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Role of Mean Fetal Kidney Length Measurement by Ultrasound in Determining Gestational Age

Dr Ravella Sowjanya, Dr Polinati Vijaya Sheela, Dr. Prasad Usha,
MD OBGAssociate Professor (Obstetrics and Gynecology), Siddhartha Medical College, Vijayawada, Andhra Pradesh.
MD OBGAssociate Professor, Department of Obstetrics and Gynecology, Siddhartha Medical College, Vijayawada Andhra Pradesh.
MD OBGAssociate Professor, Department of Obstetrics and Gynecology, Siddhartha Medical College, Vijayawada Andhra Pradesh.

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ABSTRACT: BACKGROUND:Gestational age measurement is an important aspect of obstetric care.Accurate timing of delivery helps to prevent complications like prematurity, meconium aspiation sydrome which contributes to perinatal morbidity and mortality.OBJECTIVE: To evaluate the role of mean fetal kidney length measurement by ultrasound in determining gestational age. MATERIAL AND METHODS: The present study is a cross sectional, observational hospital based study done on 300 pregnant women attending the outpatient department of Siddhartha Medical College, Vijayawada from June 2019 to September 2019. . Mean kidney length was measured and Femur length was measured.Results were tabulated and analysed using SPSS version 24. Pearson correlation and regression coefficient (r) was calculated between gestational age and kidney length and between gestational age and femur length. P value <0.05 was taken as significant. RESULTS:300 pregnant women at various gestational ages between 26 and 40 weeks were enrolled in the study. In the present study,femur length (FL) was 24±0.03 at 26 weeks and was 39.1±0.32 at 40 weeks. The Pearson coefficient of correlation (r) is 0.9894 and R^2 is 0.9789. Pvalue is <0.00001 showing a strong statistical correlation between GA (gestational age)and FL(femur length) Mean kidney length (MKL) was 26 at 26 weeks and was 38.3±0.06 at 40 weeks.The Pearson coefficient of correlation (r) is 0.9957 and R^2 is 0.9914. P value is <0.00001 showing a very strong statistical correlation between GA and MKL. CONCLUSION: Mean kidney length can be used as an independent parameter to estimate gestational age. It is reliable and can be measured fairly accurately.

KEY WORDS: mean kidney length, gestational age,ultrasound, femur length

I. INTRODUCTION

Gestational age measurement is an important aspect of obstetric care.Accurate timing of delivery helps to prevent complications like prematurity, meconium aspiation sydrome which contributes to perinatal morbidity and mortality. Knowledge of gestational age is important in following ways [1] i) To anticipate normal spontaneous delivery or to plan elective delivery within the time frame of a term pregnancy. In some cases early termination is necessary as soon as fetus becomes mature eg. preeclampsia, diabetes, central placenta previa& sensitized Rh negative mother. ii) To consider invasive procedures such as chorionic villus sampling, genetic amniocentesis and in interpretation of biochemical tests such as maternal serum alpha-fetoprotein screening. iii) To evaluate the foetal growth. iv)Gestational age influence the management decision if the foetus is diagnosed with anomaly. Hence all important clinical decisions are influenced by the gestational age. Ultrasound is safe for the patient, the foetus and the sonologist. There is no reported risk of ionizing radiation as in radiography [2] or any other known biological or embroytoxic effect. It does not require any injections as sometimes needed in imaging studies [3]

Kidneys are one of the important abdominal organs not just after birth but also during fetal development [4] .Developing fetus is suspended with in the gestational sac in the amniotic fluid. Fetal kidneys are the important source of amniotic fluid [5,6]

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It has been a known fact that estimation of fetal gestational age by conventional parameters is widely accepted. However fetal kidney length has also been shown to correlate with the gestational age and hence can be used for estimation of fetal gestational age and vis-versa for a given gestational age the normal size of kidney can be tabulated and serves as guide for appropriateness of the kidney size for the expected gestational age[7]

II. MATERIAL AND METHODS

The present study is a cross sectional, observational hospital based study done on 300 pregnant women attending the outpatient department of Siddhartha Medical College, Vijayawada from June 2019 to September 2019.

The inclusion criteria was

-Gestational age between 26 to 40 weeks and LMP (last menstrual period) was accurate within 5 days of ultrasound.

-Single fetus

Exclusion crieria was

-Obstetric complications - twins, pre eclampsia, congenital anomalies, hydramnios, fetal growth restriction, oligohydramnios, Gestational diabetes, gross obesity

-Prominent dilated renal pelvis more than 5 mm.

-Upper pole of kidney not visualised

Sonographic examination was done by an experienced sonologist using scan machine GE Health careVivid S60. Biometric parameters were measured. Fetal kidney length was measured in the para saggital plane and outer to outer pole measurements were taken.Both the right and left kidney measurements were taken. Mean kidney length was measured and Femur length was measured.Results were tabulated and analysed using SPSS version 24. Pearson correlation and regression coefficient (r) was calculated between gestational age and kidney length and between gestational age and femur length. P value <0.05 was taken as significant.

III. RESULTS

300 pregnant women at various gestational ages between 26 and 40 weeks were enrolled in the study. In the present study,femur length (FL) was 24±0.03 at 26 weeks and was 39.1±0.32 at 40 weeks.(TABLE I) The Pearson coefficient of correlation (r) is 0.9894 and R^2 is 0.9789. Pvalue is <0.00001 showing a strong statistical correlation between GA and FL Mean kidney length (MKL) was 26 at 26 weeks and was 38.3±0.06 at 40 weeks.(TABLE II) The Pearson coefficient of correlation (r) is 0.9957 and R^2 is 0.9914. P value is <0.00001 showing a very strong statistical correlation between GA and MKL.

TABLE I FEMUR LENGTH IN RELATION TO GESTATIONAL AGE

GESTATIONAL AGE in weeks	Number of cases(n=300)	FL(Femur length in weeks)
26	10	24±0.03
27	16	25.3±0.62
28	24	25.9±0.12
29	31	26.4±0.93
30	26	28.9±0.56
31	23	29.7±0.71
32	19	30.2±0.42
33	24	30.9± 0.11
34	21	32.1±0.96
35	19	32.6±0.81
36	12	34.8±0.16
37	18	35.9±0.43
38	26	37.1±0.25
39	20	37.9±0.36
40	11	39.1±0.32

The Pearson coefficient of correlation (r) is 0.9894 and R^2 is 0.9789. Pvalue is <0.00001 showing a strong statistical correlation between GA and FL.

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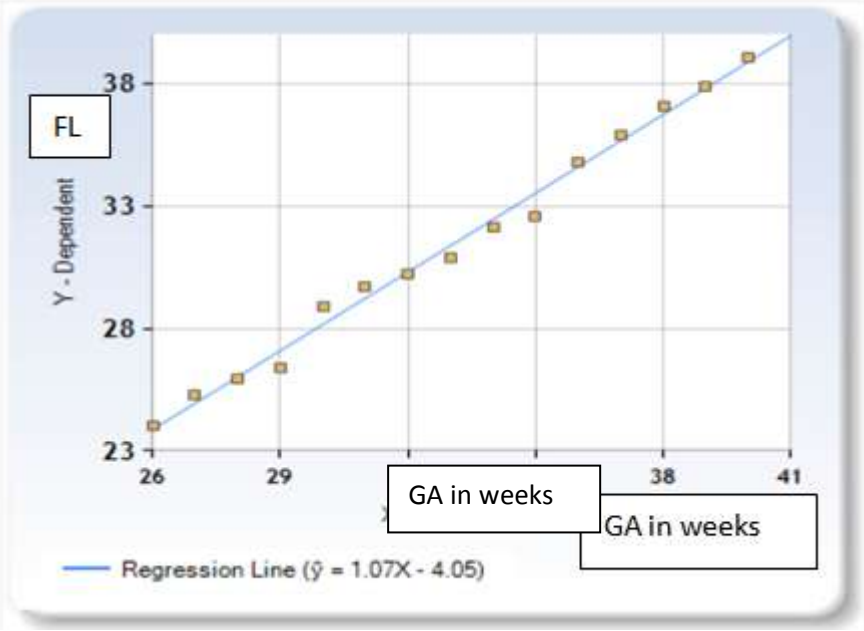

FIGURE 1: Graph between gestational age in weeks (independent variable) and femur length in weeks (dependent variable)

TABLE II MEAN KIDNEY LENGTH IN RELATION TO GESTATIONAL AGE

GESTATIONAL AGE (in weeks)	Number of cases(n=300)	MEAN KIDNEY LENGTH (in weeks)
26	10	26±0.09
27	16	27.2±0.10
28	24	28.4±0.04
29	31	29.2±0.08
30	26	29.6±0.14
31	23	31.0±0.06
32	19	32.2±0.12
33	24	32.9± 0.06
34	21	33.6±0.13
35	19	35.1±0.01
36	12	35.8±0.12
37	18	36.5±0.04
38	26	37.8±0.05
39	20	37.9±0.10
40	11	38.3±0.06

The Pearson coefficient of correlation (r) is 0.9957 and R^2 is 0.9914. P value is <0.00001 showing a very strong statistical correlation between GA and MKL.

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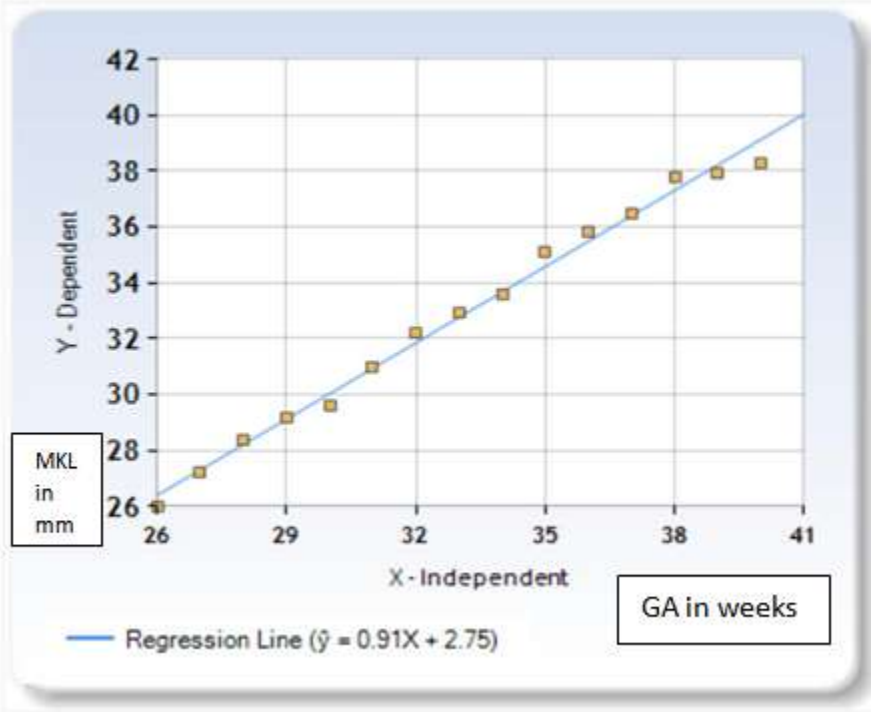

FIGURE 2: Graph between gestational age in weeks (independent variable) and mean kidney length (MKL) in mm (dependent variable)

TABLE III Linear regression equation of FL and MKL with GA

Parameter	Intercept estimate	Slope estimate	P value	R^2
Femur length(FL)	4.05	1.07	<0.00001	0.9789
Mean Kidney Length(MKL)	2.75	0.91	<0.00001	0.9914

The intercept estimate was 4.05 with femur length and 2.75 with mean kidney length. The slope estimate was 1.07 with femur length and 0.91 with mean kidney length. R^2 was 0.9789 with femur length and 0.9914 with mean kidney length.

IV. DISCUSSION

Fetal kidneys are usually imaged during routine antenatal scans. Kidneys are located on either side of the spine.The adrenal glands are closely related to the upper pole of kidney anatomically. Identifying the fetal renal poles except in cases with thick abdominal wall patients is easier. Hence accurate measurements of fetal renal length can be obtained [7]

Konje et al [8,9,10] showed that there was a significant correlation between gestational age and kidney length. They concluded that fetal kidney length could be used reliably for estimation of gestational age.Lawson et al [11] showed that measurement of fetal kidney length in mm is approximately the same as gestational age in weeks which supports the result of this study Although fetal kidney size, as for all fetal organ is affected by growth variations these appear to predominately affect only the AP and transverse diameter but not the kidney length. Rule of thumb is that "renal length in mm almost approximates GA in weeks"

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TABLE IV MEAN KIDNEY LENGTH IN VARIOUS STUDIES

GA in weeks	MKL (Kansaria and Parulekar et al)	MKL(Konje et al)	MKL(Cohen et al)	MKL(Hemraj S et al)	MKL(Present study)
24	23.8	24.2	31	32.1	-
26	25.2	26.3	34	34.2	26
28	26.9	29	34	35	28.4
30	29	30.9	38	37.4	29.6
32	30.8	33.2	41	40	32.2
34	32.5	35	42	40.5	33.6
36	34.2	38.2	42	41.2	35.8
38	36.2	40.1	44	43.8	37.8

MKL in various studies has been shown in the above table. The study by Kansaria and Parulekar et al [12] and Konje et al findings are similar to the present study. The study by Cohen et al [13] and Hemraj et al [14] showed measurements which was higher than the present study.The linear increase in MKL in millimeters as gestational age advances in weeks in the present study conccurs with Nahid Y et al[15]

V. CONCLUSION

Mean kidney length can be used as an independent parameter to estimate gestational age. It is reliable and can be measured fairly accurately.

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