DETERMINATION OF ULTRASONOGRAPHIC MEAN FETAL KIDNEY LENGTH AT DIFFERENT GESTATIONAL AGES IN A PUBLIC SECTOR HOSPITAL OF PAKISTAN

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ABSTRACT

BACKGROUND: The determination of exact gestational age (GA) has been a challenge for managing obstetricians always. It has gained importance in managing pregnancies with different risk factors. Fetal kidney length together with routine fetal biometric parameters can help in predicting gestational age in a precise manner. The purpose of this study was to determine the ultrasonographic mean fetal renal length at different stages of gestation and find its correlation with maternal age, BMI and parity in female population presenting at a teaching hospital in Punjab. **MATERIAL AND METHODS:** It was a six months observational **descriptive** case series carried out in Gynecology Unit-IV, Sir Ganga Ram Hospital, and Lahore from August 8, 2019 till Feb 8, 2020. Two hundred women presenting to the Outdoor of Department of Obstetrics and Gynecology, Sir Ganga Ram Hospital, Lahore were enrolled into this study after fulfilling the inclusion criteria. Detailed history was taken from the patients who consented to participate in the study. The pregnant females underwent ultrasonographic assessment and the fetal kidney length was measured for both kidneys. Mean of the two lengths was calculated and noted into the specially designed proforma along with gestational age and demographic details. All the ultrasonographic measurements were performed by a single radiologist on a single machine to eliminate bias. The collected data was analyzed by SPSS version 20. P- Value of ≤ 0.05 was considered to be statistically significant. **RESULTS:** The patients' mean age was 26.24 ± 5.53 years. At 24th week the mean length of left kidney, right kidney and overall length of kidney were 30.45 ± 0.26 mm, 30.49 ± 0.29 mm and 30.47 ± 0.27 mm respectively. At 28th week the mean length of left kidney, right kidney and overall length of kidney were 35.09 ± 0.58mm, 35.62 ± 0.87 mm and 35.35 ± 0.72 mm respectively. At 32nd week the mean length of left kidney, right kidney and overall length of kidney were 35.72 ± 0.40 mm, 36.25 ± 0.79mm and 35.99 ± 0.66 mm respectively. At 36th week the mean length of left kidney, right kidney and overall length of kidney were 41.51 ± 0.27 mm, 41.56 ± 0.32 mm and 41.53 ± 0.31 mm respectively. A p -value of 0.05 was obtained when the fetal kidney lengths were correlated with age, parity and BMI of the female. **CONCLUSION:** This study reached to the conclusion that the length of kidney increased as the gestational age advanced. No statistical correlation of fetal kidney length with maternal age, BMI and parity was seen in female population presenting at a teaching hospital in Punjab. So, prediction of fetal gestational age can be done in a better manner complimenting fetal kidney length with other routine parameters.

KEYWORDS: Fetus; Kidney; Ultrasonography; Kidney dimension, gestational age.

INTRODUCTION

The duration of pregnancy has to be judged accurately for its management from the very beginning till delivery, and is of special importance in dealing with cases of premature labor and post-dates deliveries. The outcome of high risk pregnancies depends on correct dating of pregnancy. In the past when ultrasound was unavailable, the last menstrual period (LMP) and examination was used to assess gestational age which had issues related to reliability. Garg et al. revealed that 30% of pregnant women didn't recall their LMP due to irregular cycles, early pregnancy complications or use of oral contraceptives in early pregnancy.[1,2]

In the last two trimesters, gestational age is determined by using various parameters like the parietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). These parameters cannot be relied upon due to variable accuracy, discrepancies in late trimester scans and Intrauterine Growth Retardation (IUGR).[3,4]

The fetal kidney shows a steady growth of 1.7 mm every fifteen days during the pregnancy and remains unaffected by the growth abnormalities. Shivalingaiah et al. observed the mean fetal kidney length to be 24.1±0.5mm at 24 weeks, 28.2±0.6mm at 28 weeks, and 32.8±0.9mm at 32 weeks and 36.5±0.9 mm at 36 weeks in Bangalore, India.[4] Kumar et al. in 2013 reported the mean fetal kidney lengths to be 21.60±1.70mm, 29.80±2.24mm, 36.20±0.7mm and 38.90±1.53mm at 24, 28, 32 and 36 weeks respectively in Uttar Pradesh, India.[45,6]

Abbas et al. in 2012 in Pakistan reported the mean fetal kidney lengths to be 30.8±0.6mm at 24 weeks, 34.5±0.8mm at 28 weeks and 42±0.3mm at 36 weeks. Yousuf et al. in 2007 reported these values to be 32.0±0.4mm and 35. 9±0.4mm at 32 and 36 weeks respectively in Bangladesh. Konje et al. in 2002 in UK reported these values to be 24.2±1.2mm, 29.0±0.4mm, 33.2±4.5mm and 38.2±4.2mm at 24, 28, 32 and 36 weeks respectively.[7,8,9]

Different studies have come to an agreement that fetal kidney length correlates strongly with the gestational age in second and third trimesters. To use mean fetal kidney length as an ultrasound tool to assess gestational age and Intrauterine Growth Retardation, there is need to determine the reference mean fetal kidney lengths at various gestational ages in local population. At the moment, only a single local study is available which has been conducted in Peshawar.[7]

The literature review reveals that there is variation in the mean fetal kidney length. It not only shows diversification among various populations but also with in different regions of a single population. To the best of authors' knowledge, no such study has been conducted in Sir Ganga Ram Hospital (SGRH), which is a teaching hospital attached to Fatima Jinnah Medical University and is located in the heart of city Lahore, the provincial capital of Punjab. Therefore this study was conducted to determine the ultrasonographic mean fetal kidney length at various gestational ages and find its correlation with maternal age, parity and BMI in female population presenting in Sir Ganga Ram Hospital, Lahore.

MATERIAL AND METHODS
Study Design: It was an Observational Descriptive cases series.

Study setting: It was conducted in the out- patient department (OPD) of Gynecology Unit-IV, Sir Ganga Ram Hospital, and Lahore.

Study period: It lasted from August 8, 2019 till February 8, 2020.

Sample Size: Sample size of 200 cases was determined with 95% confidence level, d= 0.30 and taking an expected mean ±S.D of mean fetal kidney length at 28 weeks i.e. 29.80± 2.24mm.

Sampling Technique: Non probability consecutive sampling technique was used.

Study Population: Pregnant women of any parity aged between 18-35 years with a singleton pregnancy (as per dating scan) on 24th, 28th, 32nd and 36th weeks of gestation (from last menstrual period) and patients who consented to participate were included in this study. Women with oligohydramnios or polyhydramnios, abnormally small (SGA) or large (LGA) fetus for gestational age as per ultrasonographic assessment and those with with congenital fetal kidney abnormalities like agenesis, abnormal location etc. as per ultrasonographic assessment were excluded from this study.

Data Collection Procedure: Two hundred women presenting to the OPD of Gynecology, Sir Ganga Ram Hospital, Lahore were enrolled into this study. Detailed history and informed consent was taken from each patient. The patients underwent ultrasonographic assessment and the fetal kidney length was measured for both kidneys. Mean of the two lengths was calculated and noted into the attached proforma along with gestational age and demographic details (name, age, address, parity) of the patients. All the ultrasonographic measurements were performed by a single radiologist on a single machine to eliminate bias. Exclusion was used to control the confounding variables.

Data Analysis Procedure: The data was analyzed using SPSS version 20. Using descriptive statistics, mean and standard deviation was calculated for continuous variables(age, right, left and overall fetal kidney length at 24th, 28th, 32nd and 36th weeks of gestation) while frequencies and percentages were calculated for categorical variables (BMI ≥ 30 kg/m² , <30 kg/m² and parity). Data stratification was done for maternal age, parity and fetal gender BMI (≥ 30kg/m² , <30 kg/m²) for addressing the effect modifiers. Student's t-test was used for checking the significance at various gestational ages with p-value ≤ 0.05 as significant.

RESULTS

The mean age of cases 26.24 ± 5.53 years with minimum and maximum age as 18 and 35 years. Majority of the participants had a BMI < 30kg/ m2 accounting for 67% of the total, 60% had a parity of 1 to 3 and more than half (54%) of the fetal gender was male (Table 1). Mean lengths of each kidney as well as the overall kidney lengths is given in Table 2.

When data was stratified for age, BMI, Parity and neonatal gender. We found no statistically significant difference in mean length of left, right or overall length of kidney with respect to mother's age, BMI, Parity and fetal gender giving a p-value of > 0.05. (Tables 3)

Table 1: Frequency distribution of BMI, Parity, Fetal Gender and Age Group of the Participants.

Variable		n	Percentage
BMI	≤30kg/m2	134	67%
	≥ 30 kg/m*	66	33%
Parity	1-3	120	60%
	<2	80	40%
Fetal Gender	Male	108	54%
	Female	92	46%
Age Group	18-27 years	96	48%
	28-37 years	104	52%

Table 2: Descriptive Statistics of Length of kidney at various Gestational Ages.

Length of kidney	Mean	S.D	Minimum	Maximum
At 24* week				
Left kidney length	30.45	0.26	30.00	30.89
Right Kidney length	30.49	0.29	30.00	30.99
Overall kidney length	30.47	0.27	30.00	30.94
At 28* week				
Left kidney length	35.09	0.58	34.10	36.08
Right Kidney length	35.62	0.87	34.13	37.10
Overall kidney length	35.35	0.72	34.12	36.59
At 32 week				
Left kidney length	35.72	0.40	35.15	36.54
Right Kidney length	36.25	0.79	35.10	37.88
Overall kidney length	35.99	0.60	35.12	37.21
At 36* week				
Left kidney length	41.51	0.29	41.01	42.05
Right Kidney length	41.56	0.32	41.01	42.16
Overall kidney length	41.53	0.31	41.01	42.10

Table 3: Comparisons of Length of kidney at 24*[h], 28th, 32nd and 36'[h] week with respect to age groups, BMI, parity and fetal gender.

Variables		Length of kidney (mean)				p- value
		At 24 weeks	At 28 weeks	At 32 weeks	At 36 weeks	
Age groups	18-27 years	30.41	35.29	36.05	41.56	0.38
	28-37 years	30.53	35.30	35.90	51.50	0.39
BMI	<30kg/m2	30.43	35.24	35.96	41.48	0.18
	≥30kg/m2	30.56	35.58	36.03	41.64	0.92
Parity	1-3	30.45	35.30	36.02	41.52	0.34
	>2	30.50	35.44	35.94	41.56	0.76
Fetal Gender	Male	30.45	35.94	36.91	41.52	0.171
	Female	35.30	35.44	36.02	41.94	0.409

DISCUSSION

Estimation of correct duration of pregnancy is of is of vital importance when the pregnancy is associated with various risk factors like severe preeclampsia, chronic hypertension, severe IUGR, major degree placenta previa, sensitized Rh-negative mother etc. In some of these cases, there may be a need to terminate the pregnancy as soon as fetus attains maturity. Failure in estimating GA accurately can lead to various fetomaternal consequences, leading to increased perinatal mortality and morbidity.[9]

From the second trimester onwards, kidneys have the same ultrasonographic appearance as in the postnatal life, their appearance is dependent on the gestational age at which the study is carried out. As the gestation progresses, there may be a change in accuracy of parameters due to biological factors, so true dating in late

second or third trimester is unrealistic. So, some studies have concentrated on the association of kidney size in a normal fetus with gestational age. Fetal kidney length (FKL easy to identify and measure. Its correlation to GA and linear growth during gestation has been seen on Magnetic Resonance Imaging as well. It demonstrates more accuracy for GA than BPD, FL, HC and AC after second half of pregnancy.[10,11]

In current study at 24th week the mean length of left kidney, right kidney and overall length of kidney were 30.45 ± 0.26 mm, 30.49 ±0.29 mm and 30.47 ± 0.27 mm respectively. At 28th week the mean length of left kidney, right kidney and overall length of kidney were 35.09 ± 0.58mm, 35.62 ± 0.87 mm and 35.35 ± 0.72 mm respectively. At 32nd week the mean length of left kidney, right kidney and overall length of kidney were 35.72 ±0.40 mm, 36.25±0.79mm and 35.99 ±0.66 mm respectively. At 36th week the mean length of left kidney, right kidney and overall length of kidney were 41.51 ± 0.27 mm, 41.56 ± 0.32 mm and 41.53 ± 0.31 mm respectively. Similar findings are reported in past literature, i.e. Shivalingaiah et al. in 2014, Abbas et al. in 2012 in Pakistan, Yousuf et al. in 2007 found a correlation between FKL and gestational age. These findings are in agreement with our study.[4,6,7,8]

Similarly in a study done in Turkey, the gestational age was determined by early ultrasound and date of last menstrual period. Routine fetal biometric parameters including fetal renal length were measured. The correlation between fetal kidney length and gestational age was studied and it was concluded that gestational age can be be predicted in a better way by making fetal kidney length measurement a part of other routine parameters.[9]

In 2016, Goyal et al. observed that FKL is easy to measure in second and third trimesters and shows more accurate results as compared to BPD for gestational age estimation. So FKL can easily be made a part of the model for dating pregnancies after 16th weeks of pregnancy, especially when BPD and FL are difficult to measure.[2]

Likewise, another study done in 2013 studied the mean renal length, width, thickness, volume of fetal kidneys in third trimester in Sudanese population .This study made an observation that there was a proportional relationship between gestational age and fetal weight. In a recent prospective cross sectional study, it was inferred that FKL can serve as an additional reliable parameter for accurate dating of pregnancy in an obstetric scan. This was a trial involving four hundred healthy women with no co- morbidity. The mean left FKL was found to be more than mean right FKL. A strong correlation between mean kidney length and gestational age determined by the LMP was seen.[12,13]

Bardhan and colleagues in a similar study concluded that there is positive correlation between fetal kidney length and gestational age. The fetal renal length can be helpful in prediction of gestational age in cases where other biometric measurements offer less reliability.[14]

In another recent study conducted in a Pakistani hospital involving almost four hundred pregnant women the conclusion drawn was that FKL is easier to measure. It especially becomes much more reliable in cases when other parameters like BPD, FL, HC and AC are not reliable for making an accurate estimate of gestational age in the second and third trimester of pregnancy.[15]

The limitation of this study was that the sample size was small, and it was a single -centered study. It is therefore recommended that future studies should involve larger sample size and multiple centers should be involved so that the results can be more generalized and can be projected at a national or provincial level.

Conflict of interest: None.

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CONCLUSION

We have reached to the conclusion that the length of fetal kidney increased correspondingly with gestational age. There was no statistically significant correlation of fetal kidney length with BMI, maternal age or parity of the females that participated in the study. So, fetal kidney length can be used for predicting the gestational age in adjunct to other parameters.

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