

Estimation of Gestational Age from Fetal Kidney Length in the Second and Third Trimester of Pregnancy by Ultrasonography

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Abstract

Objective: The point of this examination was to assess the criticalness of the fetal kidney length (FKL) for the estimation of gestational age. **Method:** A cross sectional study was carried out on 399 pregnant women with singleton pregnancies having no complications at Baloch Hospital Lalian. Pregnant women with single fetuses underwent standard ultrasound fetal biometry. The fetal kidney length measurements were performed from 20th weeks to 38th weeks of gestation. These measurements were used to date the pregnancies. **Results:** A positive linear relationship was found between gestational age (measured by femur length) and length of left kidney. G.A in weeks (measured by femur length) = 25.430+1.912 (Left Kidney in cm) with $R^2=0.939$ and p value=0.000<0.05. Another statistically significant positive linear relationship was found between gestational age (measured by femur length) and length of right kidney. G.A in weeks (measured by femur length) = 13.496+5.727(Right Kidney in cm) with $R^2=0.939$ and p value=0.000<0.05. **Conclusion:** FKL is easy to identify and measure. It is most accurate single parameter for estimating GA than other biometric indices especially in cases when the other parameters like BPD, FL, AC and HC are not reliable for assessing GA in the 2nd and 3rd trimester of pregnancy.

Keywords: Fetal biometry, Gestational age, Fetal kidney and length.

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INTRODUCTION

A correct estimation of the fetal development age is of most outrageous clinical criticalness owing to its gigantic clinical repercussions basically in the officials of high risk pregnancies. During human fetal improvement, the development of the urinary framework shows solitary qualities. Three barely covering kidney structures are molded, two of them will disappear in the midst of the fetal life and the last one will be the unchanging kidney [1]. The pronephros, the first kidneys, are framed toward the start of the fourth seven day stretch of advancement and vanish toward the finish of that week. They are simple and non-functional. The second ones, the mesonephros, appear in the midst of the back side of pronephros.²Before the completion of the eighth week they degenerate in the females. In humans some caudal tubules and the mesonephric conduit persevere and take part in the development of the genital framework [3]. The metanephros appears after the fifth week as the last period of kidney enhancement, showing an incredibly

made excretory limit [4]. Risk factors of high risk pregnancies like eclampsia, pre-eclampsia, gestational diabetes mellitus (GDM), placenta previa, Rh logical inconsistency, intrauterine improvement obstruction and unending renal illness, end of pregnancy is unpreventable once the fetus accomplishes its advancement, in occasions of any surprising complexities. A large portion of the ultrasound-based screening tests, biochemical tests, serological tests are being passed on at a particular gestational age, in the mid of pregnancy [5]. Expected date of delivery (EDD) estimation dependent on last menstrual period has its very own arrangement of constraints prompting false computations like asymmetrical menstrual history, first trimester draining per vagina, pregnancy amid lactational amenorrhea and sporadic menstruation [6]. Symphysis fundal stature in cm breaks even between 20 to 38 weeks of gestational age, anyway various factor impacts its estimation such as gestational diabetes mellitus, different incubation, intrauterine development impediment, and transverse fetal lie [7]. Amongst the

distinctive biometric records for fetal gestational age examination, most by and large used is Hadlock based composite gestational age assessment from bi parietal diameter (BPD), femur length (FL) and head circumference (HC). These biometric records however most regularly utilized changes with hidden restorative conditions like intrauterine development impediment and shows potential errors uniquely amid evaluation of gestational age in third trimester [8]. Fetal kidney indicates variety in its width and anterior posterior measurements, in some conditions like intrauterine development impediment. Anyway its length demonstrates no significant change with any fundamental restorative condition. Fetal kidney demonstrates an unfaltering development of 1.7 mm all through the pregnancy unaffected by any fundamental development anomalies [9]. Different independent past examinations have shown a strong relationship with the gestational age in the third trimester. Gestational age assurance is one of the best strides in the administration of the timing of pregnancy and subsequent diminishing in perinatal mortality due to preterm conveyances. In surveying the gestational age, the fetal femur length, the Bipari *et al.*, distance are considered more often than not, following 20 weeks of incubation. There is no single parameter to evaluate the gestational age. Similarly, as with all revelations and innovations, it is constantly basic to search for better and more helpful systems with an open and enquiring mind. In surveying the gestational age, the fetal kidney length opens up the likelihood of finding the gestational age with a solitary parameter.

Normally utilized sonographic biometric parameters are Crown rump Length (CRL), Bipari *et al.*, diameter (BPD), Head circumference (HC), Abdominal circumference (AC) and Femur length (FL). Conditions like oligohydramnios, numerous development, breech introduction, polyhydramnios and intrauterine growth retardation (IUGR) can influence the BPD, AC, FL estimations. As the pregnancy advances these parameters end up being dynamically faulty in estimate of GA [10].

Different nontraditional sonographic parameters for assessing fetal GA are being considered like transverse cerebellar distance, fetal foot length, epiphyseal hardening focuses, amniotic liquid volume. Placental reviewing and fetal kidney length. Fetal Kidney Length is emphatically associated to GA and is considered more exact technique for GA estimation than BPD, FL and HC after 20th week stretch of incubation [11]. Although fetal biometry estimations demonstrated precise lists for GA estimation in the second trimester, the organic decent variety of size prompt change in exactness of these parameters as the period of hatchling progressed and a genuine dating in the second or third trimester is troublesome. In this way, a few investigations concentrated on the relationship of kidney measure in a typical embryo with

gestational age [12]. This forthcoming longitudinal investigation has been directed underlining on easing constraints of past examinations by considering both second and third trimester, left kidney and right kidney length variety, keeping it a two folds visually impaired investigation and contrasting its relapse coefficient and other built up biometric fetal lists for gestational age appraisal. The point of this investigation was to assess the fetal kidney length (FKL) and its relationship with gestational age. Fetal Bipari *et al.*, diameter measurement and fetal renal length demonstrate a direct association with each other during second and third trimester of pregnancy [13]. There is additionally direct increment in renal length with gestational age [14, 15].

METHODS

A cross sectional study was conducted on pregnant ladies in the second and third trimester in the Department of Obstetrics and Gynecology Baloch Hospital Lalian from September 2017 to march 2018. Research was started after obtaining clearance by the Institutional Ethical Committee. Sample size was 399 pregnant women with typical single pregnancies whose gestational age were affirmed by LMP and early ultrasound (<13weeks). All relevant clinical history was obtained. Ultrasound scan was performed using GE logic V5 using a 3- 5 MHz convex transducer. In all the patients following parameters were obtained including BPD, HC, AC, FL and FKL. Fetal kidneys were recognized by moving transducer descending from fetal AC estimation level and each fetal kidney length was acquired by pivoting test in the sagittal plane, until full length of each fetal kidney with renal pelvis was pictured independently. Maximum length of each fetal kidney was measured from upper pole of kidney to lower pole as shown in Figures 1 to 4.

All healthy women with uncomplicated singleton pregnancies from 20 to 38 weeks having less than 1-week discrepancy between LMP and CRL were recruited.

Pregnancies with less than 20 weeks of GA, Oligohydramnios, Polyhydramnios, dilated renal pelvis >4mm, renal abnormalities, Diabetic mother, Pregnancy induced hypertension; Pre-eclampsia, Multiple gestations, and Fetal chromosomal abnormalities were excluded from study.

RESULTS

BPD, FL and AC were measured in 2nd and 3rd trimester. Mean \pm SD of BPD, FL and AC were 7.85 ± 1.07200 , 6.14 ± 0.91 and 27.7 ± 4.34 respectively as shown in Table-1.

In this study gestational age is taken by the measurement of femur length. Gestational age was taken as dependent variable while length of left and right fetal kidney was taken as independent variable in separate simple linear regression model.

A positive linear relationship was found between gestational age(measured by femur length) and length of left kidney.

$$Y^{\wedge} = \alpha + \beta(x)$$

G.A in weeks (measured by femur length) = $25.430 + 1.912$ (Left Kidney in cm) with $R^2 = 0.939$ and p value = $0.000 < 0.05$

1 cm increase in length of Left kidney the G.A will increase by 1.912 weeks in average. That is shown in Graph-1

A positive linear relationship was found between gestational age (measured by femur length) and length of right kidney.

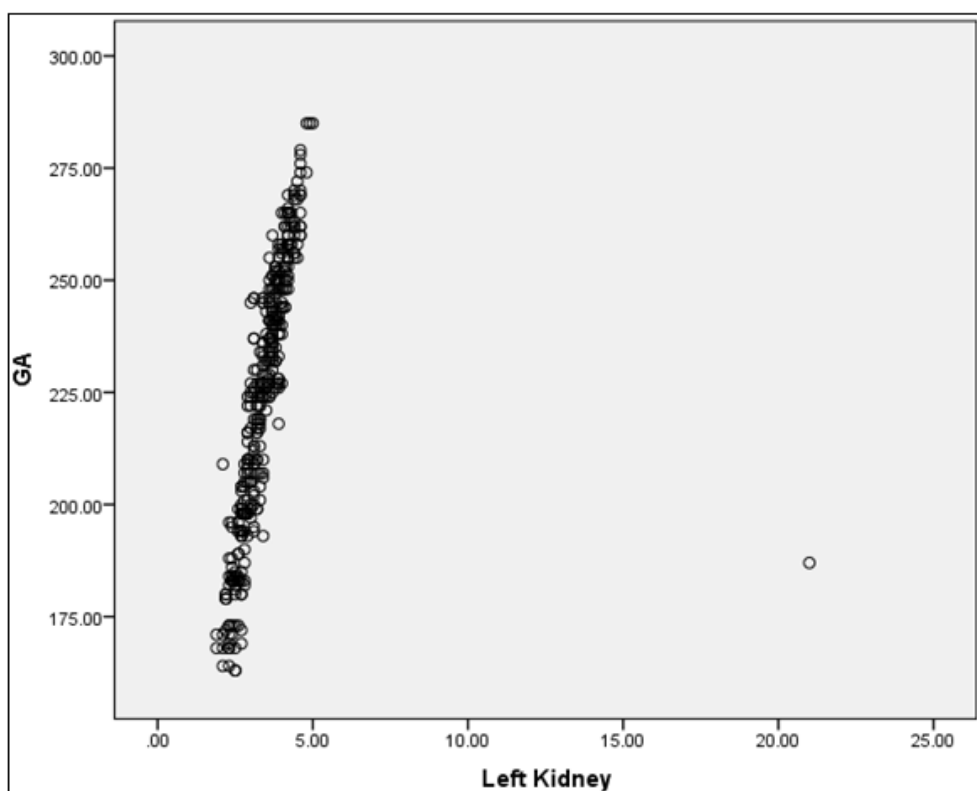
$$Y^{\wedge} = \alpha + \beta(x)$$

G.A in weeks (measured by femur length) = $13.496 + 5.727$ (Right Kidney in cm) with $R^2 = 0.939$ and p value = $0.000 < 0.05$

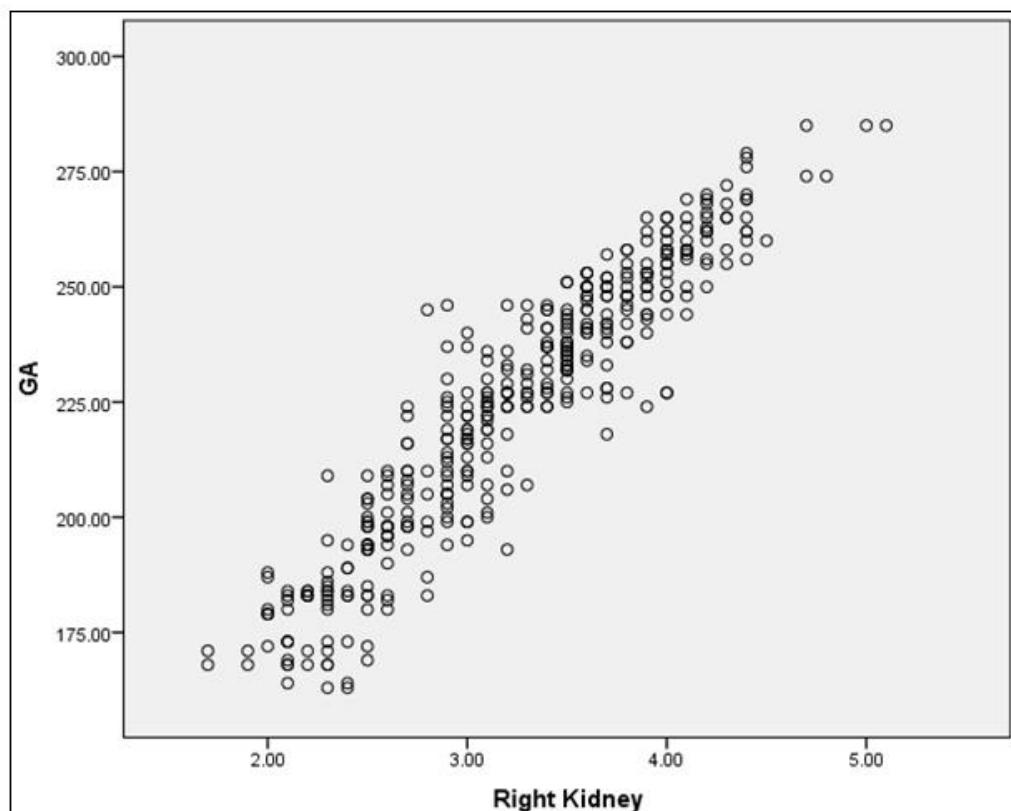
1 cm increase in length of right kidney the G.A will increase by 5.727 weeks in average. That is explained in Graph-2

Table-1:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
BPD	399	2.5	9.9	7.8521	1.072
FL	399	4.1	8.8	6.1476	0.9123
AC	399	3.2	36.2	27.703	4.34768
Left Kidney	399	1.9	21	3.4283	1.10165
Right Kidney	399	1.7	5.1	3.2286	0.67707



Graph-1:



Graph-2:



Fig-1: 20 Weeks of Gestation



Fig-2: 22 Weeks of Gestation



Fig-3: 26 Weeks of Gestation



Fig-4: 31 Weeks of Gestation

DISCUSSION

In the absence of reliable menstrual history there is no accurate alternative method of predicting the expected date of confinement. With the approach of high resolution real time ultrasonography, the capability to image various organs in utero has substantially improved. Ultrasonography fails in precise assurance of fetal age in the third trimester because of a substantial changeability in the biometric parameter readings [22]. Women booked late in pregnancy and in particularly the females who are not sure of their last menstrual period, typically difficult to date pregnancies. There is along these lines a need to examine a technique for dating pregnancies that is straightforward, simple to characterize and consistent. Fetal kidney length is such a parameter. The presence of fetal kidney changes with progressing gestational age. As pregnancy propels, expanded echogenicity from expanding perinephric fat is reported [16]. Specialized mistake or maternal heaviness may result in poor yields and abstain from

recognizing evidence of fetal kidneys especially in early pregnancy where the fetal renal and adrenal parenchyma have on a very basic level equivalent to homogenous models and closer to term this point is also obliterated by echogenic nature of lower ribs [16, 17]. This presumably clarifies the marginally unique outcomes in various examination [18]. By conquering every one of these deterrents, if renal length can be assessed legitimately, it would be a better than average parameter to assess the gestational age of the fetus. The present examination is an endeavor to discover whether fetal kidney length can be utilized as a free parameter to figure the gestational age like the other set up biometric lists (BPD, HC, FL, AC) and precision to which gestational age can be determined if kidney length is added to the four routine biometric parameters. Measurements of fetal kidney length (FKL) manifest good association with gestational age with correlation coefficient (r) 0.939 and $p < 0.05$. Similarly, Cohen *et al.*, inferred that kidney length connects well with

gestational age [19]. Kaul *et al.*, also have suggested that fetal kidney length as the most accurate single parameter for estimating gestational age because of the good correlation [20]. Diana *et al.*, concluded that FKL is increasingly exact parameter for estimation of gestational age than other biometric records particularly in situations when different parameters BPD and FL are not solid for evaluating gestational age in second and third trimester of pregnancy [21]. Monalisa *et al.*, concluded that Linear regression equation showed kidney length could predict gestational age with an accuracy ± 9.048 days and predictability when combined with other biometric indices was ± 8.299 days [22]. Kuldeep *et al.*, concluded that at 18th week of gestation is the earliest age at which fetal kidney could be seen sonographically with the mean kidney length of 12 ± 1.31 mm. The mean sonographic kidney length at 38th weeks of gestation with 40.4 ± 1.71 mm, specify that, as pregnancy progresses from 18th weeks to 38th weeks of gestation the mean kidney length increases [23]. Jayati *et al.*, concluded that Pearson's correlation coefficient value of 0.99 and regression coefficient or slope 1.0 noted between gestational age and fetal kidney length with a significance $P < 0.001$ and Fetal kidney length shows a constructive association with fetal gestational age [24]. Indu *et al.*, concluded that Standard error of prediction of gestational age was minimally significant for FKL (± 8.56 days), closely followed by femur length (± 8.9 days) and maximal for AC (± 11.72 days). The best representation in estimating fetal gestational age included all the five variables i.e. femur length, FKL, Bipari *et al.*, diameter, head and abdominal circumference with a standard error of ± 7.41 days. Fetal kidney length is the most exact single parameter for assessing GA than other biometric records in the second and third trimester and could be effectively consolidated into the samples for evaluating gestational age [25]. The result of our study is similar to previous studies [21-25].

CONCLUSION

FKL is an obvious method to identify and measure in late 2nd and 3rd trimester. In this study we found that FKL length in mm closely approximates GA in weeks with the advancing gestational age. Interestingly GA calculated by FKL is unaffected by the maternal age or parity status. There was no significant difference in the GA estimate whether right or left kidney was used for estimation. FKL can be used to measure gestational age accurately in cases of uncertain LMP, where accurate GA cannot be calculated by other parameters including IUGR, Macrosomia fetal skull and abdominal circumference abnormalities.

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