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Fetal Kidney Length Measurement to Determine Gestational Age in Local Population

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Abstract: ***Gray scale ultrasound is used to assess the length of the fetal kidneys in healthy fetuses. The objective is to ascertain how the length of the fetal kidney varies as gestational age increases and to investigate whether or not this index may be utilised to estimate gestational age.100 patients who complied with the inclusion and exclusion criteria were included in the research. Result: The length of the fetal kidneys is linearly correlated with gestational age. Conclusion: This led us to the conclusion that measuring the length of the fetal kidneys is a reliable way to estimate gestational age.***

Keywords: fetal kidney length, gestational age, last menstrual period, biometric parameters, Grey scale ultrasound

1. Introduction

Obstetric ultrasonography is regarded as the principal imaging technique for estimating fetal development and tracking growth. The necessity of ultrasonography estimate increases with an unknown last menstrual period (LMP). The length of the fetus from head to torso is known as the crown rump length (CRL), which is the most reliable gestational age estimation in early pregnancy. The most often utilized biometric parameters for determining gestational age are fetal femur length (FL), head circumference (HC), biparietal diameter (BPD), and abdominal circumference. [1]. Obstetricians are quite concerned about managing pregnant women with unidentified LMP. [2].

The Maximum fetal renal growth occurs for 26 - 35 weeks gestation. Fetal growth abnormalities do not impair fetal kidney development, with the exception of those that affect the urinary system, such as obstructive uropathy in utero. [3], [4], [5]. Conventional fetal biometric indicators based on ultrasonography are unreliable for accurately estimating EGA and EDD beyond the 34th week of pregnancy. [6]. Therefore, researchers are looking for a single trustworthy biometric measure that can be as precise as the HC and FL between weeks 20 and 34 of pregnancy and perhaps even more precise between weeks 34 and 40.

The measurement of fetal kidney length (FKL) was shown to be more accurate than the recognized fetal biometric indices (BPD, HC, FL, and AC) in estimating gestational age between the 24th and 38th weeks of pregnancy. [7]

To assess its validity as a biometric instrument between 20 and 34 gestational weeks, the sonographic FKL is measured and associated with the estimated gestational acquired from the current standard parameters (BPD, HC, FL, and AC).

2. Literature Survey

J JKansaria et al., in his study on 70 antenatal women between gestational ages 22 - 38 weeks with interval of 2 weeks said that the fetal kidney length had the highest level of accuracy with a standard error of 9.17 days, whereas the abdominal circumference had the highest level of inaccuracy with a standard error of 11.14 days. They came to the conclusion that, compared to other biometric indices, fetal kidney length more accurately predicted gestational age. [8] Konje JC et al. in 2002, studied by measuring fetal kidney length after 24th week of gestation. For this study, 73 expectant mothers with typical, straightforward pregnancies were chosen. From 24 to 38 weeks of gestation, serial measurements of fetal biometry and kidney length were taken every two weeks. According to the findings, FL and fetal kidney length (+10.29 and 10.96 days, respectively) are the best indicators of gestational age. In comparison to other fetal biometric indices including BPD, HC, AC, and FL, they found that measuring the length of the fetal kidneys was a more reliable way to determine gestational age. [9].

3. Problem Definition

The typical biometric parameters lose their reliability in the late second and third trimesters even if they are trustworthy up until the early second trimester because the error margin grows beyond 30 gestational weeks. Particularly after 34 weeks of gestation, no single factor can be utilized to precisely estimate the fetal gestational age. [2]

4. Materials and Method

a) **Type of Study** - Prospective, observational, comparative study
b) **Study setting** - OPD & IPD patients of Dr. D. Y Patil Medical College, Hospital and Research Centre, Kolhapur.
c) **Sample size** - The sample size was established using the formula below:

$$n = \frac{(Z_a)^2 \, p \, (1-p_1)}{d^2}$$

Where, Zα – Critical value of the normal distribution at α (e. g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), p – Expected prevalence, d – Margin of error.

The calculated sample size was found to be n=100.

Study design - For 18 months, the study was carried out at the radiodiagnosis division of the Dr. D. Y. Patil medical college, hospital, and research institution in Kadamwadi, Kolhapur.100 patients who complied with the inclusion and exclusion criteria were included in the research.

Inclusion Criteria

- Women who have known LMPs and a typical singleton pregnancy with a predictable menstrual cycle between gestational ages of 27 - 41 weeks.
- Appropriately dated pregnancies by Ultrasound.

Exclusion Criteria

- This study excludes women whose menstrual cycles were appropriately timed by first trimester ultrasonography but whose menstrual cycles were unknown or irregular.
- Females whose LMP is ambiguous.
- Multiple gestations.
- Possibility of oligohydramnios or polyhydramnios during pregnancy.
- Concerning maternal obesity.
- Fetus with renal pelvic dilatation greater than 5 mm and aberrant adrenal function or morphology.
- Females with extra risk factor such thyroid disorders, jaundice, anemia, hypertension, GDM, heart disease, epilepsy, autoimmune illnesses, and hypertension.

5. Methodology

After meeting the criteria for inclusion, patients were in - formed of the research's methodology in short and provided with an opportunity to provide written informed permission prior to the investigation. It is taken in - depth medical history. They were subjected to radiological inspections. A verified ultrasound in the first or early second trimester was used to calculate GA using the last menstrual period (LMP). The examination was conducted using the GE LogiqF8 and F8 Expert ultrasound systems. From the patients, fetal biometry and fetal kidney length are measured. These measures were used to determine the gestational age.

Using a 3.5–5.0 MHz transducer and a grey scale real - time ultrasound scanner as shown in Fig.1, the length of the fetal kidney is measured.

Figure 1: Measurement of length of fetal kidney

When the whole length of the kidney with the renal pelvis is visible, measurements are taken in the sagittal plane

Statistical Analysis

The data was entered into MS Excel and then imported into SPSS for analysis. The data were analysed using SPSS V 1.2.5001 software.

6. Results and Discussion

Distribution of subjects based on age The Table I and

Table I: Age distribution of cases

Age Distribution	Cases
20 - 25	49
25 - 30	43
>35	8

Fig.2 displays the age distribution of the study's participants. Ages of the patients varied from 20 to 39.

- 49% of the population was women between the ages of 20 and 25.
- 43% of those aged 25 to 30; 8% of those over 35

This study showed that when assessing gestational age, there was no noticeable association between the age of expectant women and renal length

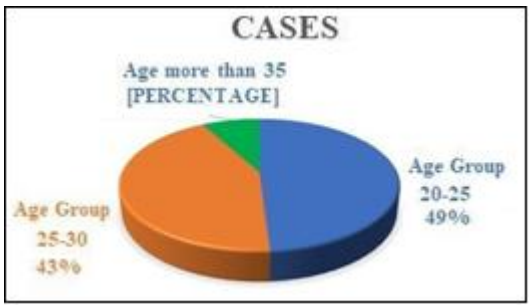

Figure 2: Age distribution of cases

a) Distribution of cases according to their parity:

Table II: Distribution based on parity

Parity	Cases
Primipara	37
Multipara	63

Table II and Fig.3 displays the distribution of the study group on basis of their parity, with 53% of the individuals being multiparous 47% of the populace were primi.

Figure 3: Distribution based on parity

Our findings show that parity had no effect on kidney length in fetuses of the same gestational age.

b) Distribution of case groups according to their gestational ages:

Table III and Fig.4 shows the distribution of case groups based on gestational age.

Table III: Distribution based on gestational age

Gestational Age	Cases
27 - 31	18
32 - 36	44
37 - 41	38

- Women who were 27 to 31 weeks pregnant accounted for 18% of all females.
- 44% from 32 to 36 weeks
- 38% of the population had gestational ages between 37 and 41 weeks. The case count was randomly assigned to each gestational age.

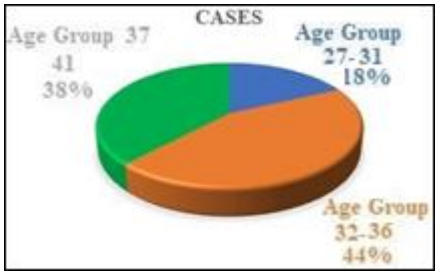

Figure 4: Distribution based on gestational age Table IV and Fig.5 depicts the distribution of patients in each gestational age.

c) Distribution of patients in each gestational age

Table IV: Distribution of patients in each gestational age

GA	No. of Patients
27	2
28	2
29	2
30	7
31	5
32	6
33	18
34	5
35	10
36	5
37	17
38	10
39	7
40	3
41	1

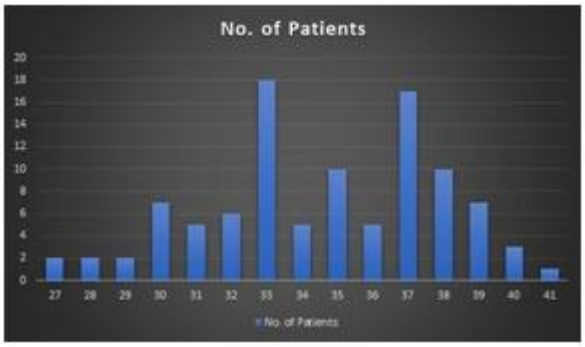

Figure 5: Distribution of patients in each gestational age

d) Mean Fetal Kidney length in each Gestational age:

Table V: Mean fetal kidney length at various gestational ages

GA	Mean Fetal Kidney Length
27	26.4 ± 0.6
28	29.27 ± 1.32
29	29.80 ± 1.4
30	29.9 ± 0.77
31	30.3 ± 1.64
32	32.63 ± 1.65
33	32.73 ± 1.68
34	33.5 ± 1.76
35	34.4 ± 2.12
36	36.3 ± 1.42
37	36.86 ± 1.64
38	38.2 ± 1.3
39	38.70 ± 0.5
40	40.25 ± 1.26
41	40.32 ± NA

Table V and Fig.6 shows the typical length of the fetal kidneys in millimeters at each gestational age. The mean fetal kidney length was calculated by averaging the measurements of the right and left kidneys. The mean fetal kidney length increased linearly with gestational age.

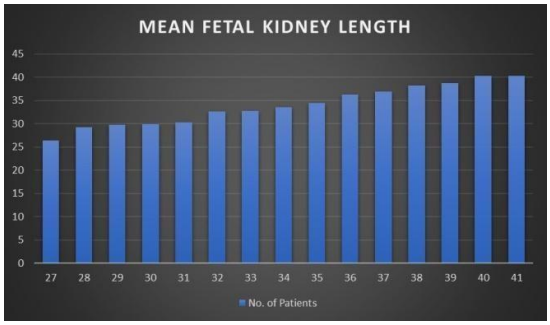

Figure 6: Mean fetal kidney length at various gestational ages

Table VI: Comparison of kidney length of fetus

Gestational Age (weeks)	Kidney length (mm) Present study	Kidney length (mm) Ansari et al 1997	Kidney length (mm) (SD) S. Afroz et al 1996
31	30.3 ± 1.64	32.00 (0.50)	30.00 (1.51)
32	32.63 ± 1.65	32.00 (0.51)	32.87 (4.83)
33	32.73 ± 1.68	32.00 (0.70)	32.80 (1.26)
34	33.5 ± 1.76	33.00 (0.66)	34.00 (2.91)
35	34.4 ± 2.12	34.00 (0.62)	35.00 (2.22)
36	36.3 ± 1.42	35.00 (0.79)	35.64 (2.89)
37	36.86 ± 1.64	36.00 (0.79)	37.00 (3.53)
38	38.2 ± 1.3	37.00 (0.74)	37.33 (2.31)
39	38.70 ± 0.5	38.00 (0.56)	38.67 (2.00)
40	40.25 ± 1.26	39.50 (0.58)	40.20 (2.97)

As shown in Table VI and Fig.7, when the kidney length from the current study was compared to those from studies by Ansari et al. and Afros et al., it revealed a strong association with these two studies

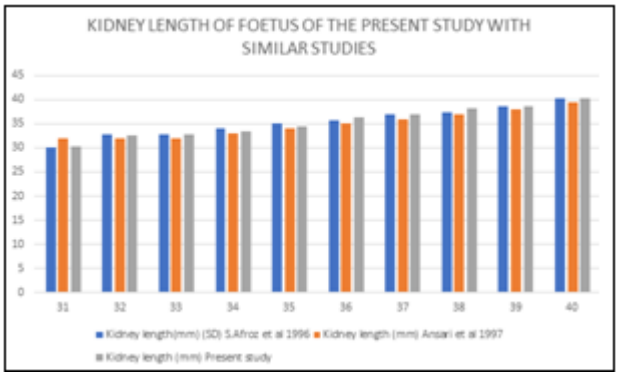

Figure 7: Comparison of kidney length of fetus

7. Discussion

Diagnostic ultrasonography is a secure, non - invasive, and beneficial technique for antepartum fetal monitoring. Numerous studies have been carried out in the past to assess the range of the FKL's ability to estimate gestational age. The gestational age in weeks and the fetal kidney length in millimeters are considered to be linearly related. This inquiry was done to check for any regional population variations. According to our research, age, parity, and kidney side had no discernible impact on measuring kidney length or gestational age.

It will be helpful for patients who are unsure of their LMP date, who skip the first trimester dating scan, and who arrive late for their prenatal check - up. It supported the 2009 study by J. J. Ansaria and colleagues. Konje et al, a standard error (SE) of 10.2 days in the work, it was determined that the measurement of the length of the fetal kidney was the most reliable metric for determining gestational age. The embryonic kidney's length is unaffected by changes in growth. Renal length in mm should, as a general rule, be near to gestational age in weeks.

The mean fetal kidney length increased linearly with gestational age, according to our study. Fetal kidney length outperformed other biometric indicators including AC, BPD, HC, and FL as predictors of gestational age. This result is in line with the research done in 2002 by Konje et al. The current study therefore supports the hypothesis that fetal kidney length may be a crucial sonographic parameter for precise fetal gestation age prediction. It is important to remember that beyond 30 weeks, a single USG test is no longer accurate for estimating gestational age. Fetal kidney length measurement can therefore be employed as an additional metric in the late third trimester together with BPD, FL, and AC to precisely establish the gestational age.

8. Summary

100 healthy pregnant women between the ages of 27 and 41 who were free of obstetrical or medical risk factors were included in the research. The distribution of the study group's age, parity, and trimesters was done at random. The gestational age was calculated from the length of the fetal kidney. We measured the left and right kidneys. It demonstrated that the length of the right and left kidneys was virtually equal for the same gestational age. Our findings show that age, parity, or the sides of the kidney have no bearing on how long the kidneys are and how long they are in relation to gestational age. Growing linearly with gestational age was the kidney's length.

9. Conclusion

In our investigation, fetal kidney measurements and a prenatal assessment of gestational age were taken from individuals with known dates of LMP. Our research demonstrates that there is no significant correlation between renal length and gestational age, independent of the age, parity or sides of the kidney. From this study, we inferred that measuring the length of a fetus' kidneys is a trustworthy sign of pregnancy. It can be combined with other commonly used characteristics to more precisely date pregnancies like BPD, FL, and AC.

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