Fetal Kidney Length: for Accurate Determination of Gestational Age in the Second Half of Pregnancy

Thesis

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By

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Mohamed Salah Ahmed Hassaan

Dedication

To:

My Parents, Sisters

for their endless love, support,

and continuous care

My Wife

&

My Daughter (Berry Mohamed Salah)

List of Contents

Title	Page No.
List of Tables	6
List of Figures	8
List of Abbreviations	10
Protocol	- 1 -
Review of Literature	
▪ The Significance and Importance of Accurate Gestational Age Estimation of the Fetus	19
▪ Various Methods of Gestational Age Estimation	29
▪ Development of Kidney & Correlation between Fetal Kidney Length and Gestational Age	48
Patients and Methods	70
Results	77
Discussion	94
Limitations of the Study	99
Summary	100
Conclusion	103
Recommendations	104
References	105
Arabic Summary	

List of Tables

Table No.	Title	Page No.
Table (1):	Average Bi-parietal Diameter in Relation to weeks of pregnancy	41
Table (2):	Femur Length Measurement Relative to Gestational Age.	44
Table (3):	Mean Fetal Kidney Length between 18 weeks and 38 weeks of Gestation	46
Table (4):	Weight & Dimensions of the fetal kidneys (mean ± SD)	60
Table (5):	The ratio between kidney weight and body weight (mean ± SD)	61
Table (6):	Fitted centiles of the size fetal kidney length, anteroposterior diameter and transverse diameter with the number of fetuses for exact weeks between 16 and 42 weeks of gestational age (GA)	63
Table (7):	Kidney length	66
Table (8):	Measurements of fetal right and left kidney length and width based on gestational age weekly in normal pregnancies	68
Table (9):	Mean kidney length and width in male and female fetuses	69
Table (10):	Demographic data of the studied cases	77
Table (11):	Gestational age by weeks among the studied cases	79
Table (12):	Comparison between mean GA by fetal kidney length and mean GA by hadlook criteria in each menstrual age week	80

List of Tables cont...

Table No.	Title	Page No.
Table (13):	Comparison between mean GA by kidney length and mean GA by Hadlock criteria in all weeks (26 – 38 weeks)	82
Table (14):	Comparison between mean GA by kidney length and BPD in each menstrual age week	83
Table (15):	Comparison between mean GA by kidney length and HC in each menstrual age week	85
Table (16):	Comparison between mean GA by kidney length and AC in each menstrual age week	87
Table (17):	Comparison between mean GA by kidney length and FL in each menstrual age week	89
Table (18):	Comparison between Rt. and Lt. kidney length in each week in correlation to gestational age.	91
Table (19):	Comparison between gestational age of both male and female fetuses by fetal kidney length in each week.	92
Table (20):	Time of fetal kidney measurement / whole procedure among the studied cases	93

List of Figures

Fig. No.	Title	Page No.
Figure 1:	Crown Rump Length	39
Figure 2:	Measurement of femur length	43
Figure 3:	Reference charts of kidney length	45
Figure 4:	Kidney length measurement	47
Figure 5:	Stages of kidney development: Pronephros, mesonephros, metanephros.	50
Figure 6:	Pronephros in kidney development.	51
Figure 7:	Mesonephros in kidney development.	52
Figure 8:	Metanephros in kidney development.	53
Figure 9:	Development of Nephron	54
Figure 10:	Development of the Collecting System	55
Figure 11:	Collecting system in kidney.	56
Figure 12:	Development of kidney	57
Figure 13:	Fetal kidneys; 1 first trimester. 2 Second trimester. 3 Third	60
Figure 14:	Charts of kidney length (a), kidney anteroposterior (AP) diameter (b), kidney transverse diameter (c), renal pelvis AP diameter (d), adrenal gland j length (e) and kidney volume (f), showing raw data and fitted 5th, 50th and 95th centiles	64
Figure 15:	Relationship between mean kidney Length (nun) and gestational age	67
Figure 16:	Gender of fetus distribution among the studied cases	78

List of Figures cont...

Fig. No.	Title	Page No.
Figure 17:	Parity among the studied patients	78
Figure 18:	Comparison between mean GA by kidney length and mean GA by hadlook criteria in each menstrual age week	81
Figure 19:	Comparison between mean GA by kidney length and BPD in each menstrual age week	84
Figure 20:	Comparison between mean GA by kidney length and HC in each menstrual age week.	86
Figure 21:	Comparison between mean GA by kidney length and AC in each menstrual age week	88
Figure 22:	Comparison between mean GA by kidney length and FL in each menstrual age week	90

List of Abbreviations

Abb.	Full term

AC ..... Abdominal circumference
ANC ..... Antenatal care
B-HCG ..... Beta Human Chorionic gonadotropins
BPD..... Biparietal diameter
CA ..... Conceptional age
Cf-fDNA..... Cell free fetal DNA
DM ..... Diabettes mellitus
EDD ..... Expected date of delivery
EFW..... Estimated fetal weight
FL..... Femur length
FW..... Fetal weight
FKL…….Fetal Kidney Length
GA ..... Gestational age
HC..... Head circumference
HTN ..... Hypertension
IUGR..... Intrauterine growth restriction
LGA..... Low for gestational age
LMP ..... Last menstrual period
Rh-ve ..... Rhesus factor negative
SE(est)..... Standard error of the estimate
SFH..... Symphsio fundal height
SGA..... Small for gestational age

PROTOCOL

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

An accurate estimation of foetal gestational age is of utmost clinical significance owing to its vast clinical implications principally in management of high risk pregnancies. Assessment of the gestational age (GA) is essential in prenatal medicine to predict fetal health and labor dating. Errors in determining the exact GA may interfere with critical management decisions, such as in preterm labor as well as growth disorders that is considered the leading cause of neonatal morbidity and mortality. This research will study a new parameter for accurate gestational age estimation in third trimester of pregnancy which is the fetal kidney length.

1. INTRODUCTION/ REVIEW

Accurate GA estimation is very important to an obstetrician for diagnosis of growth disorders, in assessment of wrong dates or forgotten dates and timing of delivery either by induction or caesarean section

The first & foremost duty of an obstetrician is to date the pregnancy as early as possible during the antenatal period. An accurate estimation of gestational age is fundamental to the management of all pregnancies, especially high-risk pregnancies. In some cases early termination is necessary as soon as fetus becomes mature e.g. severe pre-eclampsia & eclampsia, chronic hypertension, chronic renal disease, severe IUGR, patient with diabetes, central placenta previa, sensitized Rh-Ve mother etc. Accurate estimation of gestational age is also necessary to obtain materials for different tests as well as to interpret the results of these tests ***(Pernoll et al., 1994).***

Failure can result in iatrogenic prematurity or post maturity, or both of which are associated with increased perinatal morbidity & mortality. Initially, dating of pregnancy was based on the first day of the last menstrual period (LMP). In a regular 28-day menstrual cycle. But this method for dating the pregnancy is falling in those who do not exactly know their menstrual history ***(Kumar et al., 2013).***

Traditionally the duration of pregnancy is calculated in terms of 9 calendar months & 7 days or 40 weeks or 280 days, calculated from the 1st day of last menstrual period ***(Yusuf et al., 2007).***

Ultrasonographic fetal biometry is the most widespread method used to establish GA. Various sonographic biometric parameters commonly used are Crown Lump Length (CRL), Biparietal diameter(BPD), Head circumference (HC), Abdominal circumference (AC) and Femur length (FL). CRL measurements accurately predict GA to within ± 5-7 days but can be employed only in cases who present in 1st trimester ***(MacGregor 2008).***

In early 2nd trimester BPD, FL, HC andAC can predict GA with fair accuracy (±10-11days, ±10-20 days, ±10-14 days and ±10-14 days respectively.

However as the pregnancy advances these parametersbecome increasingly unreliable in prediction of GA.Therefore accurate estimation of GA in late 2nd and 3rd trimester still remains a problem. Various non-traditionalsonographic parameters for estimating GA are beingstudied like transverse cerebellar diameter, fetal foot length, epiphyseal ossification centers, amniotic fluid volume and placental grading, FKL (Fetal Kidney Length) ***(Gottlieb, 2008).***

Furthermore, there is a substantial evidence that the standard derivation for these indices widen as pregnancy progresses, and this will be even worse if the head is too low or an obvious plane cannot be obtained, which together will mislead the measurement of BPD and HC. Therefore, many researches have been conducted to determine a precise estimation of GA using ultrasonic measurements throughout the second and the third trimester ***(Kaul et al., 2013).***

FKL is one such non-traditional parameter for estimating GA under study. It is easy to identify and measure. It is strongly correlated to GA. It is more accurate method of GA estimation than BPD, FL, HC and AC after 24th week of gestation ***(Cannie et al., 2007).***

There is a similar study that was carried out and the results supported that FKL is an accurate parameter in late pregnancy ***(Toosi et al., 2013).***

The use of all four biometric indices are recommended for all pregnancies beyond 20 weeks for reduction of variabilities. in second trimester BPD,HC,AC AND FL can predict GA with fair accuracy (-/+ 10-14 days). As pregnancy advances these parameters becomes increasingly unreliable in estimation of GA Previous studies have

demonstrated that fetal kidney length (FKL) is a more accurate method of GA estimation than BPD,HC,AC and FL after 24 weeks of gestation ***(Gupta et al., 2013).***

Fetal kidney size can be used in dating labor, especially when accurate LMP is not available as there is a strong correlation between FKL and GA, which can use as an eligible parameter in dating labor. There was a very strong positive correlation between GA and FKL (r= 0.947, *p*=0.001) ***(Ahmadi et al., 2015).***

2. AIM/ OBJECTIVES

Research aim:

The aim of study is to asses the accuracy of fetal kidney length as a new parameter for determination of fetal gestational age at the third trimesters of pregnancy.

Research hypothesis:

In uncomplicated singleton pregnancies fetal kidney length may be as accurate as biparietal diameter, femur length, & abdominal circumference in estimation of gestational age

Research question:

In uncomplicated singleton pregnancies is fetal kidney length accurate in estimation of gestational age?

3. METHODOLOGY:

Subjects and Methods

- **Type of Study:**

prospective cross section study.

- **Study Setting:**

Ain Shams University Maternity Hospital (Special care unit of the fetus)

- **Study Period:**

Expected study duration is from 1-1-2018 to 30-6-2018

- **Study Population**

Inclusion Criteria:

1. Age: 18 – 40 years.
2. Pregnant women with Live singleton pregnancy at third trimester
3. Primigravidas and Multi-paras.
4. Women with no hormonal contraceptions. (3 cycles before pregnancy)
5. Women who are sure with their dates
6. Women with body mass index (19-25).
7. Women with an early pregnancy ultrasound. (for accurate dating)

Exclusion Criteria:

1. Any pregnancy related complications (DM, HTN, IUGR)
2. Multiple pregnancy.
3. Growth restricted fetus or small for gestational age.
4. Macrosomia.
5. Abnormal fetal renal morphology
6. If adrenal or renal borders cannot be clearly visualized.
7. Oligohydraminos.

- **Sample Size:**

The required sample has been calculated using the IBM © sample power © software (IBM© Corp.., Armonk,NY, USA).

A previous study reported that the relation between fetal kidney length and gestational age would achieve a power of 80 % respectively ***(Kaul et al., 2012)*** using 129 pregnant women in which 98 only where included. The same study reported that FKL was the most accurate in estimation of GA as compared to individual parameters.

So it is estimated that a simple size of 140 pregnant women would achieve a power of 90 % (r = 0.9) to asses the relation between fetal kidney length in millimeters and gestational age in weeks in the third trimester of pregnancy.

At the end of research we need 140 pregnant women (10 cases for each week from 26^{th} to 38^{th} week of pregnancy) to reach the final stage of the research.

The required sample size has been calculated using the power analysis and sample size (PASS)Software version 11.0.10 (NCSS, LLC,KAYSVILLE,UTAH).

For quantification of the relation between fetal kidney length and gestational age simple linear regression modeling will be used to estimate the slop (regression coefficient B)

Of regressing the dependent Y (gestational age) on the independent variable X (fetal kidney length).

A previous study reported that the regression coefficient B resulting from regression the gestational age on the fetal kidney length was (r =0.9) ***(Kumar et al.., 2013).***

The accuracy of fetal kidney length was such that the standard error of the estimate (SE) (Standard Error Of Prediction) was ± 8 days.

10 % to be excluded as renal problems & difficult of kidney visualization

- **Ethical Considerations:**

The study got approval from Ethics& Research Committee (ERC), Ob/Gyn department, Faculty of Medicine, Ain Shams University. The clinical research study conducted in accordance with the current approved clinical protocol and relevant policies, requirements and regulations of the Ain Shams University Maternity Hospital.

Consent: All pregnant women will be given informed consent. The investigator made certain that an appropriate informed consent process is in place to insure that potential research objects or their authorized representative are fully informed about the nature and objective of clinical study, the potential risks and benefits of study participation, and their rights as research subject. The investigator will be obtain the written signed informed consent of each subject, or the subjects authorized representative, prior to performing any study specific intervention on the subject. The investigator will retain the original signed informed consent form.

Subject confidentiality: All evaluation forms, reports and other records will not include unique personal data to maintain subject confidentially.

- **Study Interventions**

Pregnant women in between 26 & 38 weeks will be subjected to:

1- Complete history talking (including:

a) Personal, present, past history

b) Menstrual history by *Naegele's rule* which is a standard way of calculating the due date for a pregnancy when assuming a gestational age of 280 days at childbirth. The rule estimates the