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SONOGRAPHIC ASSESMENT OF GESTATIONAL AGE BY THE FETAL KIDNEY LENGTH AND VOLUME AFTER 18 WEEKS OF GESTATION IN LOCAL POPULATION

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INTRODUCTION

Obstetric care begins with determining gestational age, which has the least variability in early pregnancy. This current study was planned to provide an overview of fetal kidney length and volume as a useful adjunct parameter for better determination of gestational age.

MATERIALS AND METHODS

Normal singleton pregnancies from 18–40 weeks of gestational age, referred to the department of Radio-diagnosis and Imaging at VIMS & RC, Bangalore. Fill PC-PNDT [Prenatal Diagnostic Technique] form i.e Obstetric ultrasonography were performed using Affinity 50 G pro ultrasound scanner using a 3.5 MHz convex probe. Images were recorded in the system as DICOM.

RESULT

Out of 200 patients who presented themselves for routine obstetric ultrasound scan within the period of study, 150 patients met the inclusion criteria [18th week of gestation to term] and were selected for the study while patients were excluded from the study for the following reasons; for not remembering their LMP, fetus with IUGR, 10 patients presented with oligohydramnios, poly-cystic renal dilated renal pelvis. It correlates strongly with gestational age while the relationships between right and left kidney lengths with gestational age were established. However no correlation of gestational age with volume. Fetal kidney length increases with increase in FGA and shows excellent intra and inters class correlation coefficient which suggests good agreement and reproducibility of measurements.

KEY WORDS - Gestational age**,** Fetal kidney length, Oligohydramnios

INTRODUCTION

In obstetrics, ultrasonography is the most often utilised diagnostic method. It is convenient, painless, and produces immediate, comprehensive findings. It is also commonly regarded as safe. It is risk-free for both the patient and the foetus, as well as the sinologist [1]. It excludes the use of injectables containing radio-opaque materials. There is no risk of foetal growth restriction, birth abnormalities, learning or intellectual handicap later in life because there is no repetitive exposure to teratogenic rays in early pregnancy. As with x-ray, repeated intrauterine exposure to ultrasonography in early or late pregnancy does not increase the incidence of lymphatic or myeloid juvenile leukaemia[2].

Since the development of diagnostic ultrasound, more precise methods for determining the age of a pregnancy have emerged[3,4].

These include the size and volume of the gestational sac. In the first trimester, the crown rump length is measured. The measurement of the crown rump length has been shown to

reliably predict gestational age by +/- 4.7 days. Fetal biparietal diameter and femur length are the most often utilised measures for timing pregnancy in the second trimester[5]. Other variables, such as transcerebellar diameter, clavicle length, and foot length, have been employed as well[6].

The accuracy of a single metric for determining gestational age is dependent on the gestational age at the time of ultrasound examination. In the early second trimester, the majority of the aforesaid parameters show great accuracy. Growth adjusted sonographic age and averaging various factors are two methods for increasing accuracy[7]. However, due of the inherent variability of size in relation to age, the above listed metrics become progressively unreliable as gestational age continues. Accurate pregnancy dating remains a challenge, particularly for women who seek obstetric treatment late and are unsure of their LMP date[8].

Conditions such oligohydramnios, multiple gestation, breech presentation, and intrauterine growth restriction can all change the BPD and increase its variability. The abdominal and femoral measurements can be affected by multiple gestations and IUGR. A combination of multiple metrics can be utilised to improve the accuracy of gestational age estimation[9,10].

The goal of this study is to prove that measuring foetal kidney length and volume as an additional morphological marker of foetal growth with less variability is valid. Because these measurements are simple, they can be incorporated in the model for dating pregnancies after 20 weeks of pregnancy, especially when biparietal diameter and head circumference measurements are challenging.

MATERIALS AND METHODS

This is a prospective study done on 150 healthy women with uncomplicated gestation between 20th week and term who were referred from the Department of Obstetrics and Gynaecology of Vydehi Institute of Medical Sciences and Research Centre, Bangalore. Period of study is from December, 2019 to June 2021.

Measurements were obtained in Sagittal plane when full length of kidney with renal pelvis is visualised. Maximum length of any one fetal kidney is measured from upper pole to lower pole thrice and mean of the measurements is taken.

ETHICAL CLEARANCE

The study required to perform obstetric ultrasonography on normal pregnant women. Ethical clearance was obtained from the institutional Ethical Review committee of Vydehi Medical College.

METHOD OF EVALUATION

ULTRASOUND EXAMINATION PROTOCOL

PNDT [Prenatal Diagnostic Technique] form i.e., form F is obtained from all the patients. All relevant clinical history will be collected and the correct LMP will be confirmed. Ultrasonography was performed with patient in supine position. Good acoustic coupling was obtained using synthetic ultrasound gel. Due consent was taken.

Equipment: Obstetric ultrasonography was performed using Affinity 50 G pro ultrasound scanner using a 3.5 MHz convex probe. Images were recorded in the system as DICOM.

In all the patients following parameters was measured – BPD, AC, fetal heart rate, estimated fetal weight, AFI and placental position. Then kidney length and volume was measured and recorded.

Plane used for measuring BPD was through the third ventricle and thalami. Cavum septi pellucidi was made visible in the anterior portion of the brain and the tentorial hiatus will be made visible in the posterior portion of the brain. The cursors was positioned in outer edge of near calvarial wall to inner edge of far calvarial wall for BPD.

AC was taken in the plane showing the umbilical vein perpendicular to the fetal spine and the stomach bubble.

Fetal kidney length was measured in the sagittal plane, when full length of kidney with renal pelvis is visualized. Maximum length of any one single fetal kidney is measured from upper pole to lower pole at least thrice and mean of the measurements was taken. Perpendicular to this, in the transverse plane, the largest anteroposterior (AP) and transverse diameters of each kidney were measured by placing the calipers from outer border to outer border.

The kidney volume (V) was calculated using the formula for an ellipsoid: $V = (\pi/6) \times L \times D \times TD$, where L = kidney length, D = AP diameter and TD = transverse diameter.

viii. Normogram will be prepeared as follows: Data was recorded in tabular format. All the parameters (BPD, AC, Kidney length and volume) and values was recorded and compared with gestational age in same pregnancy.

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software.

Categorical data was represented in the form of Frequencies and proportions. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.

Pearson correlation was done to find the correlation between two quantitative variables.

Results and Discussion

Obstetric sonography was done on 150 pregnant women with an uncomplicated pregnancy and a known LMP to assess the efficacy of FKL and FKV as parameters for calculating gestational age. The gestational age ranges from 18 weeks to full term.

All of the women who took part in the study had a normal menstrual cycle and did not meet any of the study's exclusion criteria. BPD, HC, AC, FL, FKL, and FKV are foetal biometry parameters that are measured.

There was a substantial association between FKL, FKV, and other foetal biometric markers. A linear association between kidney growth and gestational age has been proven. In our study there is Foetal kidney length tends to show a strong correlation with gestational age up to 30 weeks beyond which the accuracy of correlation defers. However no significant corelation established with gestational age and fetal kidney volume. Our reference charts for size and volume of the fetal kidney may be useful to diagnostic renal pathology.

In the present study fetal kidney length as well as fetal kidney volume are measured and a linear relationship has been established in the second and third trimester and these two parameters also correlate well with clinical gestational age.

In present study, FKL correlate well with gestational age with correlation coefficient of 0.97. FKL correlates with other biometric parameters as follows: FL ($0.946, p < 0.1$), BPD ($0.961, p < 0.01$), AC ($0.952, p < 0.01$) and HC ($0., P < 0.01$) while the FKV correlates as

follows: FL (0.874, $p < 0.01$), BPD (0.901, $p < 0.01$), AC(0.907, $p < 0.01$) and HC (0.918, $p < 0.01$).

No significant corelation established with gestational age and fetal kidney volume. Accurate estimation of gestational age and early diagnosis of variety of renal abnormalities are few advantages that measurement of these parameters can provide.

In the study there was significant positive correlation between Fetal Kidney Volume and other parameters such as Biparietal Diameter, Head Circumference, Abdominal Circumference and Femur Length i.e. with increase in Fetal Kidney Volume there was increase in Biparietal Diameter, Head Circumference, Abdominal Circumference and Femur Length and vice versa.

In the study there was significant positive correlation between Fetal Kidney length and other parameters such as Biparietal Diameter, Head Circumference, Abdominal Circumference and Femur Length i.e. with increase in Fetal Kidney Length there was increase in Biparietal Diameter, Head Circumference, Abdominal Circumference and Femur Length and vice versa.

Figure 1 - Normogram of Fetal Kidney Length with respect to Gestational age

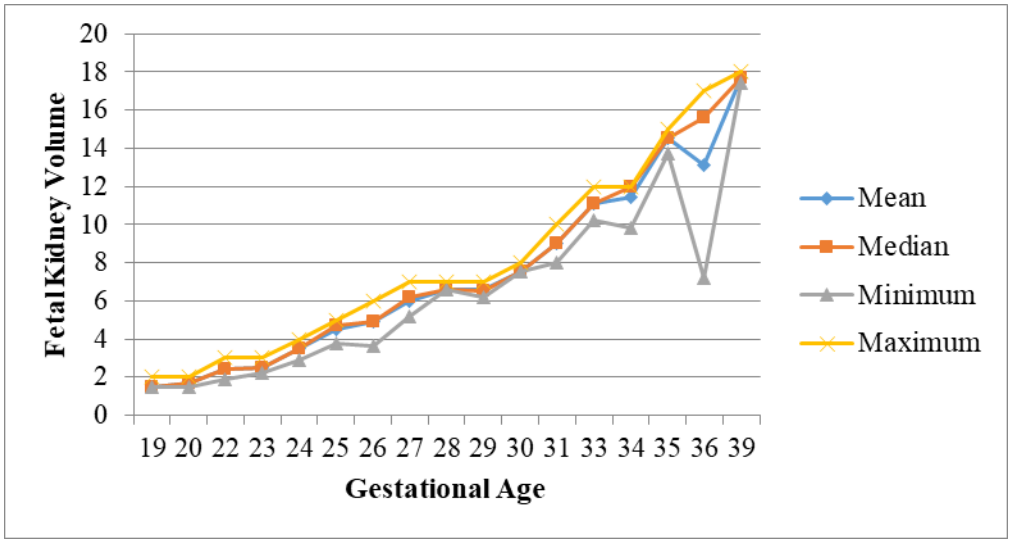

Table 1: Correlation between Fetal Kidney Length with other Measurements

		Fetal Kidney Length (mm)
Biparietal Diameter (cm)	Pearson Correlation	0.961**
	P value	<0.001*
	N	150
Head Circumference (cm)	Pearson Correlation	0.972**
	P value	<0.001*
	N	150
Abdominal Circumference (cm)	Pearson Correlation	0.953**
	P value	<0.001*
	N	150

Femur Length (cm)	Pearson Correlation	0.946**
	P value	<0.001*
	N	150

Table 2 - Correlation between Fetal Kidney Volumes with other Measurements

		Fetal Kidney Volume (mL)
Biparietal Diameter (cm)	Pearson Correlation	0.901**
	P value	<0.001*
	N	150
Head Circumference (cm)	Pearson Correlation	0.918**
	P value	<0.001*
	N	150
Abdominal Circumference (cm)	Pearson Correlation	0.907**
	P value	<0.001*
	N	150
Femur Length (cm)	Pearson Correlation	0.874**
	P value	<0.001*
	N	150

Conclusion

It can be well concluded from the above study that FKL have a positive correlation with BPD, HC, AC and FL. On plotting foetal kidney length against gestational age a linear relationship has been established. FKL can act as a useful adjunct parameter for better determination of gestational age.

References

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Supplementary material

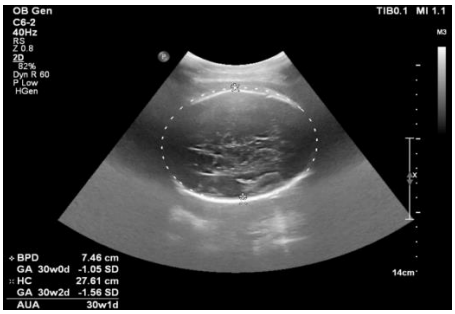
ILLUSTRATIVE CASES

All patients were referred from the Department of Obstetrics and Gynaecology of Vydehi hospital. The scan was done after filling the PCPNDT form and written consent.

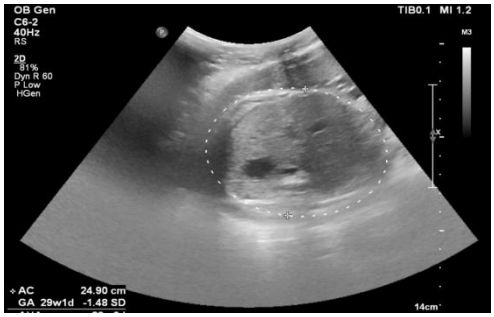
Case I

Patient 1 with LMP 29 weeks 3 days

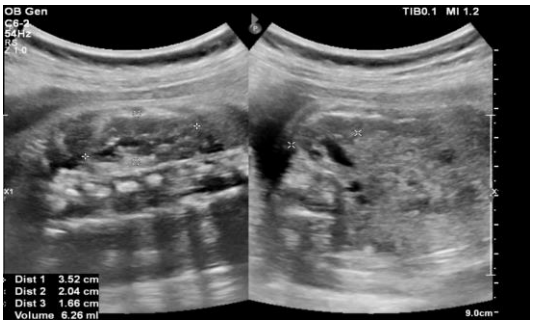
Femur length



Head circumference and Biparietal diameter



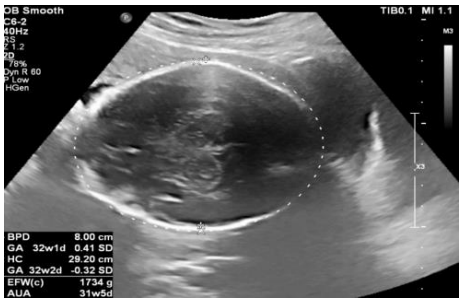
Abdominal circumference



Fetal kidney length and volume

Case 2

Patient 2 with LMP 31 weeks 3 days



Head circumference and Biparietal diameter

Femur length

Abdominal circumference

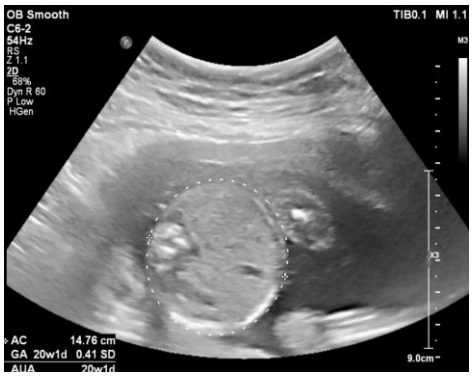
Fetal kidney length and volume

Case 3 :

Patient 3 with LMP 31 weeks 3 days:

Femur length

Head circumference and Biparietal diameter

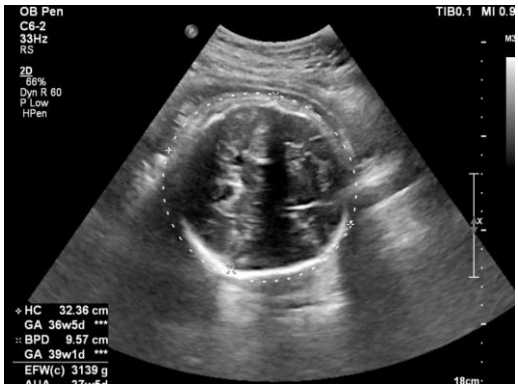


Abdominal circumference

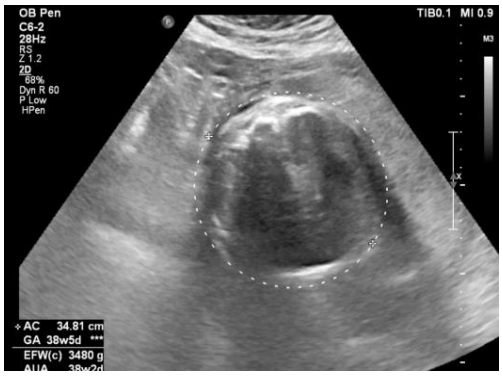
Fetal kidney length and volume

Case 4 :

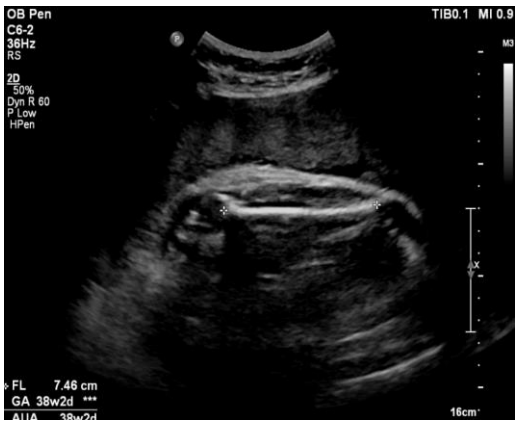
Patient 4 with LMP 31 weeks 3 days



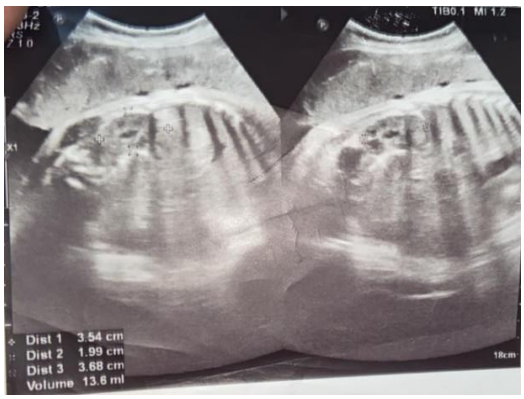
Head circumference and Biparietal diameter



Abdominal circumference



Femur length



fetal kidney length and volume