Determination of Gestational Age by Fetal Kidney Length Measurement in Uncomplicated Pregnancy in a Tertiary Care Centre

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ABSTRACT

Introsution. Gestational age of fetus is estimated by including various biometric parameters. Newer parameters like fetal kidney length have not been studied in Nepalese population.

Objective. To determine gestational age by fetal kidney length measurement after the 20th week of gestation in healthy women with uncomplicated pregnancy.

Method. Obstetric sonography was performed in 108 pregnant women with regular menstrual cycles, known menstrual age and uncomplicated pregnancy from 20 weeks to term. Fetal kidney length was evaluated as a measure to calculate the predicted gestational age.

Results. The study showed mean fetal kidney length at 20-24, 25-29, 30-34 and 35-37 weeks gestation 22.5 ± 0.5, 26.9 ± 0.7, 32.32 ± 0.7 and 36.3 ± 0.6 mm, respectively. Overall, in second and third trimester, fetal kidney length showed strong linear correlation with gestation age with highest significant Pearson correlation coefficient of 0.989 as compared to other parameters (BPD=0.986, HC=0.976, AC= 0.971, FL= 0.984).

Conclusion. Fetal kidney length can be used as a reliable parameter for determination of gestational age.

Keywords. *Biometry, Fetal, Gestational age, Kidney, Ultrasonography.*

INTRODUCTION

Fetal biometry includes various parameters like crown rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). CRL is measured in first trimester and has accuracy within ± 4.7 days. Combined biometry methods like FL and BPD, can predict gestational age with a high degree of accuracy in the early second trimester.[1] Accurate dating of pregnancies in the late second trimester or in the third trimester is more challenging, particularly, in women who do not have an early dating scan and uncer-

tain menstrual age. Using multiple parameters can reduce variability by 25% to 30 %.[2]

Conditions like oligohydromnios, multiple gestation, breech presentation and intrauterine growth restriction (IUGR) increase the variability by altering the parameters, especially fetal skull.[3] Additional parameters like clavicle length, humerus length and transcerebellar diameter have been shown to be less affected by the same.[4]

Fetal kidney length (FKL) can be easily measured in an-

tenatal scan and may be reliable with less variablility. Therefore, in the present study we evaluated the FKL as an additional morphological measurement of fetal growth for pregnancies after 20 weeks of gestation in Nepalese population and made a nomogram.

METHODS

This was a prospective cross-sectional study done in 108 healthy women with uncomplicated pregnancy between the 20th week of gestation and term referred from the Obstetrics and Gynaecology Department of Institute of Medicine, Tribhuvan University Teaching Hospital. Patients with unknown menstrual age, oligohydramnios, diabetes, pre eclampsia, multiple gestation, fetal anomalies and intrauterine growth restriction were excluded. The study period was one year from November 2019 to November 2020. It was done after ethical clearance from the Institutional Review Board, Institute of Medicine, Tribhuvan University and verbal informed consent from patient.

Obstetric ultrasound scans were performed using Samsung Accuvix A30 ultrasound scanner using a 3.5 MHz convex probe with patient in supine position. In all the patients BPD, HC, AC, FL and FKL were obtained. The routine biometric measurements were done using appropriate planes.

Measurements of FKL were obtained from upper to lower pole, after visualizing the full length with renal pelvis in the sagittal plane. Three measurements of right or left kidney were made as previous studies show no significant difference in size of either kidney and the mean obtained.[44] Ateast three such measurements were made and the mean taken.

All the relevant data was recorded in predesigned performa and analysed using appropriated statistical methods. Correlation between the FKL and gestation age as well as various morphological parameters was obtained using regression coefficient. Simple tables were used to present the data.

RESULTS

The study included 108 patients with age between 20 to 36 years with mean of 27.5 and SD 3.5. Maximum patients (44.4%) were in the age group of 25 to 29 years and only 2.8 % were more than 34 years. The highest number of cases were at 33 week (n=10, 9.3 %) and lowest at 36 weeks (n=3, 2.8 %). The mean FKL at different gestation ages and number of cases in each week is as shown in table 1.

Table 1: Mean fetal kidney length at various gestational ages.						
	FKL		95% CI		Number of cases	
CGA	Mean	SD	lower	upper	Frequency	Percent
20	20.4	0.5	19.96	20.84	5	4.6
21	21.6	0.5	21.23	21.97	7	6.5
22	22.5	0.5	22.10	22.90	6	5.6
23	23.4	0.5	22.96	23.84	5	4.6
24	24.6	0.5	24.16	25.04	5	4.6
25	25.1	0.7	24.58	25.62	7	6.5
26	25.9	0.7	25.38	26.42	7	6.5
27	26.4	0.8	25.81	26.99	7	6.5
28	28.1	0.6	27.68	28.52	8	7.4
29	29	0.7	28.39	29.61	5	4.6
30	30.4	0.5	29.96	30.84	5	4.6
31	31.4	1	30.66	32.14	7	6.5
32	31.8	0.8	31.16	32.44	6	5.6
33	33.3	0.7	32.87	33.73	10	9.3
34	34.7	0.8	34.06	35.34	6	5.6
35	36	1.2	34.82	37.18	4	3.7
36	36.3	0.6	34.62	35.98	3	2.8
37	37.4	0.5	36.96	37.84	5	4.6
Total					108	100

Table 2: Nomogram of FKL

FKL (mm)	CGA (weeks)
20	20.3
21	21.2
22	22.2
23	23.2
24	24.2
25	25.2
26	26.2
27	27.2
28	28.2
29	29.2
30	30.2
31	31.2
32	32.2
33	33.2
34	34.2
35	35.2
36	36.2
37	37.2

Nomogram of FKL is shown in table 2. All the correlations of CGA and FKL with different biometric parameters were statistically significant (p<0.001). The correlation for CGA with different biometric parameters was significant, being least for CGA and AC (r: 0.971), similar for BPD, HC and FL (r: 0.986, 0.976, and 0.984 respectively) and maximum for CGA and FKL (r: 0.989). Likewise, the correlation was best for FKL and CGA, FL(r: 0.989 and0.981) and least for FKL and AC (r: 0.966) (Table 3).

Table 3: Regression coefficients of morphological parameters for predicting gestation age							
	Intercept coefficient (α)	SE	Slope coefficient (β)	SE	p	R2	Sep (days)
BPD	-1.866	0.49	1.05	0.017	<0.001	0.973	6.1
HC	-2.88	0.668	1.073	0.023	<0.001	0.952	8.3
AC	-2.684	0.729	1.065	0.025	<0.001	0.943	9.1
FL	-3.558	0.549	1.082	0.019	<0.001	0.968	6.9
FKL	0.312	0.423	0.997	0.015	<0.001	0.978	5.3

DISCUSSION

Gestational age calculation in different trimesters uses multiple morphological parameters, traditionally based on CRL in first trimester and Hadlock's formula using BPD, HC, AC and FL in second and third trimester.[5] Gestational age determination based on a single USG examination after 30 weeks is not reliable. Additionally, these parameters may vary in conditions like oligohdramnios, IUGR which affect the fetal skull and abdominal circumference, thus rendering the gestational age estimation doubtful. In such circumstances, additional morphological parameters like transcerebellar diameter, clavicle and kidney length may be helpful. Fetal kidney size is also affected by growth variations like other organs, but, these affect only the antero-posterior and transverse diameter, sparing the kidney length.[6] Our study was done to determine any difference in FKL in Nepalese population and describe the nomo-

gram. We found a statistically significant linear relationship during the late second and third trimesters between the fetal kidney growth measured in mm and the gestational age in weeks. This is consistent with other studies which also show a linear relationship between the fetal kidney length in millimeter and the gestational age in weeks.

We found FKL correlates with gestation age with highest correlation coefficient of 0.989 as compared to other parameters (BPD= 0.986, HC= 0.976, AC= 0.971, FL= 0.984). The mean FKL was found to be greater when compared to ours in a study which included 397 fetuses from 18-41 weeks.[7] They also found a strong correlation between FKL measurement and gestational age estimated by fetal biometry and that there was no significant difference between the right and left kidney lengths (r=0.91). Likewise, in a study including 102 pregnancies more than

30 weeks, FKL showed a linear correlation with gestational age with conclusion that it can be used as an additional parameter for the estimation of gestational age.[8]

Our study showed SD variation between ± 0.5 to ± 1.2 in 31 to 37 week gestational age. This compares well with that in other studies, SD variation being higher in study by S. Afroz et al and lower in Ansari et al. Our values for fetal kidney length at different gestational ages were same or lower than the study by Konje et al. Our FKL at different gestational ages were lower than those reported by Konje JC et al and higher than Ansari et al. The regression coefficient of present study was 0.978 and compares well with others. [8, 9, 10,11]

We found FKL had minimum standard error of 5.3 days, while AC had maximum of 9.1 days. A study evaluating FKL serially at 2 weeks intervals from 24-36 weeks, showed that FL and FKL are the best parameters for determination of gestational age (+10.29 and 10.96 days respectively) which is similar to ours.[9] Another similar research in 70 antenatal women between 22 -38 weeks of gestation found FKL to be the most accurate with lowest standard error of 9.17 days and AC had highest standard error of 11.14 days.[11]

We found that the mean fetal kidney length increased linearly as the gestational age increases. The results of present study are consistent with other previously published studies and suggest that additional improvements in estimation of gestational age can be achieved by incorporating the FKL. The best such combination needs to be evaluated and formula worked on. Newer NICHD formula using the routine parameters that is, BPD, HC, FL and AC in later pregnancy has been shown to be more accurate that the Hadlock's.[12]

Our FKL nomogram was derived from cross sectional data and may be appropriate for comparing renal size at a known gestational age with the reference data. Our study may be limited by technical and observer errors like uncertainty of end points and difficulty in separating adrenal glands from kidneys, though efforts were made to avoid the same.

CONCLUSION

Fetal kidney length shows a strong positive correlation with fetal gestational age, with a steady growth rate throughout pregnancy and should be included in gestational age extimation.

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