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Foetal Kidney Length Comparing Its Efficacy with Other Biometric Parameters as a Parameter for Determination of Gestational Age in Pregnancy by Ultrasonography

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Abstract
Background: *Accurate monitoring of fetal gestational age is one of the most critical components of prenatal care. The ability to accurately determine the fetal gestational age and growth was recognizing its abnormal patterns, helps us to decide that if early intervention is necessary in high risk pregnancy or not.*
Aims: *This study intends to determine the accuracy of fetal gestational age estimation using mean fetal kidney length and comparing its efficacy with other biometric parameters and gestational age derived from last menstrual period as taken as a standard.*
Material & Method: *This cross section hospital based study period of one year from 2015 to 2016. Pregnant women (n=100) with known dates of different parity and ages were included in this study. The subjects were taken informed before they were enrolled in the study.*
Results: In present study, gestational age was ranging from 28 to 40 weeks and their mean BPD was ranging from 68.00 to 98.00 mm (table 2) and their mean femur length was ranging from 53.00 to 78.00mm.
Conclusion: *The kidney length is more accurate method of determining gestational age than the fetal biometric indices of biparietal diameter, head circumference, femur length and abdominal circumference between 24 to 38 weeks of gestation. However, large and multicentric studies are required to recommend it.*
Keywords: *Biparietal Diameter (BPD), Head Circumference (HC), Femur Length (FL) and Abdominal Circumference (AC).*

Introduction

Accurate monitoring of fetal gestational age is one of the most critical components of prenatal care. Ultrasound has become a vital tool in obstetrical examination and also in the accurate estimation of fetal gestational age. The ability to accurately determine the fetal gestational age and growth was recognizing its abnormal patterns, helps us to decide that if early intervention is necessary in high risk pregnancy or not. Various biometric

parameters have been utilized for the same namely, fetal biparietal diameter, abdominal circumference, head circumference and femur length. Other parameters that have been suggested for gestational age estimation are fetal foot length, clavicular length and transcerebellar diameter. Recent studies have shown that fetal kidney length can also be used to make an accurate measurement of the fetal gestational age, particular in the third trimester of pregnancy.[1]

The development of diagnostic ultrasound has opened new possibilities for more confident assessment of dating. Gestational age can be estimated in the first trimester by ultrasonic measurement of diameter and volume of gestational sac as well as crown-rump length (CRL).[1-3] Also other biometric indices such as fetal biparietal diameter (BPD), femur length (FL), transcerebellar diameter (TCD), clavicular length (CL), foot length and head circumferences (HC) are used for GA estimation during different pregnancy trimester.[3]

In routine ultrasonography, the ultrasonologist measures the biparietal diameter (BPD), head circumferences (HC), abdominal circumferences (AC) and femur length (FL) in estimating the GA and estimated date of delivery.[4] The use of all four biometric indices are recommended for all pregnancies beyond 20 weeks for reduction of variabilities.[5] As pregnancy advances these parameters become increasingly unreliable in estimation of GL.[6] Previous studies have demonstrated that fetal kidney length (FKL) is a more accurate method of GA estimation than BPD,HC, AC and FL after 24 weeks of gestation.[7-10]

This study intends to determine the accuracy of fetal gestational age estimation using mean fetal kidney length and comparing its efficacy with other biometric parameters and gestational age derived from last menstrual period as taken as a standard.

The investigational tool will accurately predict the estimated date the confinement without being affected by the discrepancy of late trimester or by growth retardation of the foetus.

Material & Methods

This cross section hospital based study was conducted in the department of Obstetrics and Gynecology, PBM and Associated group of hospitals, attached to S.P. Medical college, Bikaner during study period of one year from 2015 to 2016. Pregnant women (n=100) with known dates of different parity and ages were included in this study.

The women were evaluated as per history, general physical examination and routine antenatal investigations and using third trimester ultrason-ography. Gestational age was calculated from mean fetal kidney length using normogram by Cohen et al[11].

The subjects were informed about the study and informed consent was taken before they were enrolled in the study.

Inclusion Criteria: 1) All cases with singleton pregnancies in the third trimester (28 to 40 weeks) 2) Cases who were sure of the dates of their last menstrual period 3)Normal antenatal pregnant women with no associated risk factors.

Exclusion Criteria: 1) Anomalous fetus 2) IUGR 3) Pregnant women with unknown dates 4) off-spring of diabetic mothers 5) Renal pelvic dilatation of 5mm or greater 6) Twin pregnancies 7) Renal anomalies or known case of renal anomalies informed

Results

The present study was conducted on 100 pregnant women in their 3rd trimester who presented in antenatal clinic during 2015 to 2016. These out of 100 patients while most of the females were in middle age group (n=90) (table 1). In present study, gestational age was ranging from 28 to 40 weeks and their mean BPD was ranging from 68.00 to 98.00 mm (table 2) and their mean femur length was ranging from 53.00 to 78.00mm. (table 3).

The present study showed gestational age was ranging from 27 to 40 weeks and their mean head circumferences was ranging from 29.00 to 34.50 mm (table 4). The abdominal circumferences was ranging from 24.00 t0 30.25 mm (table 5).

Table 1: Distribution of cases according to age group (years)

Age Group	No.	%
≤ 19 (Teenage)	5	5.0%
20-34 (Middle)	90	90%
> 34 (Elderly)	5	5.0%
Total	100	100%

Table 2: Distribution of cases showing BPD for various gestational ages

Gestational age in weeks (n=100)	Mean BPD in mm	SD	Median
28 (n_1=3)	68.00	1.73	67.00
29 (n_2=3)	72.00	0.00	72.00
30 (n_3=6)	75.00	0.00	75.00
31 (n_4=8)	76.75	0.71	77.00
32 (n_5=9)	79.77	0.44	80.00
33 (n_6=7)	82.00	0.00	82.00
34 (n_7=12)	84.00	0.00	84.00
35 (n_8=16)	87.00	0.00	87.00
36 (n_9=14)	88.64	1.33	89.00
37 (n_{10}=14)	91.00	0.00	91.00
38 (n_{11}=6)	93.00	0.00	93.00
39 (n_{12}=1)	95.00	0.00	95.00
40 (n_{13}=1)	98.00	0.00	98.00

Table 3: Distribution of cases showing femur length (FL) for various gestational ages

Gestational age in weeks (n=100)	Mean FL in mm	SD	Median
28 (n_1=5)	53.00	0.00	53.00
29 (n_2=2)	55.00	0.00	55.00
30 (n_3=7)	56.42	1.15	57.00
31 (n_4=6)	59.83	0.40	60.00
32 (n_5=8)	62.00	0.00	62.00
33 (n_6=6)	64.00	0.00	64.00
34 (n_7=7)	66.00	0.00	66.00
35 (n_8=16)	68.00	0.00	68.00
36 (n_9=21)	70.00	0.00	70.00
37 (n_{10}=13)	72.30	1.10	72.00
38 (n_{11}=7)	74.00	0.00	74.00
39 (n_{12}=1)	76.00	0.00	76.00
40 (n_{13}=1)	78.00	0.00	78.00

Table 4: Distribution of cases showing Kidney Length (KL) for various gestational ages

Gestational age in weeks (n=100)	Mean KL in mm	SD	Median
28 (n_1=5)	28.00	0.00	28.00
29 (n_2=2)	29.00	0.00	29.00
30 (n_3=6)	29.67	0.51	29.00
31 (n_4=7)	30.28	0.48	30.00
32 (n_5=5)	32.00	0.00	32.00
33 (n_6=9)	32.88	0.33	32.00
34 (n_7=9)	33.44	0.52	33.00
35 (n_8=16)	34.68	0.47	34.00
36 (n_9=17)	35.76	0.56	35.00
37 (n_{10}=17)	36.76	0.43	36.00
38 (n_{11}=5)	37.40	0.54	37.00
39 (n_{12}=1)	38.00	0.00	38.00
40 (n_{13}=1)	40.00	0.00	40.00

Table 5: Distribution of cases showing head circumferences (HC) for various gestational ages

Gestational age in weeks (n=100)	Mean HC in mm	SD	Median
27 (n_1=1)	29.00	0.00	29.00
28 (n_2=4)	26.50	1.00	27.00
29 (n_3=2)	27.00	0.00	27.00
30 (n_4=4)	28.00	0.00	28.00
31 (n_5=7)	28.57	0.53	28.00
32 (n_6=8)	29.25	0.46	29.00
33 (n_7=7)	30.14	0.37	30.00
34 (n_8=6)	30.83	0.75	31.00
35 (n_9=15)	31.06	0.70	31.00
36 (n_{10}=20)	32.00	0.32	32.00
37 (n_{11}=17)	32.88	0.48	33.00
38 (n_{12}=4)	33.25	0.50	33.00
39 (n_{13}=1)	32.00	0.00	32.00
40 (n_{14}=4)	34.50	0.57	34.00

Table 6: Distribution of cases showing Abdominal circumferences (AC) for various gestational age

Gestational age in weeks (n=100)	Mean AC in mm	SD	Median
28 (n_1=3)	24.00	0.00	24.00
29 (n_2=6)	25.00	0.00	25.00
30 (n_3=8)	26.00	0.00	26.00
31 (n_4=5)	27.00	0.00	27.00
32 (n_5=6)	27.83	0.41	28.00
33 (n_6=9)	30.22	3.31	29.00
34 (n_7=11)	30.00	0.00	30.00
35 (n_8=19)	31.00	0.00	31.00
36 (n_9=7)	32.00	0.00	32.00
37 (n_{10}=11)	33.00	0.00	33.00
38 (n_{11}=11)	34.00	0.00	34.00
39 (n_{12}=4)	35.25	0.00	35.00

Table 7: Result of regression equation application between KL,HC,FL,BPD, AC v/s GA

		Intercept estimate	Intercept SE	Slope estimate	Slope SE	R^2	SE_p	P value	Conclusion
KL v/s GA	N=100	0.3016	0.3434	9.907	0.0998	.9888	0.2814	<0.001	Highly significant
HC v/s GA	N=100	-8.801	1.457	1.397	0.0469	.9006	0.9369	<0.05	Significant correlation
FL v/s GA	N=100	7.196	0.898	0.4088	0.01349	.9036	0.8959	<0.05	Significant correlation
BPD v/s GA	N=100	6.877	0.9452	0.9013	0.03108	.9906	0.9704	<0.001	Significant correlation
AC v/s GA	N=100	-1.725	0.3546	0.4247	0.00418	.8956	0.2729	<0.001	Significant correlation

Discussion

The present study showed maximum no. of cases (90%), who were presented for study were in middle age group i.e. 20-34 years and least in elderly age group (> 34 years).

Our study was carried out in the pregnant women in 3rd trimester, the fetal heart sound was also observed in all the cases. Many sonographic parameters have been proposed for estimating gestational age in the 3rd trimester of pregnancy.

These include several fetal biometric measurements like biparietal diameter (BPD- Kurts et al[12] 1980 and Doubilet et al[13] 1993), head circumference (HC) – (Law et al[14] 1982), abdominal circumference (AC) (Hadlock et al[15] 1982), femur length (FL) (Doubilet et al[13] 1993, Hadlock et al[16] 1984, Jeanty et al[17] 1984) and combination of two or more fetal measurement.

The ultrasonographic study of 100 fetus for the measurement of BPD was done at different gestational ages. The range of mean BPD was minimum 67 mm at 22 weeks to maximum 92.5 mm at 38 weeks of gestation. The above study is comparable with the findings of the Kurtz et al[12] (1980) and Doubilet et al[13] (1993). It shows that as the gestational age increases, the BPD also increases and mean femur length are comparable with the findings of Hadlock et al[16] (1984), Jeanty et al[18] (1984) and Doubilet et al[13] (1993). It shown that as the gestational age increases, the femur length also increases.

To confirm our measurement, we correlated our figures with published neonatal studies. Rosenbaum et al[19] (1984), noted the mean renal length in neonates (0-1 weeks) as 44.8 mm with a 3.1 mm standard deviation. Han & Babcock et al[20] (1985) noted measurements of 39 to 59 mm in neonates. Fitzsimons[21] (1983) showed measure-ment of neonates kidney among premature infants whose gestational age was determined by menstrual history, fetal sonographic measurement or maturity assessment were higher to those of our foetuses at equivalent gestational age, both our measurement and those of Fitzsomons[21] (1983) showed little difference in the renal length measurement between 22 to 40 weeks, we have no explanation for these findings.

When gestational age determined by clinical data which is compared with the gestational age determined by ultrasonography across the 21 to 40 weeks it was shown that there is no significant difference was found in the majority of cases, only few cases at the end of pregnancy had significant differences in their gestational age. Similar findings had also been observed when the gestational age determined by BPD, HC, AC, and FL are compared with fetal kidney length across the 27 to 40 weeks of gestation. There is no significant differences found in majority of cases in 3rd trimester of gestation. Only few cases at the end of pregnancy had significant differences in their gestational ages.

Conclusion

The kidney length is more accurate method of determining gestational age than the fetal biometric indices of biparietal diameter, head circumference, femur length and abdominal circumference between 24 to 38 weeks of gestation. When combined with biparietal diameter, head circumference and femur length, the precision of dating is improved. This measurement is easy to make and could therefore be easily incorporated into the model for dating pregnancies after 24 weeks of gestation, in particular when measurements of the biparietal diameter and head circumferences are difficult. However, large and multicentric studies are required to recommend it.

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