p = 0.365) difference among patients. **Conclusion**: FKL is easy to identify and measure. It is the most accurate single parameter for estimating GA than other biometric indices especially in cases when the other parameters like BPD, AC and HC are not reliable for assessing GA in 3rd trimester of pregnancy.

Keywords: Amniocentesis, biparietal and transvaginal sonography, third trimester, gestational age, fetal kidney length.

An accurate fetal age plays an important role in obstetric management of mother especially those with uncertain LMP and no USG in early trimester for diagnosis of growth disorder, procedures like amniocentesis, chorionic villus sampling, etc.[1] Planning termination of pregnancy in high - risk cases like gestational diabetes mellitus (GDM), placenta praevia also requires correct gestational age estimation.[1] Incorrect estimation can lead to complications like unnecessary induction, operative delivery, dysfunctional labor, iatrogenic pre and post maturity complications along with false interpretation of test increasing perinatal mortality and morbidity.[3,4]

According to Haines et al[5], it was noted that a combination of uncertain date of LMP and any obstetric high-risk conditions such as placenta previa, pregnancy induced hypertension, Intrauterine growth restriction (IUGR) placed the fetus in jeopardy because of the difficulty in deciding the optimal time of delivery.

In the first trimester gestational sac (GS) diameter and volume and crown rump length are used while biparietal diameter (BPD) and femur length (FL) are used in 2nd trimester.[1,6] However, these are unreliable in with advancing pregnancy and in IUGR. Several studies indicated that fetal kidney length (FKL) is easy to determine and measure in 2nd

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and 3rd trimester and correlation with GA has been established [1, 7 – 14].

From past, ultrasound has played a vital role in the estimation of fetal gestational age (FGA) and has become an integral part of obstetric practice. Sonographic estimation of gestational age is derived from calculation based on fetal measurement which serves as an indirect indicator of gestational age. Numerous equations regarding the relationship between fetal biometric parameters has been described and have proven early antenatal ultrasound to be an objective and accurate means of establishing FGA. There are well established biometric parameters such as gestational sac (GS), crown rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). Moreover, fetal biometry by USG is the most common method used in these cases. The parameters are CRL, BPD, HC, AC, FL. Moreover, CRL can predict GA within 5-7 days accurately but can be used only in first trimester. In early 2nd trimester BPD, FL, HC, AC can predict GA with fair accuracy.[10 – 14] Zalel et al [15] stated that fetal kidney could be reliably measured by using transvaginal –sonography (TVS) between 14 -17 weeks of gestation and it was also established to measure through transabdominal ultrasonography from 18 weeks of gestation and above. It has been recommended in past studies that the combination of multiple biometric parameters along with FKL with the help of USG for the evaluation of FGA in 3rd trimester instead of depending on a single parameter.[1, 16, 17]

The study of easy measurement of GA based on FKL by using USG has been found in many parts of the globe and India but this study is lacking in eastern India especially in the pregnant women of West Bengal. In the present study, it was attempted to study the correlation between fetal kidney length on ultrasonography (USG) and gestational age as well as compared with different biometric parameters in pregnant women presenting third trimester.

Materials and methods

The study was conducted among antenatal mothers of singleton pregnancies and parity attended in gynaecology and obstetrics OPD at IPGME&R & SSKM Hospital, Kolkata, India within a period of February 2019 to August 2020. The study design included 100 singleton pregnancies of different ages and parity who attended department of OBG in their third trimester. All patients reliably knew their date of last menses. The study does not require any invasive investigations or interventions to be conducted on patients or other humans or animals. Ethical clearance has been obtained from the institution.

This was a cross sectional study, and the method of sampling was purposive sampling. The sample was designed according to the inclusion and exclusion criteria mentioned below. All those patients who attended the antenatal centre and satisfied the following selection criteria were included in the study.

Inclusion criteria -

1. Uncomplicated pregnancies with single live normal fetus from 28 to 41 weeks
2. Pregnant females who clearly remember their LMP
3. Pregnant females with normal antenatal course with no associated risk factors
4. Mothers who gave informed consent for their voluntary participation in study after proper counselling the procedure.

Exclusion criteria -

1. Multiple gestation
2. Complicated pregnancy
3. Anomalous fetus
4. Oligohydramnios/Polyhydramnios
5. Dilated renal pelvis >4mm

Ultrasound assessment was done using TOSIBA MODEL XARIO using TAS curvilinear probe of frequency range 2.5-5MHZ. History, Clinical examination and counseling was performed. After taking detailed history, performed clinical examinations and routine investigations of mother attended antenatal clinic. A single USG scan was done during the third trimester of pregnancy. Mean FKL along with fetal BD, AC were measured and recorded by USG. The gestational age was calculated from the mean FKL from USG and from other fetal biometric indices, which were calculated by Hadlock chart of predicted fetal movements. These values were then compared with actual gestational age derived from LMP date taken as standard.

Statistical analysis: For statistical analysis data were entered into a Microsoft excel spreadsheet and then analysed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Correlation was calculated by Pearson correlation analysis. P-value $\leq$ 0.05 was considered for statistically significant.

Results

The data related to GS, FKL and others biometric indices in pregnant women presenting third trimester were

evaluated. The correlation was studied between POG by LMP, POG by DS, MKL, BPD, AC, FL, weight, HC and AUA with MKL.

Table 1: Demographic and clinical profiles of studied subjects

Parameters	Frequency	Percentage
Age groups (years)		
20-25	35	35
26-30	47	47
>31	18	18
Age (years M ± SD)	27.12 ± 4.12	
Parity		
P0+0	20	20
P1+0	63	63
P2+0	16	16
P3+0	1	1
POG by LMP (days M ± SD)	35.73 ± 3.71	
POG by DS (days M ± SD)	35.19 ± 3.46	
MKL (mm M ± SD)	38.08 ± 3.76	
BPD (mmM ± SD)	33.75 ± 2.60	
AC (mmM ± SD)	33.38 ± 2.18	
FL (mm M ± SD)	34.03 ± 2.45	
Weight (Kg M ± SD)	233.93 ± 692.46	
HC (mm M ± SD)	317.04 ± 23.67	
AUA (daysM ± SD)	33.88 ± 2.45	

LMP = Last menstrual period, POG = Period of gestation, DS = Dating scan, MKL = Mean kidney length, BPD = Biparietal diameter, AC = Abdominal circumference, FL = Femur length (FL), HC = Head circumference, AUA = Actual ultrasound age

Table 2: Correlation between POG by LMP, POG by DS, MKL, BPD, AC, FL, weight, HC and AUA with MKL (N = 100)

Parameters		MKL	Remarks
POG by LMP	Pearson Correlation Coefficient (r)	0.262	Positive
	P-value	0.043	Significant
POG by DS	Pearson Correlation Coefficient (r)	0.232	Positive
	P-value	0.020	Significant
BPD	Pearson Correlation Coefficient (r)	0.260	Positive
	P-value	0.009	Significant
AC	Pearson Correlation Coefficient (r)	0.339	Positive
	P-value	0.001	Significant
FL	Pearson Correlation Coefficient (r)	0.195	Positive
	P-value	0.052	Not significant
Weight	Pearson Correlation Coefficient (r)	0.267	Positive
	P-value	0.007	Significant
HC	Pearson Correlation Coefficient (r)	0.092	Positive
	P-value	0.365	Not significant
AUA	Pearson Correlation Coefficient (r)	0.209	Positive
	P-value	0.037	Significant

LMP = Last menstrual period, POG = Period of gestation, DS = Dating scan, MKL = Mean kidney length, BPD = Biparietal diameter, AC = Abdominal circumference, FL = Femur length (FL), HC = Head circumference, AUA = Actual ultrasound age

Out of 100 pregnant women recruited in the study after following inclusion and exclusion criteria. A maximum frequency of about 47% of age groups 26-30 years followed by 35% and minimum of about 18% of >31 years were recorded and the mean age (mean± SD) of patients was 27.12 ± 4.12 years was obtained (table 1). In our study, maximum frequency of about 63% of P1 parity followed by P0+0 parity of about 20% and P2+0 parity of about 16.0% while minimum of about 1% of P3+0 parity among patients were noted (table 1).

In table 1, the mean± SD values were recorded for POG by LMP (35.73 ± 3.71 days), POG by DS (35.19 ± 3.46 days), MKL (38.08± 3.76 mm), BPD (33.75± 2.60 mm), AC (33.38± 2.18 mm), FL (34.03 ± 2.40 mm), weight (233.93± 692.46 mm), HC (317.04 ± 23.67 mm), and AUA (33.88 ± 2.45 days) among patients.

In table 2, the values of Pearson correlation coefficient (r) were 0.262 and 0.232, which observed significantly (p = 0.03 and 0.020) positive correlation between POG by LMP and DS vs MKL among patients. The values of Pearson correlation coefficient (r) for other parameters such as BPD, AC, FL, weight, HC and AUA were also evaluated in which all the values were observed significantly (p = 0.009, p = 0.001, p = 0.007 and p = 0.037) positive correlation (0.260, 0.339, 0.195, 0.267, 0.092 and 0.209) except FL and HC did not observe significant (p = 0.052 and p = 0.365) difference among patients.

Discussion

The measurement of FKL is most accurate technique for the determination of GA than fetal biometric parameters such as HC, AC, BPD and FL during 2nd and 3rd trimester.[17]

Goyal et al [8] found that fetal kidney could be seen easily sonographically at 16th weeks of gestation. FL was the most accurate single parameter (SE +7.95 days) followed by FKL ± 9.56 days while BPD was the least accurate ± 9.86 days. GA can be calculated most accurately by combining FKL with FL and BPD with SE ± 7.12 days. FKL is easy to measure in 2nd and 3rd trimester and more accurate than BPD for GA. But our study observed MKL (38.08± 3.76 mm), BPD (33.75± 2.60 mm), AC(33.38± 2.18 mm), FL (34.03 ± 2.40 mm), weight (233.93± 692.46 mm), HC (317.04± 23.67 mm), and AUA (33.88± 2.45 days) among patients of eastern India. Whereas FKL was found to be the most accurate single biometric index with SE of ±10.29 days and 10.45 days as per Konje et al[1] and Gupta et al.[18] These studies were found contradiction with the present study related to only FL.

Yusuf et al [7] found that the study found a strong Pearson's correlation (r=0.52, p =0.03) for kidney length vs gestational age. They reported that fetal renal lengths could be aided in estimating GA when the other standard biometric

parameters could not be measured (low head-position), or are not reliable (in IUGR abdominal circumference), if patients reported in late second or third trimester when the standard fetal biometric parameters are not reliable. In the present study, all the biometric indices were significantly positively correlated except the parameters like FL and HC related to MKL. Cinnusamy et al [12] found that the FKL correlated with the GA with a correlation coefficient of 0.1715 and a determination coefficient of 0.822, which was better than all the conventional parameters used. Their study observed good correlation between gestational age derived from FKL and gestational age from established biometric indices like BPD, HC, AC, and FL. In another study by Shaheen et al[11] reported that the Pearson correlation coefficient r=0.988, which obtained a strong correlation with kidney length and gestational age and p value was highly significant (0.00). They also emphasized that fetal kidney length easily estimated the GA accurately than other standard traditional parameters. It is more accurate in late 2nd and 3rd trimesters of pregnancy when other parameters are not much reliable. It is easy to detect and measure where the risk of mortality and morbidity among neonates.

Conclusion

In conclusion, FKL measurement correlated well with other routinely used parameters for the estimation of GA during 3rd trimester. Moreover, it is well - known that FKL measurement is the accurate parameter to date pregnancy, and this could be combined with other routinely used parameters (BPD, FL, AC) to date pregnancy more accurately. FKL is easy to identify and measure. It is the most accurate single parameter for estimating GA than other biometric indices especially in cases when the other parameters like BPD, AC and HC are not reliable for assessing GA in 3rd trimester of pregnancy. It is suggested in future study with larger sample size and multicentre approach for demonstrating its applicability in routine clinical practice.

Conflict of interest: None. **Disclaimer:** Nil.

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