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ORIGINAL ARTICLE

Accuracy of Fetal Kidneys Measurement in Estimation of Gestational Age

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Abstract

Background: ***Preterm birth is a major contributor to infant death, and one of the most effective ways to manage pregnancy timing and reduce perinatal mortality is through gestational age (GA) assurance. The fetal kidney length allows for determining the GA with a single metric, which greatly simplifies the process.***

Aim and objectives: ***To assess the precision of fetal kidney measurements in determining GA.***

Patients and methods. ***This prospective research was done among 100 women attending the Obstetrics and Gynecology Department for Antenatal Care at El Hussein University Hospital and Etai El Baroud General Hospital. The study duration was from February 2021 to August 2022.***

Result: ***While there was a positive association between the mean fetal kidney length and the other factors (age, height, BMI, gravidity, parity, and the number of abortions), the mean fetal kidney length did not vary substantially from the other variables. Contrasting the estimated gestational ages from fetal kidney measures to the LMP gestational ages showed no substantial distinction.***

Conclusion: ***The length of the fetal kidneys is associated positively with FGA and has a high correlation coefficient, indicating high levels of agreement and consistency among measurements.***

Keywords: Fetal kidneys; gestational age; pregnancy

1. Introduction

Successful prenatal care, planning, and managing all pregnancies depend on an exact assessment of GA. Preeclampsia, intrauterine growth retardation, and gestational diabetes mellitus are examples of high-risk pregnancies that have already been scheduled to terminate, with the GA being considered. Using an incorrect GA estimate can lead to iatrogenic preterm or postmaturity, which in turn increases the risk of perinatal mortality and morbidity. [1]

The GA calculation has made use of a plethora of parameters. Birth weight (GA) is estimated using ultrasound measurements such as the following: first menstrual period (LMP) date, gestational sac volume and diameter, crown-rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), and fetal kidney length.[2]

The kidney is a component of the urinary system and is a very important organ in the body. Sonography's ability to determine a kidney's length allows for detecting renal abnormalities. Early kidney development is detectable as early as 14 weeks of pregnancy. During the later stages of pregnancy, the kidney becomes more easily visible because the fat around it has increased echogenicity, creating space between the kidney and the surrounding soft tissues.[3]

The fetal kidney has been proven to expand normally, at a rate of 1.7 mm per two weeks, during pregnancy. Sixty percent of nephrons form during the third trimester, and their number stops increasing after 36 weeks of pregnancy.[4]

Improved fetal and maternal care, as well as fewer complications after birth, results from more precise estimates of gestational age. It is the only way to avoid intervening too soon or too late during a critical situation.[5]

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From 20 weeks of pregnancy[6], all pregnant women are required to have routine biometric ultrasound measurements taken involving the baby's biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femoral length (FL), and fetal weight. However, late in pregnancy, these measurements are often inaccurate due to technical difficulties, intrauterine growth retardation, or complications. Daily use, especially toward the end of the third trimester, revealed a large variation in these parameters.[7]

A technical problem makes FKL assessments more reliable in late pregnancy. Although the kidneys and suprarenal glands share a similar echogenicity and possibly inspirable appearance in the first two trimesters of pregnancy, by the eighth month of pregnancy, the perinephric fat has become more visible, allowing for a clear demarcation between the kidneys and surrounding structures.[8]

This study aimed to assess the precision of fetal kidney measurements in determining GA.

2. Patients and methods

This was prospective research conducted on 100 women attending the Obstetrics and Gynecology Department for Antenatal Care at El Hussein University Hospital and Etai El Baroud General Hospital from February 2021 to August 2022.

2.1.Inclusion criteria: Pregnant cases who were certain of their LMP, Women who had prior regular menstrual cycles, pregnant women who were experiencing no problems, and women between 28 and 40 weeks of gestation.

2.2.Exclusion criteria: polyhydramnios, oligohydramnios, indistinct adrenal or renal boundaries, gestational diabetes, preeclampsia, multiple pregnancies, fetal abnormalities, renal malformations, intrauterine growth restriction, and multiple pregnancies

2.3.Sample Size (n):

This study is based on the study carried out by According to KAHSAY et al., the following assumptions were used for calculating the sample size using Epi Info STATCALC: The study was conducted with a margin of error of 5% and a power of 80%, using a two-sided confidence level of 95%. Epi-Info output a maximum sample size of 89 in the end.

Therefore, the sample size was augmented to include 100 cases to account for any dropout throughout the follow-up period. [9]

$$\left(\frac{Z_{a/2} + Z_B}{P_1 - P_2}\right)^2 (p_1q_1 + p_2q_2)$$

Takazawa& Morita. [10]

n = sample size

Z a/2 (The crucial number that demarcates the center 95% of the Z distribution)

ZB (The crucial number that demarcates the center 20% of the Z distribution)

p1 = prevalence in case group

p2 = prevalence in control group.

q = 1-p

2.4.Methods

All patients were subjected to the following:

A thorough history was taken, standard antenatal investigations were conducted, a physical examination (gynecological, obstetrical, and maybe local), and a standard ultrasound and kidney exam by Mindray, Toshiba Ultrasound Machine.

2.5.Ethical consideration

Each participant gave their informed verbal agreement, and the research was conducted with the utmost regard for their privacy. The protocol was given the green light by the AL Azhar University Faculty of Medicine's ethical committee.

2.6.Statistical analysis

Data was tabulated and analyzed using SPSS 16 (Spss Inc., Chicago, IL). Categorical data was shown by numbers and percentages. At $P > 0.05$, the Kolmogorov-Smirnov test checked quantitative data for normal distribution. Quantitative data was represented by mean SD, median, and range. The Student "t" test compared normally distributed variables between groups. Spearman's correlation (rho) measured non-parametric variables' correlation. A significance level of 0.05 was chosen in this investigation.

3. Results

Table 1. Age and anthropometric assessments of the researched sample

VARIABLE (N=100)	MEAN ±SD	RANGE
AGE (YEARS)	25.20±5.18	18-37
WEIGHT (KG)	80.42±12.94	55-107
HEIGHT (CM)	164.47±4.50	157-175
BMI (KG/M²)	29.76±4.95	22-38

This table demonstrated that the average age (25.20±5.18) years, weight (80.42±12.94) kg, height (164.47±4.50) cm, and BMI (29.76±4.95) (kg/m2) Table 1

Table 2. Gestational age by the LMP method

VARIABLE		
GESTATIONAL AGE (W)	Mean ±SD	34. 30±3.63
	Range	(28w-37.57w)

This table demonstrated that the average GA was 34.30±3.63 (w). Table 2

Table 3. Biometric measures of the fetuses and their estimated GA

VARIABLE (N=100)	MEAN ±SD	RANGE
BPD (MM)	85.53±3.77	77.8-92.1
HC (MM)	310.28±12.77	285 – 332
AC (MM)	307.07±18.04	268 – 338
FL (MM)	67.10±3.77	60.4 – 74.3
TCD (MM)	48.30±3.88	40.9 – 54.4
MEAN FETAL KIDNEY LENGTH (MM)	39.74±1.59	36.3 – 42.5

This table showed that the mean of BPD (mm) was (85.53±3.77), HC (mm) (310.28±12.77), AC (mm) (307.07±18.04), and FL (mm) (67.10±3.77), TCD (mm) was (48.30±3.88), and the mean fetal kidney length (mm) was (39.74±1.59). Table 3

Table 4. Analyzing the estimated GA against the LMP GA

VARIABLE (N=100)	MEAN ±SD	RANGE	T. TEST	P. VALUE
LMP GA	34. 30±3.63	28w-37.57w		
BPD GA (W)	34.45±1.65	31.14w-37.42w	0.142	0.707
HC GA (W)	34.57±1.73	31.28w – 37.71w	0.451	0.503
AC GA (W)	34.58±1.74	30.85w – 37.57w	0.484	0.488
FL GA (W)	34.62±1.79	31.28w – 38.00w	0.625	0.430
TCD (W)	34.64±1.83	31.28w – 37.71w	0.700	0.404
MEAN FETAL KIDNEY LENGTH (W)	34.35±1.90	31w – 38w	1.489	0.884

This table demonstrated that there was no discernible discrepancy among the estimated GA and LMP GA. Table 4

Table 5. Average fetal kidney length and its correlations with other factors

WITH	MEAN FETAL KIDNEY LENGTH (MM)	
	R	P value
AGE (YEARS)	.147	.145
WEIGHT (KG)	.233	.020
HEIGHT (CM)	-.034-	.735
BMI (KG/M²)	.234	.019
GRAVIDITY	.125	.215
PARITY	.135	.181
NO OF ABORTIONS	.009	.930
GA LMP (W)	.591	.000
BPD (MM)	.966	.000
BPD GA (W)	.970	.000
HC (MM)	.974	.000
HC GA (W)	.971	.000
AC (MM)	.970	.000
AC GA (W)	.969	.000
FL (MM)	.978	.000
FL GA (W)	.978	.000
TCD (MM)	.983	.000
TCD (W)	.980	.000
MEAN FETAL KIDNEY LENGTH (W)	.993	.000

R→ Pearson's correlation

This table showed there was a positive link among the other factors and the mean fetal kidney length, while there was no substantial distinction among the mean fetal kidney length and age.

height, BMI, gravidity, parity, and number of abortions). Table 5

Table 6. Comparing the predicted gestational ages based on fetal kidney measurements and LMP GA

VARIABLE (N=100)	MEAN ±SD	RANGE	T.TEST	P.VALUE
LMP GA (W)	34.30±3.63	28w-37.57w		
PREDICTED GA USING MEAN LENGTH OF BOTH FETAL KIDNEYS (W)	34.35±1.90	31w – 38w	1.489	0.884

This table showed that there was no substantial variance in comparing the predicted gestational ages based on fetal kidney measurements with the LMP gestational age. Table 6

4. Discussion

Improvements in fetal and maternal care and a decrease in postnatal complications can be attributed largely to more precise estimates of GA. It is the only method to prevent unnecessary or premature medical procedures and determine when they are needed. [5]

The current research confirms a favorable association between the average fetal kidney length and GA LMP.

This aligns with the goals of Abdelrazek et al., who sought to determine how to minimize maternal and fetal mortality. This research aimed to prospectively analyze the accuracy of the FKL US assessment for estimating GA in the third trimester. They discovered a robust statistical relationship between GA and kidney length on average. Women who have either forgotten their LMP or have an erroneous one may benefit from a novel approach that uses FKL as a single measurement to estimate their GA with a standard error of 6.4 days. [11]

From 20 weeks until term, Peter et al. calculate FKL as a parameter, and their results are roughly as stated before (r = 0.974, P 0.001). [8]

In this research, we discovered that the mean fetal kidney length and weight were positively correlated.

Contrary to the outcomes of Cohen et al. and Nahid et al., maternal weight was correlated with FKL in our research. This investigation is prospective cross-sectional research on an African population, while the previous work by Nahid et al. was prospective longitudinal research on an Asian population. [12, 13]

This research demonstrated that the average length of a fetus's kidneys did not differ substantially from the average height.

Nahid et al. found no significant association between maternal height and FKL in their prospective longitudinal investigation among an Asian population, which is consistent with our findings. [13]

This agrees with what Edevbie and Akhigbe found; they found no correlation between MKL and maternal height (r = 0.072, P = 0.153). [14]

Mean fetal kidney length was positively correlated with BPD, GA, HC, HC GA, AC, AC GA, FL, and FL GA.

This is consistent with what was expected by BPD, HC, FL, and AC and what was found by Edevbieand Akhigbe, namely a highly positive and substantial relationship among MKL in millimeters and GA in weeks.[14]

This research confirms the findings of numerous previous studies by showing that MKL, measured in millimeters, correlates positively and considerably with GA, measured in weeks, as expected by BPD, HC, FL, and AC.[15, 16]

This research revealed that there is no substantial variance when contrasting computed Ga to LMP GA.

LMP GA = (36.5±2.6), BPD GA = (36.0±2.72), HC GA = (35.8±2.70), AC GA = (35.5±2.9), and FL GA = (36.5±2.73) compared to projected LMP GA using various factors. These findings suggest that fetal kidney length is the best GA indicator.[17]

4. Conclusion

The length of the fetal kidneys correlates positively with FGA and has a high correlation coefficient, indicating high levels of agreement and consistency among measurements.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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