Fetal kidney length correlation with mean gestational age

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Abstract

Purpose: Of this study is to establish the correlation and regression coefficient between fetal kidney length in mm and the mean gestational age on ultrasound.

Methods and materials: a prospective cross sectional study was conducted on 73 healthy women with uncomplicated pregnancy between the 20th weeks of gestation and term, over a duration of eight months October 2019 to may 2020. Gestational age and fetal kidney length was determined using ultrasound machine. Statistical analysis was done using tests of correlation and simple linear regression. All analysis was done using SSPS software.

Results and discussion: the correlation was best for FKGA vs FKL (r:0.996) then with BPD and AC; least for FKGA vs FL (r;0.938). The correlation coefficient (r = 0.939) observed in the present study was higher as compared to Cohen et al. (r = 0.82), Schlesinger et al. (r = 0.859), Gloor et al. (r = 0.90), Chiara et al. (for RK, r = 0.84, for LK, r = 0.87) and less than the studies performed by Konje et al. (r = 0.91) and Kaul et al.(r = 0.958).

Conclusion: fetal kidney length shows a positive correlation with fetal gestation age, with a linear growth rate throughout pregnancy irrespective of underlying medical condition like IUGR so can serve as an additional reliable parameter for accurate dating of GA during obstetric scan.

Keywords: fetal kidney length, clinical gestational age, pregnant women, ultrasound.

Introduction

In pregnant women accurate dating of gestational age plays a pivotal role Influencing the management and health of the new born. Methods to date pregnancies should be simple, repeatable and straightforward, regarding of gestational age.

Obstetric sonography plays a significant role in determination of gestational age because of its accuracy and easily reproducibility. FKL is emerging as a new

parameter and is claiming to be more accurate in determination of gestational age with certain situations.

Obstetric sonography due to its non-invasiveness and non-ionizing nature besides its cost effectiveness lead to wider acceptability [1,2]. The last two decades have seen a tremendous progress in application of ultrasound as a diagnostic modality revolutionized the management towards better care of pregnant females.

Gestations with oligohydromnios, multiple gestation, breech presentation and intrauterine growth restriction (IUGR) that can alter the size, shape of the fetal skull, affecting BPD and increase the variability [3]

The present prospective study is to validate the fetal kidney length Measurement, which is easy to consider as an additional sonological parameters of fetal growth with less variability can therefore be easily incorporated in for dating pregnancies after 20 weeks of gestation, particularly when measurements of biparietal diameter and head circumference are difficult.

Materials &Methodology

Prospective study was done in 73 healthy women with uncomplicated pregnancy between the 20th week of gestation and term referred from the Obstetrics and Gynaecology department of NSCB Medical college Jabalpur M.P were included in this study whereas patients with unknown or inaccurate date of LMP, oligo-polyhrdamnios, diabetic mother, pregnancy induced hypertension, pre eclampsia, fetal congenital anomalies and IUGR were excluded from this study.

The study period is for eight months from October 2019 to may 2020.

Measurements are obtained in the para sagittal plane, when full length of kidney with renal pelvis is visualized. Maximum length of anyone single fetal kidney is measured from echogenic outer to outer cortex excluding the adrenals, mean of three measurements is considered.

PNDT form i.e form F is obtained from all the patients. All relevant clinical history was obtained and the correct LMP was confirmed.

In all the patients following parameters were taken, BPD, HC, AC, FL, fetal heart rate, estimated fetal weight, AFI and placental position.

Plane used for measuring BPD and HC were section through the third ventricle and Thalami. For BPD cursors are positioned in outer edge of near calvarial wall to inner edge of far calvarial wall, HC the cursors are positioned in outer edge of the near calvarial wall and the outer edge of the far calvarial wall. Plane showing the umbilical vein perpendicular to the fetal spine and the stomach bubble is used for AC. The FL was obtained by aligning the transducer to the long axis of the diaphysis of Femur cursors are placed at the junction of the cartilaginous epiphysis and bone, with exclusion of epiphysis.

Statistical Analysis

Data were tabulated and all statistical analyses were done using SSPS software. Pearsons's correlation was calculated for each parameter and P value was obtained from that. Quantitative data are presented as the means ± standard deviation. The Mann-Whitney U, Fisher's exact and $\chi2$ tests were used for unpaired comparisons between the quantitative parameters.

Results

Table 1: Correlation co-efficient of FK GA with CGA, BPD, HC, AC, FL and FKL

Pair	Pearson Correlation	P Value
FK GA vs CGA	0.939	<0.001
FK GA vs BPD	0.945	<0.001
FK GA vs HC	0.944	<0.001
FK GA vs AC	0.945	<0.001
FK GA vs FL	0.938	<0.001
FK GA vs FKL	0.996	<0.001

The above table shows the association between foetal measurements with FKGA.The correlation was best for FK GA vs FKL (r : 0.996) then with BPD and AC; least for FK GA vs FL (r: 0.938). All the correlations were statistically significant.

Table 2: Correlation co-efficient of CGA with BPD, HC, AC, FL, FK GA and FKL

| Pair	Pearson Correlation	P Value
CGA vs BPD	0.983	<0.001
CGA vs HC	0.987	<0.001
CGA vs AC	0.976	<0.001
CGA vs FL	0.980	<0.001
CGA vs FK GA	0.939	<0.001
CGA vs FKL	0.939	<0.001

This table shows the association between the foetal measurements and CGA.

The correlation was best for CGA vs HC (r : 0.987) and least for CGA vs FKL (r :0.937) All the correlations were statistically significant.

Table 3: Correlation co-efficient of FKL with CGA, BPD, HC, AC, FL and FK GA

Pair	Pearson Correlation	P Value
FKL vs CGA	0.939	<0.001
FKL vs BPD	0.946	<0.001
FKL vs HC	0.948	<0.001
FKL vs AC	0.946	<0.001
FKL vs FL	0.938	<0.001
FKL vs FK GA	0.996	<0.001

This table shows the association between the fetal measurements and FKL. The correlation was best for FKL vs FK GA (r : 0.996) and least for FKL vs FL (r : 0.938) All the correlations were statistically significant.
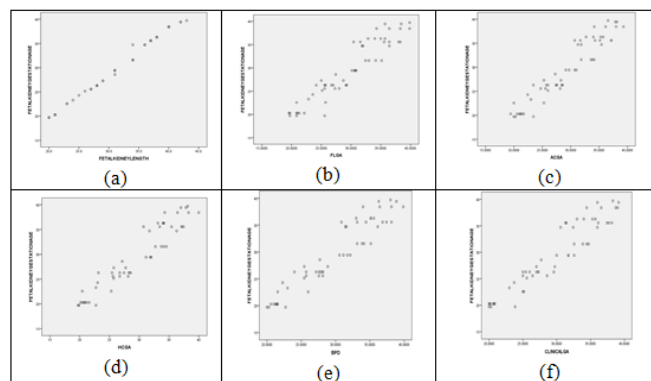
Graph 1

(a) A scatter diagram showing the correlation and regression analysis of the FK GA with FKL. Here FK GA has correlated with FKL by 99.7%.

(b) A scatter diagram showing the correlation and regression analysis of the FK GA with FL. Here FK GA has correlated with FL by 96.2%.

(c) A scatter diagram showing the correlation and regression analysis of the FK GA with AC. Here FK GA has correlated with AC by 97.1 %.

(d) A scatter diagram showing the correlation and regression analysis of the FK GA with HC. Here FK GA has correlated with HC by 96.9 %.

(e) A scatter diagram showing the correlation and regression analysis of the FK GA with BPD. Here FK GA has correlated with BPD by 97.1 %.

(f) A scatter diagram showing the correlation and regression analysis of the FK GA with CGA. Here FK GA has correlated with CGA by 96.4 %.

Table 4: Mean fetal Kidney length according to fetal kidney Gestational age

Gestational Age (Weeks)	Number	Fetal Kidney Length (mm)		
		MEAN	SD	95%CI
20	9	20.8	1.4	18 to 23.6
21	0	-	-	-
22	2	22	0	22 to 22
23	5	22	2.5	19.8 to 24.2
24	0	-	-	-
25	6	26.1	2.4	24.2 to 28
26	4	28.5	3.1	25.5 to 31.5
27	6	28.8	1.3	27.8 to 29.8
28	2	29.5	3.5	24.6 to 34.4
29	4	30	2.1	27.9 to 32.1
30	3	32.3	3.2	28.7 to 35.9
31	4	34	3.5	31.5 to 39.5
32	3	33.6	2.5	30.8 to 36.4
33	3	35.6	2	33.3 to 37.9
34	6	36.5	3.6	33.6 to 39.4
35	3	37	1.7	35 to 39
36	4	38.2	3.5	34.8 to 41.6
37	3	38.3	2.3	35.7 to 40.9
38	3	40	3	37 to 43
39	2	41	1.4	39 to 43
40	1	41	0	41 to 41

All the patients were grouped under three age groups; 65% were between 26 and 35 years, whereas 35% were between 18 and 25 years. Nearly 39% of all patients were nulliparous, while 46% were the mothers of one child. If consider the weight of the patients, more than half (58%) of the patients were between 50 and 60 kg. All the patients were more or less evenly distributed among different GA. Of 73 patients,32 were between 20-27 weeks, 6 were between 28 and 32 weeks, 25 belonged to 33 to 40 weeks.

With these demographic data, we started measuring the parameters and correlated them one by one with the GA calculated using LMP and FKL.

In our study, [table 1-3] We first correlated FKGA with other conventional parameters using pearson's correlation. Pearson coefficient correlation (R) showed highest value for FKL (r=0.996) followed by BPD and AC (both r=0.945) and showed least correlation with FL (r=0938)

When CGA was similarly correlated, the pearson's coefficient correlation showed highest value for BPD

(r=0.983), for FKGA (r=0.939) and least for FL (r=0.938) and when FKL was correlated the pearson's coefficient correlation showed highest value with FKGA (r=0.996) which was better than showing linear correlation on scatter plot (chart 1) all the above tests were statistically significant at P<0.001

We found a very strong correlation between FKL and CGA as compared to previous studies. The correlation coefficient (r = 0.939) observed in the present study was higher as compared to Cohen et al. (r = 0.82), Schlesinger et al. (r = 0.859), Gloor et al. (r = 0.90), Chiara et al. (for RK, r = 0.84, for LK, r = 0.87) and less than the studies performed by Konje et al. (r = 0.91) and Kaul et al. (r = .958). [4-9]

Discussion

Accuracy and easily reproducibility of sonographic fetal biometric parameters for gestational dating are clinically important for the optimal obstetric management of pregnancies.

It becomes much more significant when, determining timing of a variety of gestational tests, assessing adequacy of growth and timing of delivery for the optimal obstetric outcome.3

Growth variations affecting fetus, these appear to predominately affect only anterior- posterior and transverse diameters, renal size remains the same, even in SGA.

The values for the foetal kidney length at different gestational ages was higher than the study of those reported by Cohen et al.4 , Konje et al.8 , Lawson et al10. , Bertagnoli, et al11 and Jeanty, et al12-14.

Figure 1: Kidneys are identified, moving the probe caudally in transverse section just below the level for abdominal circumference measurement. Once kidneys are located probe is rotated longitudinally till full length of kidney was identified for its length calculation. The fetal kidney was measured from outer to outer margin. Here the fetal kidney length was calculated as 32.5 mm and Hadlock based average mean gestational age was 32 weeks.

Figure 2: Fetal kidney length measured from outer to outer margin was 34.2mm and Hadlock based average means gestational age was 33 weeks and 6 days. The present study also showed that kidney length in mm is approximately the same as the gestational age in weeks which is interpreted by the above mentioned pearson's correlation and scatter diagram. (Table 4 and chart 1)

A number of reasons could explain these differences. This include: The number of operators (multiple v/s two skilled operators /one skilled

Operator), uncertainty of end points of kidneys, Inclusion of adrenals in the measurement of renal size(discoid in shape), Quality of ultrasound machine (older v/s newer), Racial differences.

The present study hence validates and recommends the inclusion of fetal kidney length can be used as an important sonographic parameter for accurate prediction of fetal Gestation age. The results of present study and previously published studies on FKL shows that additional small improvements in accurate gestational dating can be achieved by incorporating the results of FKL with some combination of other routine fetal biometric parameters.

Conclusion

- FKL positively correlated with BPD, HC, AC and FL.

- Sonogram of the FKL shows that there is a linear relationship between the fetal kidney length and the gestational age.

- FKL can be used as a reliable parameter for determination of gestational age.

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