A COMPARATIVE STUDY TO DETERMINE THE GESTATIONAL AGE IN THIRD TRIMESTER USING MEAN FETAL LENGTH VERSUS MULTIPLE BIOMETRIC PARAMETERS
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ABSTRACT: Reliable estimation of gestational age is important in providing appropriate obstetric care. The objective of the study was to compare the gestational age estimated by mean fetal kidney length and multiple biometric parameters (BPD, HC, AC & FL) with the actual gestational age derived from reliable last menstrual period. METHODS: A single third trimester ultrasound examination was done in a total of 100 well dated patients. Gestational age assessment was done by measuring multiple biometric parameters and mean fetal kidney length. RESULTS: Comparison of linear coefficient of mean fetal kidney length with gestational age demonstrated kidney length has high degree of correlation with an Intra class correlation coefficient of 0.860, which is the best of all the parameters in the overall third trimester. In the 38-41 weeks group, MKL (mean 38.27±2.523) in weeks was close to actual period of gestation (39.26±0.867) in weeks. The other parameters in this sub group were more deviant and MKL had the best correlation. A very strong correlation was seen when mean fetal kidney length was added with multiple parameters (correlation co efficient r=.830). CONCLUSION: This study showed that ultrasonographic measurement of mean fetal kidney length is a reliable indicator of gestational age, in third trimester. Where there is discrepancy between the dates and the uterine size, it is better to include mean fetal kidney length in the multiple biometric parameters.

KEYWORDS: Mean fetal kidney length, Third trimester, Multiple parameters, Gestational age.

INTRODUCTION: Estimation of gestational age and fetal maturity is a key factor in prenatal care. The expected date of delivery has profound medical, social and personal implications for the pregnant women and is a vital yard stick for the doctor, who is responsible for the safe delivery of the child.

Accurate assessment of gestational age is pivotal to the quality of maternal care. It guides the management of pregnancies, in which labour ensues less than 38 weeks or fails to ensue after 42 weeks. Failure of accurate gestational age assessment can result in iatrogenic prematurity or post maturity, both of which are associated with increased perinatal mortality and morbidity.¹

Dilemma occurs in patients who seek late prenatal care and who have no idea of their LMP or when conception occurred.² Scanty bleeding in early pregnancy and occurrence of irregular menstrual cycles in mothers on oral contraceptives may interfere with proper recording of last menstrual period. In a patient with significant medical obstetric history, the best treatment hinges on the gestational age of the fetus.
Ultrasound gives a more objective evidence of gestational age. It dates a pregnancy most precisely, when images are obtained early in gestation. The most frequently used parameters are crown rump length (CRL), parietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). The standard deviations of biometric measurements taken from normal pregnancies, increase as pregnancy progresses. However usefulness of these parameters in establishing gestational age in late pregnancies and in assessing fetal growth in patients with uncertain dating in third trimester is limited. This has been attributed mainly to biologic variability in the growth of fetuses.

There is therefore a need to investigate a method of dating pregnancies that is simple, easy to define and reproducible, especially in third trimester.

Currently improved instrumentation, coupled with increased diagnostic capability have ushered in a new era in identification of fetal anatomy more explicitly and employing measurement of many more growth parameters for estimation of gestational age. Fetal Kidney Length diameter (FKL) in suggested as an indicator of gestational age when dates are uncertain and other parameters are lagging behind.

This study was undertaken to precisely estimate the accuracy of prediction of gestational age by MFKL and to compare it with multiple growth parameters (BPD, HC, AC, FL) by a single third trimester ultrasound examination.

**The following were the aim and objectives of the study:**

1. To measure the mean fetal kidney length (MFKL) by ultrasound examination in the third trimester for estimation of gestational age.
2. To measure BPD, FL, AC and HC by ultrasound examination in third trimester for estimation of gestational age.
3. To compare the gestational age estimated by MFKL and multiple growth parameters like BPD, HC, AC & FL with the actual gestational age derived from the reliable last menstrual period.

**MATERIALS AND METHODS:** This study was done in the department of Obstetrics and Gynaecology, Father Muller Medical College hospital, Mangalore from July 2008 to January 2010 in collaboration with department of Radiology.

A total of 128 well dated normal pregnant patients attending the OBG Department in 3rd trimester were studied based on purposive sampling technique. All the patients belonged to low socioeconomic status and were booked in the same institution. The patients were of differing parity and ages. All the patients reliably knew their date of last menstrual period. Written informed consent was obtained from all of the participants and institutional review board and institutional ethics committee approval were given to the study.

**INCLUSION CRITERIA:**

1. Singleton pregnancies (28 to 41) weeks.
2. Regular menstrual cycles and known last menstrual period with dating scan of 12 to 20 weeks.
3. No history of oral contraception use for at least 3 months before pregnancy.
4. All fetal biometric parameters visualized and measured.
5. Normal antenatal patients with no risk factors.

EXCLUSION CRITERIA:
1. Anomalous fetuses.
2. Suspected IUGR.
3. Patients with unknown dates.
4. Multiple gestation.
5. Offsprings of diabetic mothers.
6. Renal pelvic dilatation of 5 mm or greater.

A detailed history was taken. Clinical examination and necessary investigations were done in all patients. A single ultrasonographic scan was done during the last trimester of pregnancy with PHILIPS 140A, 3.75 MHZ probe. LMP was not revealed to the sonologist. Mean fetal kidney length was measured along with BPD, HC, AC and FL. The gestational age was calculated from Mean FKL using nomogram by Cohen et al. A separate gestational age was derived from multiple parameters BPD, HC, AC and FL using nomogram by Hadlock et al. These values were then compared with actual gestational age derived from excellent dated reliable LMP.

**Ultrasound Scanning:** During the procedure of ultrasound recording the Biparietal Diameter, Head Circumference, Abdominal Circumference, Femur Length and Mean fetal kidney length were taken using standard methodology. A minimum of three readings were obtained for mean fetal kidney length on both sides and average was taken. Age prediction was done from Cohens nomogram.

**Mean Fetal Kidney Length (MFKL):** The fetal kidney length was measured. Fetus was scanned in the transverse plane until the kidneys were visualized just below the stomach. The probe was then rotated through ninety degrees to outline the longitudinal axis of the kidney. Kidney length was measured from upper pole to lower. Both the left and right kidney were taken and the average was calculated.

These estimated gestational age readings by individual parameters were compared with actual gestational age obtained by reliable LMP.

The whole of third trimester (28-41 weeks) was divided into three subgroups as 28-32 weeks, 33-37 weeks and 38-41 weeks. The correlations between individual parameters and the LMP derived gestational age was seen in each gestational age group.

![Picture 1: Philips 140 a ultrasound machine](image-url)
Picture 2: Ultrasound measurement of biparietal diameter

Picture 3: Measurement of fetal kidney length-left side. Similarly, the right side is measured and the average is calculated as mean kidney length

Picture 4: NORMOGRAM
• There is an increase in mean kidney length relative to progress of the gestational age.
• Based on this analysis, a correlation coefficient was found to be 0.82 (p < 0.001) in the nomogram by Cohen et al.

Fetus was scanned in the transverse plane until the kidneys were visualized just below the stomach. The probe was then rotated through ninety degrees to outline the longitudinal axis of the kidney.

OBSERVATION AND RESULTS:

![Picture 5: Fetal renal length identification](image)

Only about 20% of cases were between 28-32 weeks, followed by 33–37 weeks (46%) and most were between 38-41 weeks (62%).

|          | N  | Minimum | Maximum | Mean  | Std. Deviation |
|----------|----|---------|---------|-------|----------------|
| LMP - GA | 128| 28.00   | 41.60   | 36.53 | 3.282          |
| BPD      | 128| 28.00   | 40.00   | 35.27 | 2.768          |
| HC       | 128| 27      | 40      | 35.53 | 2.973          |

![Fig. 1: Gestational age distribution](image)
Mean kidney length (35.98±3.513 in weeks) was found to be more close to LMP derived gestational age (36.53±3.282 in weeks) than the multiple parameters (35.495±3.2179 in weeks), overall in the third trimester.

*multiple parameters: BPD +HC+AC+FL+MKL

|          | BPD | HC  | AC  | FL  | MKL | POG with multiple parameters |
|----------|-----|-----|-----|-----|-----|-------------------------------|
| LMP-GA   | .636| .771| .800| .168| .867| .830                          |
| P        | .000| .000| .000| .000| .000| .000                          |
| N        | 128 | 128 | 128 | 128 | 128 | 128                           |

Comparison of linear coefficient of MKL with gestational age demonstrated a good correlation (r=0.867). A very strong correlation was seen with gestational age when mean kidney length is combined with the other parameters parameters (r=0.830). Poor correlation with gestational age was seen with FL (r =0.168)
When MKL is correlated, the regression equation is MKL GA = 6.42 + 0.81 * LMP GA. r = 0.867, r² = 0.57.

| POG in WEEKS | Number | Mean  | Standard deviation |
|--------------|--------|-------|--------------------|
| 28-32 wks LMP GA | 20     | 30.75 | 1.209              |
| BPD          | 20     | 31.20 | 2.118              |
| HC           | 20     | 30.95 | 2.114              |
| AC           | 20     | 30.55 | 1.731              |
| FL           | 20     | 31.00 | 1.864              |
| MKL multiple parameters | 20 | 31.70 | 3.556              |

| 33-37 wks LMP GA | 46     | 35.37 | 1.511              |
| BPD          | 46     | 34.67 | 1.606              |
| HC           | 46     | 34.74 | 1.867              |
| AC           | 46     | 34.18 | 2.003              |
| FL           | 46     | 34.46 | 2.307              |
| MKL multiple parameters | 46 | 34.74 | 1.971              |

| 38-41 wks LMP GA | 62     | 39.26 | 0.867              |
| BPD          | 62     | 37.02 | 1.963              |
| HC           | 62     | 37.18 | 2.100              |
| AC           | 62     | 37.08 | 2.175              |
| FL           | 62     | 37.05 | 2.107              |
| MKL multiple parameters | 62 | 38.27 | 2.523              |

Table 3: Mean value (in weeks) in sub groups of gestational age

When comparing mean values in each subgroups of gestational age, it was observed that in,

**38-41 weeks group:**
- MKL (mean 38.27±2.523 in weeks) was close to actual period of gestation (39.26±0.867) in weeks.
- The other parameters in this sub group were more deviant and MKL had the best correlation.

**33-37 weeks group:**
- MKL (34.74 ± 1.971 in weeks) was close to gestational age (35.37±1.511 in weeks)
- The best correlation was seen when mean kidney length was combined with BPD, HC, AC and FL i.e multiple parameters were used (34.991±3.2386).
- The second best correlation with gestational age was in this group was with HC (34.74±1.876)
28 - 32 weeks age group:
- The best correlation was seen when HC (30.95±2.114) and AC (30.5±1.731) were used.
- Second closest was gestational age with multiple parameters (31.080±1.8574) and MKL alone (31.70±3.556).
- Correlation of mean fetal kidney length with the gestational age derived from LMP was excellent (intra class coefficient 0.860).
- Mean fetal kidney length was best among all the categories followed by gestational age with multiple parameters (intra class correlation coefficient 0.857).

| SUBGROUPS LMP GA   | MEAN   | STANDARD DEVIATION | P VALUE | ICC  |
|--------------------|--------|--------------------|---------|------|
| 28-32 WKS LMP      | 30.75  | 1.209              | 0.180   | 0.507|
| POG FKL            | 31.70  | 3.556              |         |      |
| 33-37 WKS LMP      | 35.37  | 1.511              | 0.021   | 0.654|
| POG FKL            | 34.74  | 1.971              |         |      |
| 38-41 WKS LMP      | 39.26  | 0.867              | 0.002   | 0.341|
| POG FKL            | 38.27  | 2.523              |         |      |
| OVERALL LMP        | 36.53  | 3.282              | 0.010   | 0.860|
| POG FKL            | 35.98  | 3.513              |         |      |

Table 4: Correlations in subgroups of gestational age: LMP derived gestational age with FKL

Mean fetal kidney length:
- **28 to 32 weeks**: moderate correlation with gestational derived from the last menstrual period (ICC 0.507).
- **33 to 41 weeks**: Correlation was excellent (ICC 0.860), and is the best of all the parameters.

**DISCUSSION:** In our study mean age of the pregnant mother was 24.55±3.878 years. All the patients belonged to low socio economic status and all were booked cases.

In our study 54.7% of patients were primigravida and 45.3% cases were multi gravida. The mean parity of the pregnant women taken in the study by Konje et al\(^1\) was 0.8 (Range 0 to 3).

Maternal age, multiparity, fetal gender and shape of fetal head affect GA estimation by 1–2 days when using BPD (p= 0.0001–0.02).

In a prospective ‘Two Operator study’ done by Konje et al.\(^5\) It demonstrated that no significant differences in fetal renal length was seen between male and female fetuses. The study involved 73 women in whom dating with mean renal length was compared with gestational age from menstrual dates.
Sampiao et al demonstrated that in the third trimester the male fetuses had a significantly greater volume than the female fetuses. However, studies by Bertagnoli et al\(^6\) and Konje et al\(^5\) showed that there were no significant differences in renal length between the two genders.

In the present study, no differences between male and female fetal kidneys could be noted, as gender identification was prohibited and not done.

In the present study, Mean kidney length (35.98±3.513 in weeks) was found to be more close to LMP derived gestational age in weeks (36.53±3.282) in the third trimester).

Period of gestation has an excellent positive correlation with the gestational age derived from Mean kidney length in the third trimester. (ICC 0.860)

Comparison of linear coefficient (r) showed a very strong correlation with gestational age from mean fetal renal length (r =0.867) in comparison to when all four parameters were added together (r= 0.830). The least degree of correlation was seen with FL (r 0.108.)

MKL is statistically highly significant overall in the third trimester with a p value of 0.010, and is very significant between 38 to 41 weeks period of gestation.

| Table 5: Correlation coefficient of various studies |
|--------------------------------------------------|
| Konje et al\(^1\) r 0.93                        |
| Present study r 0.867                          |

In a comparative study, Mahasset et al reported that mean fetal kidney length measurements sonographically during pregnancy continued to correlate well with gestational age measured by BPD FL and AC and an average of the three.

In our study, similarly it has been observed that fetal renal length increases linearly with gestational age.

- Between 28 to 32 weeks Mean kidney length had a moderate correlation with gestational derived from the last menstrual period (ICC 0.507).
- Between 33 to 41 weeks, Correlation was excellent (ICC 0.860), and Mean fetal kidney, length is the best of all the parameters in this period.
- Comparison of linear coefficient (r) of MKL alone with gestational age in third trimester demonstrated a very strong correlation (r=0.867). A good correlation was seen when mean fetal kidney length was added with multiple parameters (r=.830). Poor correlation with gestational age was seen with FL (r =.168)
- Correlation of mean fetal kidney length with the gestational age derived from LMP was excellent (intra class coefficient 0.860) and the best among all the parameters, for gestational age assessment in the third trimester.
- Gestational age estimated when mean fetal kidney length is added to the other biometric parameters i.e., multiple biometric parameters (all five parameters taken together), it has an excellent correlation in between 33 to 37 Weeks of gestation as compared to other individual parameters(ICC 0.863).

At this earlier stage of defining a new method of predicting gestational age, establishing its accuracy is crucial and restricting the number of operators is vital. Such a study on a larger
reference population can establish a national reference value as a new parameter for gestational age estimation.

CONCLUSION: This study showed that ultrasonographic measurement of MKL is a reliable indicator of gestational age, in third trimester.

- All parameters have positive correlation with gestational age. But compared to other parameters, kidney length has high degree of correlation with an Intra class correlation coefficient of 0.860 and r 0.867, which is the best of all the parameters in the overall third trimester.

  The present study showed that there is a significant correlation between renal length and gestational age particularly in the third trimester.

- A very strong correlation was seen when mean fetal kidney length was added with multiple parameters (correlation coefficient r=.830).

  The fetal kidneys are easy to identify and measure. Kidney length in millimeters approximates gestational age in weeks.

  Kidney length is a reliable single parameter used in estimating gestational age and is a useful parameter in estimating gestational age in a patient with unknown LMP or who present late for maternity care. In cases of doubt, where there is discrepancy between the dates and the uterine size, it is better to include mean fetal kidney length, as a part of fetal biometry.

  In patients with poor early dating criteria and an unknown last menstrual date, MKL is more reliable in the third trimester.

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