Determination of Gestational Age by Fetal Kidney Measurements in Pregnancy

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Abstract

Introduction: In a country like India, where ultrasonograms are an important part of the diagnostic and monitoring protocol of a pregnant female, obstetric sonograms are the go-to modality for fairly accurate gestational age detection incorporating multiple parameters. We conducted the present study to analyse the use of fetal kidney length for estimation of the gestational age as a discrete as well as adjunct parameters.

Material and Methods: In present study, sonographic assessment of 95 women with single intrauterine pregnancies was done. Kidney length (KL) was measured as maximum cranio-caudal length in all patients. Other parameters like head circumference(HC) and femur length(FL) were assessed . The data was analysed with IBM SPSS Statistics software. Chi- square test and student t test were done to assess of level of significance.

Results: The mean kidney length was found to be varying from 25.35±2.52 mm at 24-26 weeks to 39.17±2.22 mm at 36-38 weeks. as the gestational age progressed, a linear correlation between the kidney length and the gestational age was appreciated.

Conclusion: Fetal kidney length can be used as an adjunct and potential discrete parameter in estimation of fetal gestational age in late second and third trimester.

Keywords: *Gestational, Age, USG, Fetal, Kidney length*

Introduction

One of the assessments essential to deliverance of optimal maternal care is precise gestation age calculation. The diagnosis of growth disorders and timing of delivery date is wholly dependent on the estimated gestational age and sonographic evaluation(1). Iatrogenic post-maturity and prematurity directly result from wrongly estimated dates and gestational age calculation.

There are many instances where women present for the first obstetric evaluation, later in pregnancy and are unsure of their last menstrual period date, in such cases the dating scan proves to be an important tool in establishing the estimated delivery date.(2)

Since the advent of sonography and its widespread application in dating of gestation, many dependable techniques have developed and have been incorporated in a routine study of pregnancy. In the first trimester, gestational sac diameter and crown rump length are most commonly used. In second trimester, biparietal diameter, femur length, head and abdominal circumference are assessed. however, these indices become progressively unreliable in later stages of pregnancy(3)(4). Also, there are discrepancies in predicted gestational age in fetuses which are short for gestational age and have various degree of intrauterine growth retardation.

Adrenal glands along with fetal kidneys are evident in a sonogram beyond the gestational age of 9 weeks.

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They can be visualiased on either side of the fetal spine. The fetal kidneys are echogenic in the early weeks, and gradually turn hypoechoic in the later weeks when compared with the adjacent bowel and liver[5]. The fetal kidney should be seen in all fetuses in the anomaly scan, whereas it tends to be seen in 80% of the cases at 11 weeks and in 92% of cases at 13 weeks of gestation. [6]

The renal system is radiologically perceptible in 14th week and by 17th week, either one or both kidneys can be identified in 90% of cases and by 20th week in about 95% cases. Although like all organs, even kidneys are susceptible to growth variations, these variations primarily affect anteroposterior and transverse diameters. the length of the kidney is relatively spared from the growth deviations, even in fetuses who are small for gestational age.[7] [8]

Many studies have been conducted on similar lines for correctly estimating gestational age with various mensuration such as fatal kidney length of which, kidney length has proven to strongly correlate with gestational age in the later stages of pregnancy viz. beyond 20 weeks. Therefore, this study was conducted in department of Radiodiagnosis to establish the validity and reliability of the kidney length in the dating scan and accurately estimating the estimated delivery date.

Integration of this measurement is possible in the existing dating scan algorithm and it has a manageable learning curve, especially when taken in gestation beyond 20 weeks, more so in those where measurement of biparietal diameter and femur length is not feasible.

Materials and Methods

Our cross-sectional study was conducted in the department of Radiodiagnosis and Imaging, PBM Hospital, associated with Kalinga Institute of Medical Sciences, Bhubaneswar over a study period of one year from Jan 2018 to Jan 2019. We included a total of 95 pregnant women belonging to various ages and different parities.

We evaluated the patients on the basis of history, routine antenatal investigations and Third trimester sonograms. the parameters acquired were Mean fatal kidney length, head circumference, femur length, abdominal circumference and biparietal diameter. Van vuuren et al proposed a nomogram for fetal kidney length, using which the gestational age was evaluated.

This Estimated value was compared with the actual dates considered as definitive.

The subjects were informed regarding the study at the time of appointment for the scan and informed consent was taken regarding the same.

Inclusion criteria

1. Patients undergoing routine sonographic evaluation of pregnancy beyond 20 weeks of gestation.

2. Patients who are certain about their last menstrual period date.

3. Pregnant married women without any accompanying risk factor.

4. Pregnant married women undergoing USG test done before between 8th to 10th weeks of gestational age

Exclusion criteria

1. Patients with fetal anomaly.

2. Pregnant women who are unsure about their last menstrual period date.

3. Patients with intrauterine growth retardation.

4. Renal anomalies or known case of renal anomalies

5. Pregnant diabetic, HTN and pregnant females with eclampsia.

6. Twin pregnancies or Multiple pregnancies.

7. Dilatation of renal pelvis measuring 5 mm or greater.

8. pregnant women having oligohydramnios (<8cm deepest pocket) and polyhydramnios (>25 cm deepest pocket)

Ultrasonogram equipment used was Philips Affiniti 30. Using curvilinear transducer of 5-7 Hz kidney length was measured in craniocaudal axis. Also, analysis of femur length and biparietal diameter was done. Kidneys were identified in the longitudinal axis in the paraspinal gutters and axial and longitudinal sectional images were

acquired. All the measurements were done by two skilled radiologists and were repeated thrice by each radiologist. Maximum fetal renal length was measures when the kidneys were visualized in sagittal plane from upper pole to lower pole, in parasagittal gutter of the fetus. when the probe was rotated with a 90-degree rotation the long axis of kidneys was measured. After compilation of all the data, statistical analysis was done using SPSS 2.0 software. Level of significance was calculated using Chi-square test and Student t-test. P- value of <0.05 was considered significant.

Results

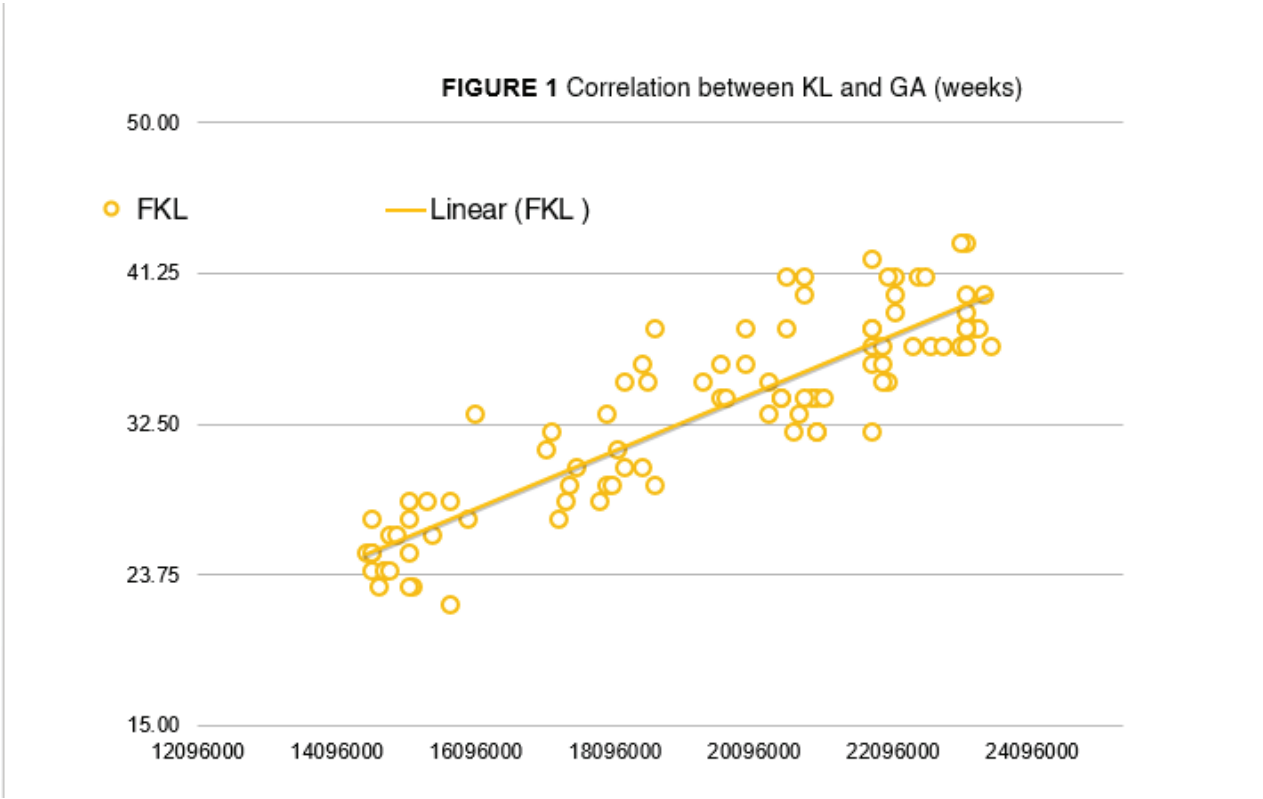
TABLE 1 Distribution of cases showing Kidney Length (KL) for various gestational ages.

	Mean KL (in mm)	Standard Deviation SD	Confidence Interval	Standard Error SE
At 24-26 weeks				
KL	25.35	±2.52	1.05	0.053
At 28-30 weeks				
KL	30.73	±3.07	1.42	0.725
At 32-34 weeks				
KL	35.20	±2.65	1.10	0.565
At 36-38 weeks				
KL	39.17	±2.22	0.75	0.386

Out of the 95 cases studied, most of the cases belonged to 36 to 38 weeks gestational age group. The mean kidney length was measured to be varying from 25.35±2.52 mm at 24-26 weeks to 39.17±2.22 mm at 36-38 weeks. as the gestational age progressed, a linear correlation between the kidney length and the gestational age was appreciated. As compared to previous studies our study did not show much variation in standard deviation with increasing gestational age and the kidney length progressed corresponding to the standard biometry as well as clinically calculated gestational age. On regression analysis, a strong correlation was found between the kidney length and the gestational age with correlation coefficient of 0.89 and p value.

TABLE 2 Regression analysis between KL and GA

	Intercept Estimate	Slope Estimate	Correlation	p-value	Conclusion
KL vs GA	0.57	0.1451	0.89	<0.001	Strong Correlation



Discussion

In countries like India where the rate of maternal mortality is very high, there is a need for accurate diagnostic and management protocols for maternal and perinatal pathologies. Regular sonological assessment is a widely accepted modality for dating and ruling out gross intrauterine anomalies(9). among the sonologically assessed parameters, there is a wide variety of indices that can be evaluated(10). Although multiple factors are studied during the obstetric sonogram which are already established to be valid, there is a constant search for those which are least affected by the pathological processes such as growth retardation.

These diagnostic techniques, especially the ones assessing the fetal growth and delivery date estimation for best obstetric outcome, need to be simple, accurately replicable and easily incorporated in the existing protocol for a wide scale implementation into the regular obstetric evaluation by ultrasound.

We studied a total of 95 healthy pregnant females with single uncomplicated pregnancies and the results favored a correlation of gestational age with metal kidney length. Using regression analysis, we were able to articulate a linear association during the second a third trimester of pregnancy between fatal kidney growth and gestational age. Statistically, the drawn data between the fatal kidney length and the gestational age was found to be significant pointing towards an association between the two. The correlation coefficient for the third trimester was calculated to be 0.89, which is at par along with other parameters studied (BPD, HC, AC) for computing the gestational age.

Although the kidney size was influenced by various growth disturbances, it was found that these variations are primarily limited to the transverse and the antero-posterior diameters, sparing the crania-caudal length of the kidney. Information regarding these measurements can be used in the early diagnosis and management of a spectrum of kidney abnormalities along the precise delivery date estimation[11]. In our study all the patients evaluated were of eastern Indian population. We charted a nomogram for the studied population which has potential to serve as a baseline study for this population. Such nomograms can be developed for separate ethnicities to predict the gestational age.

A review of previous studies which evaluated the variability of fatal kidney length to the gestational age indicated a similar outcome. The kidney lengths delineated by Cohen et al[12], Konje et al.[13], Lawson et al.[14], Kiran et al.[15], Kansaria et al.[16] Chatterjee et al[17] were slightly lesser than our values.

The values for the fetal kidney length at different gestational ages was higher than the study of those reported by Indu et al.[18] and Peter et al[19]. The present study depicted that the length of kidney in millimeter corresponds to the gestational age in weeks.

The inconsistencies in the result could be attributed to a few diverse influences including:

• Operator variability (multiple and 1 or 2 skilled operator)

• Valuation of gestational age (exacted to 2 decimal points and rounded off)

• Resolution of instrument used

• Ethnic variances.

Our fetal kidney lengths were formed using cross sectional statistics. They are not fit for arbitrating the relevance of the development of kidneys longitudinally across time. They are suitable for matching kidney size at an identified gestational age with normogram data. Some observation errors can occur in getting the fetal kidney length dimension, another main cause of errors are possible regarding uncertain end points and askew, oblique images of the kidneys.

The fetal suprarenal gland is comparatively sizeable, and is challenging to differentiate it from the kidney, because of the lack of perirenal fat and a comparable echotexture. This can cause false increase in the measurement of the kidney. These potential errors were not assessed in this analysis.

Apart from the described thinkable technical and observer errors, the measurements acquired in the present study were reasonably accurate. Our analysis therefore corroborates the recommendation that the fetal renal cranio-caudal length can be taken into consideration as an significant ultrasound parameter for accurate estimate of gestation age.

Conclusion

Fetal kidney length can be used as an adjunct and potential discrete parameter in estimation of fetal gestational age in late second and third trimester. Fetal length in millimeter correlates well with fetal gestation age in weeks, however in later gestation the fetal kidney length is generally higher than the gestation age.

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