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Placental Thickness, Trans-Cerebellar Diameter and Foetal Kidney Length as Parameters for Gestational Age Estimation in Normal Singleton Pregnancies: A Prospective Observational Study

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Abstract

Background: Accurate estimation of gestational age (GA) is fundamental to optimal obstetric care. Conventional ultrasound parameters such as biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) may be affected by fetal growth variations and presentation. Novel sonographic parameters including placental thickness (PT), transcerebellar diameter (TCD), and fetal kidney length (FKL) have shown promise as reliable indicators of gestational age.

Objectives: To evaluate the accuracy of placental thickness, transcerebellar diameter, and fetal kidney length individually and as a composite parameter for estimation of gestational age in normal singleton pregnancies, and to compare them with conventional sonographic parameters.

Materials and Methods: This prospective observational study was conducted in the Department of Radiodiagnosis, Gandhi Medical College and associated Hamidia Hospital, Bhopal, from May 2023 to November 2024. Pregnant women with normal singleton

pregnancies and reliable last menstrual period (LMP) were included. Ultrasonographic measurements of PT, TCD, FKL, and conventional parameters (BPD, HC, AC, FL) were obtained. Gestational age estimates were compared with LMP-based gestational age using correlation and regression analysis.

Results: Placental thickness, transcerebellar diameter, and fetal kidney length demonstrated strong positive correlations with gestational age ($p < 0.001$). Among the novel parameters, TCD showed the highest correlation with gestational age, followed by FKL and PT. Composite gestational age derived from novel parameters showed excellent agreement with LMP-based gestational age and conventional sonographic estimates, with minimal mean difference.

Conclusion: Placental thickness, transcerebellar diameter, and fetal kidney length are reliable sonographic parameters for gestational age estimation. Transcerebellar diameter emerged as the most accurate single parameter. A composite model using these novel parameters can serve as a valuable adjunct or alternative to conventional biometric indices, especially in situations where standard parameters are unreliable.

Keywords: Gestational age; Placental thickness; Transcerebellar diameter; Fetal kidney length; Obstetric ultrasound

Introduction

Gestational age estimation is a cornerstone of obstetric management, influencing antenatal surveillance, timing of interventions, and perinatal outcome assessment. Traditionally, gestational age is calculated using the first day of the last menstrual period (LMP) and corroborated by ultrasound biometry. However, inaccuracies in LMP recall, irregular menstrual cycles, and biological variability in fetal growth limit the precision of these methods. Ultrasound biometry using BPD, HC, AC, and FL is widely accepted, yet these parameters may be affected by fetal head molding, growth restriction, macrosomia, or abnormal fetal presentation. Consequently, there is growing interest in alternative sonographic markers that demonstrate consistent growth patterns and minimal inter-observer variability. Placental thickness reflects placental growth and maturation, which parallels fetal development. Transcerebellar diameter represents cerebellar growth, a structure relatively resistant to growth disturbances. Fetal kidney length increases steadily throughout gestation and is less influenced by fetal growth abnormalities. These characteristics make PT, TCD, and FKL promising candidates for gestational age estimation. This study evaluates the role of these novel parameters individually and collectively, and compares their performance with conventional ultrasound measurements in normal singleton pregnancies.

Materials and Methods

Study Design and Setting

Prospective observational study conducted at the Department of Radiodiagnosis, Gandhi Medical College and associated Hamidia Hospital, Bhopal.

Study Duration

May 2023 to November 2024.

Study Population

A total of 180 pregnant women with normal singleton pregnancies between first and third trimester were included.

Inclusion Criteria

- Normal singleton pregnancy
- Reliable last menstrual period
- Gestational age between first and third trimester
- Willingness to participate in the study

Exclusion Criteria

- Multiple pregnancies

- Congenital fetal anomalies
- Maternal systemic illness affecting fetal growth
- Placental abnormalities

Ultrasound Technique

Ultrasound examinations were performed using high-resolution real-time ultrasound machines with a curvilinear transducer(3.5–5 MHz). All measurements were obtained following standard guidelines.

- Placental Thickness (PT): Measured in millimeters at the level of umbilical cord insertion, perpendicular to the uterine wall.
- Transcerebellar Diameter (TCD): Measured as the maximum transverse diameter of the cerebellum in the posterior fossa view.
- Fetal Kidney Length (FKL): Measured as the maximum longitudinal length of the kidney in the sagittal plane.
- Conventional Parameters: BPD, HC, AC, and FL measured using standard techniques.

Statistical Analysis

Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation. Pearson correlation coefficient was used to assess correlation between sonographic parameters and gestational age. Regression analysis was performed to derive predictive equations. A p-value < 0.05 was considered statistically significant.

Results

Table 1: Distribution of patients according to maternal age

Age Group (years)	Number (n)	Percentage
<20	18	10.0%
21–25	72	40.0%
26–30	63	35.0%
>30	27	15.0%

Table 2: Descriptive statistics of novel sonographic parameters

Parameter	Mean ± SD
Placental Thickness (mm)	32.4 ± 4.6
Transcerebellar Diameter (mm)	28.9 ± 6.8
Fetal Kidney Length (mm)	34.1 ± 5.9

Table 3: Correlation of sonographic parameters with gestational age

Parameter	Correlation Coefficient (r)	p-value
Placental Thickness	0.881	<0.001
Transcerebellar Diameter	0.972	<0.001
Fetal Kidney Length	0.946	<0.001

Table 4: Comparison of gestational age estimates

Method	Mean Difference from LMP (weeks)
Conventional parameters	0.4 ± 1.2
Composite novel parameters	0.2 ± 0.9

Discussion

Accurate gestational age estimation remains challenging, particularly in late pregnancy and in cases with uncertain LMP. The present study demonstrates that placental thickness, transcerebellar diameter, and fetal kidney length correlate strongly with gestational age, supporting their role as reliable sonographic markers. Transcerebellar diameter showed the highest correlation with gestational age, consistent with previous studies reporting its relative resistance to growth disturbances. Fetal kidney length also demonstrated a steady linear relationship with gestational age, while placental thickness reflected placental maturation and fetal growth. The composite gestational age derived from novel parameters further improved accuracy, suggesting that a multi parametric approach may overcome limitations of individual measurements. These findings are in agreement with previously published literature and highlight the clinical utility of these parameters, particularly when conventional indices are unreliable.

Clinical Implications

- Useful in cases with uncertain LMP

- Reliable in fetal growth restriction or abnormal presentation
- Adjunct tool to conventional biometric parameters
- Potential role in screening for placental and fetal anomalies

Strengths and Limitations

Strengths: Prospective design, inclusion of multiple novel parameters, comparison with conventional indices.

Limitations: Single-center study and exclusion of high-risk pregnancies.

Conclusion

Placental thickness, transcerebellar diameter, and fetal kidney length are reliable sonographic parameters for gestational age estimation in normal singleton pregnancies. Transcerebellar diameter is the most accurate single marker. A composite model using these parameters provides excellent agreement with established methods and can serve as a valuable adjunct in routine obstetric practice.

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