

Determination of Gestational Age by Ultrasonographic Measurement of Fetal Kidney Length during Third Trimester of Pregnancy

Thesis

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List of Abbreviations

Abb.	Full term
AC	Abdominal circumference
AP	Anteroposterior
bHCG	Beta-human chorionic gonadotropin
BPD	Biparietal diameter
CA	Conceptional age
CI	Cephalic index
CRL	Crown–rump length
EDD	Expected date of delivery
FKL	Fetal kidney length
FL	Femur length
GA	Gestational age
HC	Head circumference
hCG	Human Chorionic Gonadotropin
LMP	Last menstrual period
MFKL	Mean fetal kidney length
SPSS	Statistical Package for the Social Sciences
X²	Chi square test

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ABSTRACT

Background: Gestational age assessment from bi-parietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), though most commonly used might be inaccurate in late pregnancy, especially when a pregnant woman can't recall her last menstrual period. They also varies with underlying medical conditions and shows potential discrepancies especially in late trimesters. Fetal kidney length is characterized by a constant growth as 1.7 mm fortnightly throughout pregnancy and isn't changed with growth problems.

Objectives: To assess the accuracy of MFKL measurement in calculating the gestational age in the third trimester.

Patients and Methods: The study included a number of 112 pregnant women with singleton pregnancy between 28-40 weeks who are sure of the dates of their first day of last menstrual period with no associated risk factors, they were subjected to routine ultrasonography including measuring of various biometric parameters as fetal head circumference, femur length, abdominal circumference, biparietal diameter along with mean fetal kidney length. A separate gestational age will be calculated from multiple biometric indices BPD, HC, AC and FL using normogram by Hadlock et al. Gestational age will be calculated from MFKL using normograms by Cohen et al.. These values will be compared with actual GA derived from actual dates.

Results: According to the current study, fetal kidney length and the other biometric indices showed strong positive correlation ($P < 0.001$) with the clinical gestational age in the third trimester but best correlation was found to be with FKL with a correlation coefficient of 0.994 when compared with other parameters like BPD ($r=0.981$), HC ($r=0.981$), AC($r=0.987$), FL ($r=0.993$).

Conclusion: Kidney length can be used as an individual parameter in estimating gestational age, especially in later trimesters.

Keywords: pregnancy, kidney length, ultrasound, Gestational age



PROTOCOL OF A THESIS FOR PARTIAL FULFILMENT OF MASTER DEGREE IN OBSTETRICS & GYNECOLOGY

Title of the Protocol: Determination of Gestational Age by Ultrasonographic Measurement of Fetal Kidney Length During Third Trimester of Pregnancy

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What is already known on this subject? AND What does this study add?

Gestational age assessment from bi-parietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), though most commonly used might be inaccurate in late pregnancy, especially when a pregnant woman can't recall her last menstrual period. They also varies with underlying medical conditions and shows potential discrepancies specially during assessment of gestational age in third trimester. Fetal kidney length has been shown a steady growth as 1.7 mm fortnightly throughout pregnancy and is unaffected by growth abnormalities. So This study will evaluate the accuracy of mean fetal kidney length measurement in determining the gestational age in third trimester.

1. INTRODUCTION/REVIEW

An accurate age of fetus plays a pivotal role in obstetric care. Uncertain dates and no assigned ultrasound date in early trimester poses a dilemma in management decision leading to iatrogenic pre or post-maturities. In high risk pregnancies like preeclampsia, IUGR, GDM, planning termination of pregnancy due to complications or to plan for fetal investigations or therapy requires an accurate gestational age (*Shivalingaiah et al., 2014*).

Even if menstrual history is correct, the exact time of ovulation, fertilization, and implantation cannot be known. Women may undergo several "waves" of follicular development during a normal menstrual cycle, which may mean ovulatory inconsistency during any given cycle. Sperm may survive for 5 to 7 days in the female reproductive tract, a "known" conception date is therefore not completely reliable. Recent studies suggest the ovulation-to-implantation duration can vary by as much as 11 days, and this may affect fetal size and growth (*Butt et al., 2014*).

Even in women who are certain of menstrual dating, delayed

ovulation is an important cause of perceived prolonged pregnancy and is more likely to occur than early ovulation. Some authors have suggested that 282 days should be used instead of 280 to improve dating accuracy, since it is more likely that women will ovulate later rather than earlier than predicted. All of these factors conspire to make it difficult to accurately predict gestational age based on menstrual history (*Butt et al., 2014*).

In routine ultrasonography the ultrasonologist measures the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) in estimating the gestational age (GA) and estimated date of delivery (*Gupta et al., 2013*). However as the pregnancy advances these parameters become increasingly unreliable in prediction of GA. Therefore accurate estimation of GA in late 2nd and 3rd trimester still remains problem (*Kaul et al., 2014*).

Fetal kidney length has been shown a steady growth as 1.7 mm fortnightly throughout pregnancy and is unaffected by growth abnormalities. Various studies have reported that fetal kidney length (FKL) strongly correlates with the gestational age in third trimester (*Toosi et al., 2013*). Fetal kidney is easy to identify and measure but has not been studied extensively as a biometric index for gestational age estimation, although ultrasound textbooks often have tables, of different dimensions (*Goyal et al., 2016*).

2. AIM OF WORK

The aim of this study is to assess the accuracy of the gestational age estimated by MFKL compared to multiple growth parameters like BPD, HC, AC & FL and the actual gestational age derived from the reliable last menstrual period.

Research Hypothesis

In pregnant women in the third trimester, MFKL may be as accurate as multiple growth parameters in predicting the fetal gestational age.

Research Question

In pregnant women in the third trimester, does MFKL predict gestational age accurately as multiple growth parameters

3. METHODOLOGY

Type of the study:

Cross sectional hospital based study for new diagnostic test.

Study setting:

The study will be conducted at ultrasound unit; department of Obstetric and gynecology, Faculty of Medicine, Ain Shams University.

Study population:

The present study will be conducted on a total of 112 antenatal patients in their 3rd trimester over a period of about six months.

The selected patients will fulfill the following criteria:

- All women with singleton pregnancies in the third trimester (28 to 40 weeks).
- women who are sure of the dates of their last menstrual period (1st day) cycles should be regular at least 3 months before pregnancy.
- Normal antenatal pregnant women with no associated risk factors.

Exclusion criteria:

- Patients with high risk pregnancies such as preeclampsia, fetal growth restriction (FGR), macrosomia, oligohydramnios, and polyhydramnios.
- Pregnant women with unknown dates.
- Diabetic mothers.
- Multiple pregnancies.
- Fetal Renal anomalies or known case of renal anomalies.

- Obscured adrenal and renal borders or margins.
- Gross maternal obesity.

Sample size calculation:

Sample size was calculated using PASS[®] version 11 program, setting the type-1 error (α) at 0.05 and the power ($1-\beta$) at 0.9. Results from a previous study (*Manasvi et al., 2015*) showed that there was a strong positive correlation between GA and MFKF ($r=0.714$). Calculation according to these values produced a **minimal** sample size of 30 cases however, a sample of 112 cases will be recruited to detect a correlation between this two variable with lower correlation coefficient($r=0.35$).

METHODS:

All pregnant women in third trimester attending antenatal care clinic will be subjected to routine ultrasonography including measuring of various biometric parameters mean fetal kidney length along with fetal head circumference, femur length, abdominal circumference and biparietal diameter will be measured.

A separate gestational age will be derived from multiple parameters BPD, HC, AC and FL using normogram by Hadlock et al.

The fetal kidney length will be measured. Fetus will be scanned in the transverse plane until the kidneys are visualized just below the stomach. The probe will be rotated through ninety degrees to outline the longitudinal axis of the kidney. Kidney length will be measured from upper pole to lower. Both the left and right kidney will be taken and the average will be calculated. Generally, fetal kidney identification before 17 weeks may be very difficult for a routine sonographer, so we will select our cases beyond 28 weeks when fetal kidney evaluation is clear

Gestational age will be calculated from mean fetal kidney length using normograms by *Cohen et al. (1991)*.

These values will be compared with actual gestational age derived from actual dates taken as a standard.

Ethical considerations:

The information collected out in this study, as regard the conduct, evaluation and documentation of this study, will be designed to ensure that the investigators apply the principles of good clinical practice and the ethical principles laid down in the current revision of the Declaration of Helsinki for Ethical Medical Research [last updated in Korea, 2008]. This study will be presented to Ethical Committee of Ain Shams University.

Statistical package and statistical Analysis:

The collected data will be revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (**SPSS 15.0.1 for windows; SPSS Inc, Chicago, IL, 2001**). Pearson correlation coefficient will be used to detect linear relationship between numerical variables. Univariate and multiple linear regression analyses were performed to estimate beta coefficients. R^2 will be calculated to show the effectiveness of a model. P - value < 0.05 will be considered statistically significant.

Informed consent forms:

Patient must consent to participate after explaining the nature, scope, and possible consequences of the clinical study in an understandable form to her.

An informed consent document, in Arabic language, contains all locally required elements and specifies who informed the patient. After reading the informed consent document, the patient will give consent in writing by the personally dated signature of the patient.

If the patient is unable to read, oral presentation and explanation of the written informed consent form and information to be supplied to patients must take place in the presence of an impartial witness. Consent will be confirmed at the time of consent orally and by the personally dated signature of the patient or by a local legally recognized alternative (e.g., the patient's thumbprint or mark).

The original signed consent document was be retained by the investigator.

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