Original Research Paper

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Radio-Diagnosis

ESTIMATION OF GESTATIONAL AGE BY USING FETAL KIDNEY LENGTH AND PLACENTAL THICKNESS

Dr.Venkata satish A	Final year resident, Department of Radiology, Sri Venkateshwaraa Medical College Hospital and Research centre, Puducherry, 605102, India
Dr. Ratna Vasanthan S*	Professor, Department of Radiology, Sri Venkateshwaraa Medical College Hospital and Research centre, Puducherry, 605102, India*Corresponding Author
Dr. Mohammed Ansari Gaffoor	Associate Professor, Department of Radiology, Sri Venkateshwaraa Medical College Hospital and Research centre, Puducherry, 605102, India
Dr. Armel Arputha Sivarajan	Professor, Department of Radiology, Sri Venkateshwaraa Medical College Hospital and Research centre, Puducherry, 605102, India

ABSTRACT

Background: As pregnancy progresses, the effectiveness of current methods for estimating gestational age diminishes. Meanwhile, fetal kidney length and placental thickness typically increase linearly with advancing gestational age. This observational study aims to explore whether fetal kidney length and placental thickness can serve as reliable indicators for estimating gestational age in healthy singleton pregnancies. **Methodology:** This was a prospective observational study in which 125 patients who came for regular antenatal checkup after 20weeks of gestation has undergone antenatal ultrasound examination were included on the basis of a predefined inclusion and exclusion criteria. First gestational age estimation was done using fetal biometry (head circumference, biparietal diameter, abdominal circumference and femur length). To measure fetal kidney length, the ultrasound transducer was first oriented longitudinally along the fetal spine. A slight adjustment in angulation allowed visualization of the paravertebral plane, capturing the complete length of each fetal kidney separately. Measurements were then averaged for accuracy. Placental thickness was assessed at its thickest point, typically near the umbilical cord insertion site. The correlation between placental thickness and gestational age, and between fetal kidney length and gestational age, was evaluated using biometric measurements and analyzed using Pearsons correlation coefficient. P value less than 0.05 was taken as statistically significant. **Results:** In our study, the fetal kidney length and placental thickness correlated well with assigned gestational age. A positive linear relationship of gestational age with fetal kidney length and placental thickness was found. Correlation of gestational age with fetal kidney length and placental thickness was 0.966 and 0.966 respectively. **Conclusion:** In conclusion, the study's results confirm the efficacy of using fetal kidney length (FKL) and placental thickness measurements as reliable indicators for estimating gestational age. These ultrasound measurements have proven accurate in adverse sample, enhancing the potential for widespread application in prenatal care. By enabling precise gestational age estimation, these biometric parameters can improve the timing of prenatal interventions, potentially reducing the risk of premature births and optimizing neonatal outcomes. The findings highlight the importance of integrating these measurements into routine prenatal screening protocols, suggesting that they could significantly enhance the quality and effectiveness of maternal and fetal health management. Despite challenges such as measurement variability due to operator dependency and the limitations of a cross-sectional study design, the study's impact is potentially transformative, particularly in settings where access to advanced prenatal care technologies is limited. Moving forward, further research should focus on longitudinal studies to track these measurements over time and refine the methodology to reduce variability and increase the reliability of these crucial prenatal assessments.

KEYWORDS :

AIM OF THE STUDY: The primary aim of this study is to determine gestational age using fetal kidney length and placental thickness, and to assess the accuracy of these measurements in comparison with other parameters.

OBJECTIVES:

1. To Evaluate the correlation between fetal kidney length and placental thickness with gestational age as determined by standard ultrasound parameters.

2. To assess the potential for integrating fetal kidney length and placental thickness measurements into routine prenatal screening protocols to improve the accuracy of gestational age estimation

METHODOLOGY:

STUDY TYPE: Cross-sectional observational study

SAMPLE SIZE AND STUDY POPULATION: Patients referred to the Radiology Department for routine antenatal checkups after 20 weeks of gestation.

The sample size of 125 patients is calculated based on the research by Singh A et al in their study "Estimation of Gestational Age by Using Fetal Kidney Length and Transcerebellar Diameter in Comparison with Other Biometric Indices" (Donald School Journal of Ultrasound in Obstetrics and Gynecology, 2021). This sample size assumes a confidence interval of 95%, a power of 75%, and a correlation coefficient of 0.875.

STUDY DURATION: This study was conducted over a period of 18 months following Institutional Ethics Committee (IEC) approval, spanning from 2022 (October) to 2024 (April).

INCLUSION CRITERIA:

- Patients undergoing routine sonographic evaluation of pregnancy beyond 20 weeks of gestation
- Pregnant married women.
- Patients with known last menstrual period.

EXCLUSION CRITERIA:

- Unknown last menstrual period.
- Irregular menstrual cycles.
- Multiple gestations.
- Placental anomalies and poor visualization of the placenta.
- Renal anomalies or known cases of renal anomalies.
- Oligohydramnios and polyhydramnios.
- Pregnant women with diabetes, hypertension, or eclampsia.

DATA COLLECTION PROCEDURE:

Approval was obtained from the Scientific Research Committee and the Institutional Human Ethical Committee. Patients attending routine antenatal checkups after 20 weeks of gestational age underwent transabdominal ultrasonography using a Mindray Resona i9 equipped with a SC 6-1s MHz convex probe. For each patient, measurements were taken for biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), kidney length (KL), and placental thickness (PL). To measure the fetal kidney, the transducer was initially positioned to longitudinally display the fetal spine. With a slight angulation, the paravertebral plane was achieved,

showing the entire length of the fetal kidney. Measurements were separately taken for both kidneys, and the average was calculated. Placental thickness was measured at the point of maximum thickness at the site of umbilical cord insertion

DATA ANALYSIS:

Quantitative variables such as gestational age and ultrasonographic measurements will be expressed as means and standard deviations. Pearson Correlation analyses will assess the relationships between placental thickness, fetal kidney length, and gestational age. Data will be entered into Microsoft Excel and analyzed using SPSS version 23.

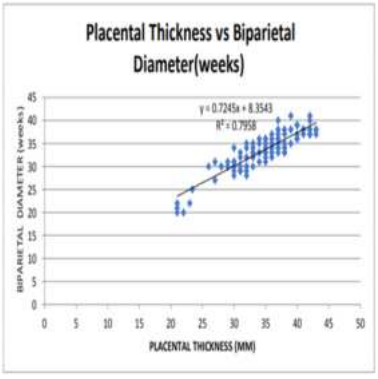
ETHICAL CONSIDERATIONS:

Informed written consent was obtained from all patients. Patients were included in the study only after obtaining informed consent. Institute ethical committee approval was sought and obtained before the study was begun.

RESULTS:

Correlation Between Placental Thickness and Biparietal Diameter (Weeks)

Variables	N	Pearson Correlation	p value
Placental Thickness mm vs Biparietal Diameter Weeks	125	0.892**	0.001

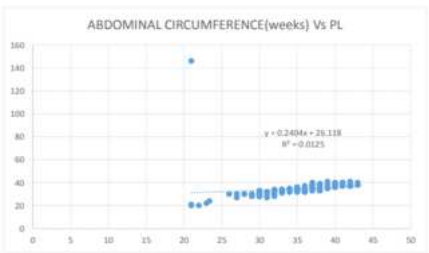


Correlation Between Placental Thickness and head circumference (Weeks)

Variables	N	Pearson Correlation	p value
Placental thickness vs Head circumference (weeks)	125	0.112	0.215

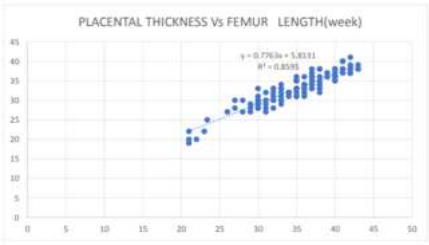
Correlation Between Placental Thickness and abdominal circumference (weeks)

Variables	N	Pearson Correlation	p value
Placental thickness vs Abdominal circumference (weeks)	125	0.112	0.215



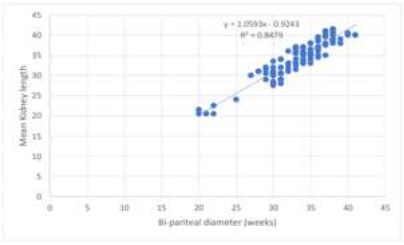
Correlation Between Placental Thickness and femur length (weeks)

Variables	N	Pearson Correlation	p value
Placental thickness vs Femur length (week)	125	0.927	0.001



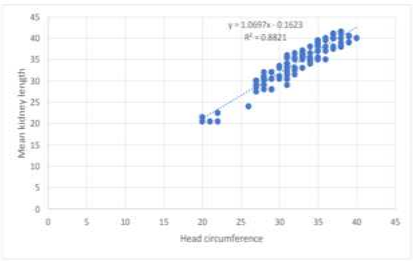
Correlation Between Biparietal Diameter and Mean Kidney (Weeks)

Variables	N	Pearson Correlation	p value
Biparietal diameter (Weeks) Vs Mean Kidney	125	0.921**	0.001



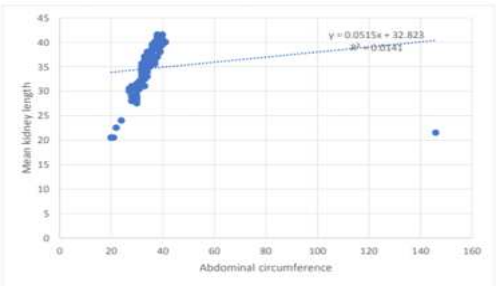
Correlation Between Head Circumference and Mean Kidney (weeks)

Variables	N	Pearson Correlation	p value
Head circumference (weeks) Vs Mean Kidney	125	.939**	0.001



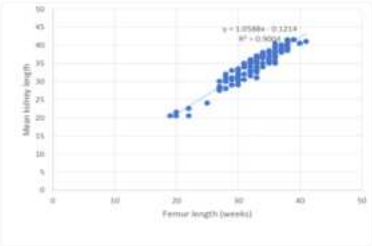
Correlation Between Abdominal Circumference and Mean Kidney(weeks)

Variables	N	Pearson Correlation	p value
Abdominal circumference (weeks)Vs Mean Kidney	125	0.119**	0.187



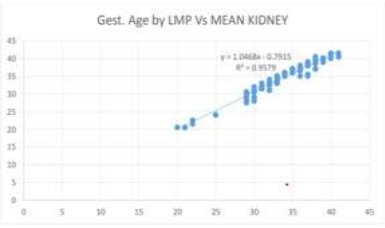
Correlation Between Femur Length (Weeks) and Mean Kidney

Variables	N	Pearson Correlation	p value
Femur length (weeks) Vs Mean Kidney	125	.949**	0.001



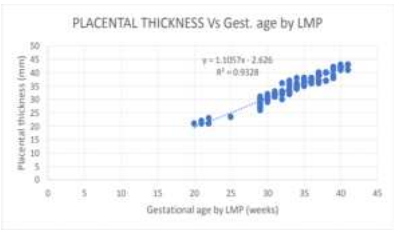
Correlation Between Gestational Age by LMP and Mean kidney length

Variables	N	Pearson Correlation	p value
Gestational Age By LMP Weeks Vs Mean kidney length	125	.966**	0.001

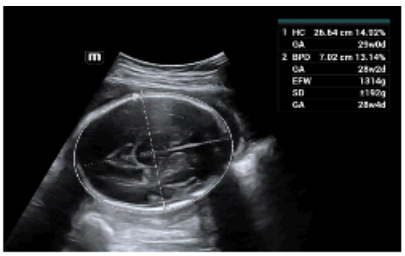


Correlation Between Placental Thickness and Gestational Age by LMP

Variables	N	Pearson Correlation	p value
Placental Thickness mm Vs Gestational Age By LMP Weeks	125	.966**	0.001



ILLUSTRATIONS:

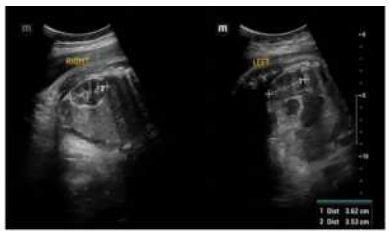


USG image of Head circumference and biparietal diameter at GA 29 weeks

USG image of Biparietal diameter at gestational age 36weeks

USG image of Abdominal circumference at gestational age 20 weeks

USG image of Placental thickness at GA 21 weeks



USG image of Right and left fetal kidney length at GA 36 weeks

DISCUSSION:

The changes in fetal kidney length and placental thickness reflect developmental stages and their potential as reliable indicators of gestational age:

DEVELOPMENTAL BIOLOGY OF FETAL KIDNEYS: Fetal kidney length (FKL) as a developmental marker is rooted in the biological understanding that the kidneys undergo significant morphological changes during gestation. The growth trajectory of fetal kidneys, being relatively linear, is reflective of critical developmental processes such as nephrogenesis.[1,2] Our findings corroborate the theory that kidney development is closely tied to overall fetal growth and can thus reliably indicate gestational age. The consistent measurement of FKL across various stages of pregnancy highlights its potential utility in monitoring not only the gestational age but also the developmental health of the urinary system, which is crucial for assessing the fetus overall health.[3,4]

DEVELOPMENTAL SIGNIFICANCE OF PLACENTAL THICKNESS: Placental thickness serves as a marker of placental maturity and functionality. The placenta's role in nutrient and gas exchange is vital for fetal development, and its growth pattern is an indicator of this functional capacity. Our study's observation that placental thickness increases with gestational age until a plateau or slight decrease toward term aligns with the biological understanding that the placenta adapts its structure to meet the evolving needs of the growing fetus. The changes in placental thickness throughout gestation can be indicative of placental health and efficiency. A deviation from the normal growth curve could signal potential complications such as placental insufficiency or intrauterine growth restriction (IUGR), thus providing a crucial diagnostic tool within obstetric care.[5,6] Our study focused on evaluating the efficacy of fetal kidney length and placental thickness as reliable indicators for estimating gestational age.

THE KEY FINDINGS OF THIS RESEARCH ARE: A strong positive correlation was consistently observed between fetal kidney length and gestational age across the second and third trimesters. This suggests that as the fetus develops, kidney size could be used as a significant predictor of how far along the pregnancy is. Similar to fetal kidney length, placental thickness demonstrated a clear and predictable increase with advancing gestational age. Our results

indicated that the growth pattern of the placenta correlates well with standard gestational timelines, particularly up to the 34th week, after which the increase in thickness tends to plateau or slightly decrease. When compared with traditional biometric parameters such as biparietal diameter and femur length, both fetal kidney length and placental thickness showed equal or superior capabilities in certain cases. This was particularly evident in later stages of pregnancy, where traditional methods may become less reliable. Our study's results align well with existing literature while also contributing new insights into the use of fetal kidney length and placental thickness as indicators of gestational age.

FETAL KIDNEY LENGTH (FKL): Consistent with findings from Joshi et al. (2021), our study found a strong correlation between fetal kidney length and gestational age, particularly in the second and third trimesters. Both studies emphasize the potential of FKL as a reliable marker for fetal development. However, our study extends these findings by comparing FKL not only to traditional measurements but also to newer biometric indices, reinforcing its reliability across various stages of pregnancy.21 Studies like that of Kumar et al. (2013) and Gayam et al. (2018) also highlighted the progressive increase in kidney length with gestational age. Our findings corroborate these observations, suggesting a broader applicability and potential for standardization in clinical settings.[7,8]

PLACENTAL THICKNESS:
The positive correlation between placental thickness and gestational age reported in our study mirrors the conclusions drawn by Ranjan et al. (2021) and Basnet and Adhikary (2020), where placental thickness was identified as a progressive marker aligning with gestational advancement.[9,10] Our results further solidify the use of placental thickness measurements up to the 34th week, providing a practical timeline for its reliability. Unlike Pant and Dashottar (2017), who observed a marginal decrease in placental thickness beyond 35 weeks, our study found this decrease to be slightly more pronounced, suggesting variability that could be explored further in subsequent studies. This discrepancy may be attributed to differences in measurement techniques, population demographics, or sample size.[11] Comparison with Standard Biometric Parameters: Similar to findings from Tawfik et al. (2021), our results demonstrate that when combined with other biometric parameters, FKL and placental thickness enhance the accuracy of gestational age estimation.[12] This supports the notion of integrating these measurements into routine prenatal assessments, as also suggested by Kumar et al. (2021).[13] The findings from our study on the use of fetal kidney length (FKL) and placental thickness as indicators for estimating gestational age have substantial implications for clinical practices in prenatal care. Incorporating fetal kidney length (FKL) and placental thickness measurements into prenatal care can significantly improve gestational age estimation, crucial for scheduling timely prenatal tests like screenings for chromosomal abnormalities. These measurements enhance fetal health monitoring, allowing early detection of conditions such as fetal growth restriction or placental insufficiency, prompting timely medical interventions. They also aid in managing high-risk pregnancies and meticulously planning the timing of delivery to prevent complications such as premature birth. Furthermore, the accessibility of ultrasound technology enables the use of these measurements in both high-resource and low-resource settings, standardizing the assessment of fetal growth globally. Training for healthcare providers is essential for accurate measurement and interpretation, while ongoing research could lead to further innovations, such as software that automatically calculates gestational age, enhancing prenatal care efficiency.

CONCLUSION:

In conclusion, the study's results confirm the efficacy of using fetal kidney length (FKL) and placental thickness measurements as reliable indicators for estimating gestational age. These ultrasound measurements have proven accurate in a diverse sample, enhancing the potential for widespread application in prenatal care. By enabling precise gestational age estimation, these biometric parameters can improve the timing of prenatal interventions, potentially reducing the risk of premature births and optimizing neonatal outcomes. The findings highlight the importance of integrating these measurements into routine prenatal screening protocols, suggesting that they could significantly enhance the quality and effectiveness of maternal and fetal health management. Despite challenges such as measurement variability due to operator dependency and the limitations of a cross-sectional study design, the study's impact is potentially transformative, particularly in settings where access to advanced prenatal care technologies is limited. Moving forward, further research should focus on longitudinal studies to track these measurements over time and refine the methodology to reduce variability and increase the reliability of these crucial prenatal assessments

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