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Fetal kidney length as a useful adjunct parameter for determination of gestational age

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Abstract--Introduction: Accurate gestational age assessment is important in obstetric care ultrasonography. Fetal kidney length is one of the emerging parameter in estimation of fetal gestational age in 3rd trimester. Objectives: Is to the ascertain the precision of ultrasonographic fetal kidney length measurement as a reliable parameter for determination of gestational age in 3rd trimester. Materials and Methods: Cross-sectional observational study was conducted on 152 antenatal women in the 3rd trimester. Gestational age was estimated by early fetal ultrasound measure and last menstrual period. Results: Mean kidney length showed a Pearson's correlation coefficient of 0.907 and a determination coefficient of 0.822 with GA. The test was significant at $P < 0.05$. Conclusions: This study confirms that the fetal kidney length measurement for estimating the gestational age accurately in the 3rd trimester.

Keywords---Fetal kidney length, femur length, gestational age.

Introduction

Accurate gestational age assessment is important in obstetric care ultrasonography. For any obstetrician, it is of utmost importance the fetus in assessing the growth of the fetus and to determine the expected date of delivery. Fetal growth retardation and macrosomia may be missed if accurate GA is unknown. Previously, patient's history and clinical signs were routinely utilized to determine the GA. In 1958, Sir Ian Donald took the landmark step in implementing ultrasound (USG) for obstetric scan. Biparietal diameter (BPD) was first used to determine the GA in third trimester. Since then many other parameters have been used, conventional ones being head circumference (HC), abdominal circumference (AC), and femur length (FL).

Fetal kidneys grow in a linear fashion with the GA. They are easy to identify after mid-trimester at around 18 weeks. Hence, this study was undertaken to correlate fetal kidney length (FKL) with GA and to compare its efficacy with other routine parameters that are currently used.

Aims and objectives

1. Is to ascertain the precision of ultrasonographic fetal kidney length measurement as a reliable parameter for determination of gestational age in 3rd trimester.
2. Comparing the accuracy of mean fetal renal length with other biometric parameters (BPD, HC, FL, and AC) in determining the GA.

Materials and Methods

Cross sectional observational study was conducted after informed consent, 152 pregnant mothers with uncomplicated singleton pregnancies who were sure of their GA were included in this study carried between december 1, 2021, and march 31, 2022, in the Department of Radiodiagnosis in sumandeep hospital, pipadiya, wagodiya.

Exclusion criteria

- Patients with anomalous fetus
- suspected intrauterine growth restriction
- Unknown last menstrual period (LMP)
- Multiple gestations
- Fetal hydronephrosis
- Oligo/polyhydramnios

Inclusion Criteria

- Normal singleton pregnancy of 28-40 weeks who were sure about their last menstrual period or have first trimester ultrasound confirmation of GA by means of crown rump length measurement.
- Women consenting to participate in the study.

GE LOGIQ V5 USG machine was used for measurement and all the data were collected using the same 2–5 MHz curvilinear probe. Average of three measurements was taken for all the parameters by the same observer and tabulated. The standard methods for obtaining the BPD, HC, AC, and FL as given in the textbook by Callen *Ultrasonography in Obstetrics and Gynecology*. For fetal kidney, first, the transducer was placed in such a manner that the fetal spine was visible longitudinally. With slight angulation of the transducer, the paravertebral plane was obtained where the fetal kidney was visible in its whole length. Separate measurements were taken for both the kidneys and averages were taken.

Data were tabulated and all the statistical analyses were done using SPSS software. Pearson's correlation coefficient was calculated for each parameter and P value was obtained from that. All the averages were presented as mean \pm standard deviation.

Results

All the patients were grouped under three age groups; 57% were between 26 and 35 years, whereas 42% were between 20 and 25 years. Nearly 34% of all patients were nulliparous, while 44% were the mothers of one child. If consider the weight of the patients, more than half (54%) of the patients were between 50 and 60 kg. All the patients were more or less evenly distributed among different GA. Of 152 patients, 66 were between 28 and 32 weeks, 55 belonged to 33 to 36 weeks, and rest 34 were between 37 and 40 weeks. With these demographic data, we started measuring the parameters and correlated them one by one with the GA calculated using LMP.

We first correlated AC with GA using the Pearson's correlation. Pearson's correlation coefficient (R) came out to be 0.895 with a determination coefficient of 0.801 and the test was significant at $P < 0.05$ with a $P < 0.00001$. Similarly, BPD showed a Pearson's correlation coefficient of 0.883 and FL showed the highest value among the conventional parameters with a $R = 0.901$. Finally, HC was correlated with a Pearson's correlation coefficient of 0.879. All the above tests were significant at $P < 0.05$.

In the present study, the FKL correlated with the GA with a correlation coefficient of 0.907 and a determination coefficient of 0.822 which was better than all the conventional parameters used. We found a very strong correlation between FKL and GA as compared to previous studies. The correlation coefficient ($r = 0.907$) observed in the present study was higher as compared to other parameters.

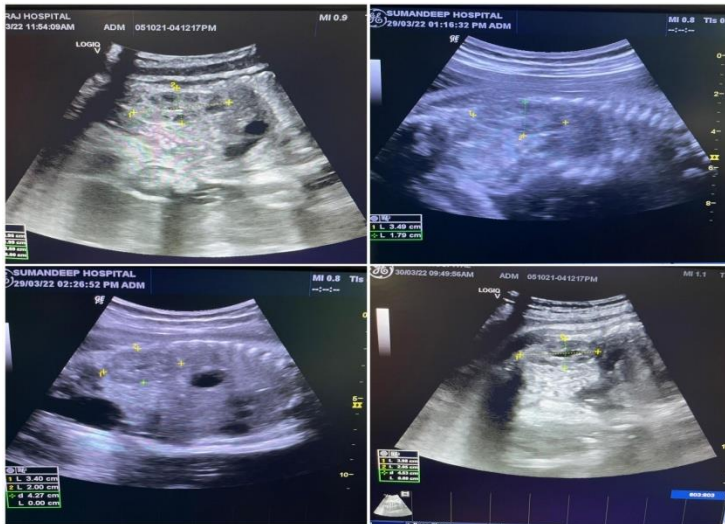
We found a very strong correlation between fetal kidney length and gestational age as compared to previous studies. The correlation coefficient ($r=0.907$) observed in the present study was higher as compared to Cohen et al. ($r=0.82$)⁹, Schlesinger et al. ($r=0.859$)⁸, Gloor et al. ($r=0.90$)⁶ and less than the studies performed by Kaul et al. ($r=0.958$)⁷.

GA in weeks	Avg BPD	SD in mm	HC in mm	SD in mm	FL in mm	SD in mm	AC in mm	SD in mm	Avg FKL in mm	SD in mm
28	68.3	2.12	255	7.87	51.1	3.3	232	8.7	29.2	1.1
29	73.5	2.28	271	11.13	53.3	2.8	241	7.2	30.7	2.0
30	74.8	2.4	279	11.26	56.8	2.82	259	12.1	31.7	1.3
31	77.3	3.05	285	15.09	56.1	3.2	260	13.3	32.9	2.5
32	79.8	2.94	293	7.81	59.4	2.85	269	9.9	34.8	1.5
33	80.5	3.11	299	7.09	60.0	3.74	271	11.2	34.7	1.6
34	82.7	4.1	306	13.9	63.5	3.3	288	12.3	36.4	0.6
35	84.9	2.6	313	12.4	64.8	3.9	299	10.8	37.1	1.2
36	87.4	3.2	321	11.04	67.2	3.9	302	7.5	38.0	1.7
37	88.7	2.26	330	12.4	68.8	4.1	309	10.0	38.6	1.6
38	86.9	4.33	321	20.5	70.1	3.4	314	7.8	38.8	2.1
39	90.4	1.4	341	10.3	71.9	2.8	309	4.4	39.9	1.1
40	90.4	3.7	333	18.22	70.1	2.8	314	4.8	39.5	1.3

GA versus BPD,HC,AC,FL and FKL

GA- gestational age, BPD- biparietal diameter, HC- head circumference, FL- femur length, FKL- fetal kidney length.

Parameter	Correlation coefficient	Coefficient determination	P value
BPD	0.833	0.781	<0.00001
HC	0.879	0.773	<0.00001
AC	0.895	0.801	<0.00001
FL	0.901	0.871	<0.00001
FKL	0.907	0.822	<0.00001



Longitudinal diameter
of Fetal Kidney

Discussion

Sonographic measurement of fetal body parts is known as fetal biometry. There are three primary objectives for measuring fetal parts:

1. To assess the average fetal age.
2. To diagnose fetal growth disorders by comparing if measured fetal parts are appropriate size for GA.
3. To determine the appropriateness of the dimension of fetal structures against each other (ratio) and/or against GA.

The first trimester USG is a very useful and reproducible modality for the assessment of GA. Crown-rump length and mean gestational sac diameter are the two parameters for assessment of GA in the 1st trimester. Crown-rump length should never include the yolk sac and the extremities. It is useful from 8 weeks till 12 weeks of gestation. Sonographic parameters that are used in the second and third-trimester pregnancy are as follows: BPD, HC, AC, or FL. Combining measurements significantly improve accuracy compared with a prediction based on HC alone. However, the clinical significance of this improvement is marginal because the improved accuracy represents < 1 day. Rumack et al., in their textbook, mentioned that the kidneys grow throughout pregnancy and can provide a nomogram of renal lengths at 14–42 weeks of gestation and the renal/AC ratio remains constant at 0.27–0.30 throughout pregnancy.

USG is an accurate and useful modality for the assessment of GA in pregnancy and, as a routine part of prenatal care, can greatly impact obstetric management and improve antepartum care. From this study, we could find that the most accurate method for evaluation of GA was the KL followed by FL and AC.

Conclusion

Kidneys are easy to identify and measure. Measuring KL can help in the determination of GA, In addition to that, it could be a more valuable tool in cases where other established biometric indices are difficult to obtain and show gross discrepancies with each other or with GA. Since classically the GA is still determined, in some places, by LMP, the chances of error increases, therefore the need for the use of USG investigation is highly recommended as the only measuring tools for GA determination. The present study emphasizes on the use of KL as the potentially accurate parameter for GA determination; we recommend, therefore, the use of KL to be included in the conventional methods for GA estimation

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