



ULTRASOUND EVALUATION OF FETAL KIDNEY SIZE AT DIFFERENT GESTATIONAL AGE BEYOND 20TH WEEK

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ABSTRACT

Background: FKL is a reliable parameter for fetal age assessment beyond 20th week of gestation as other parameters. Ultrasonography has become a routine investigation for assessing fetal maturity and calculation of EDD. Assessment of accurate gestational age of fetus is of utmost importance for proper obstetric management. This study was aimed to establish fetal kidney normogram for North Indian population and assess the correlation between fetal kidney measurements and gestational age. **Material And Methods:** A prospective observational study was carried out in the Department of Radiodiagnosis in 270 pregnant female from January 2021- September 2022 in FH Medical College and Hospital, Agra attending outdoor and indoor clinics. The pregnant women with a history of more than 20 week of amenorrhoea were included in this study. **Results:** We observed that no statistically significant difference was seen between mean dimensions of both kidneys ($p > 0.05$) at different gestational age beyond 20 weeks. FK parameters shows linear correlation with gestational age. Mean fetal kidney dimensions with standard deviation in late second trimester i.e. between 20-25 weeks; length 24.05 ± 2.23 mm, antero-posterior diameter 11.25 ± 1.70 mm, transverse diameter 12.47 ± 1.31 mm and volume 1.72 ± 0.47 cm³ and between 26-30 weeks; length 29.62 ± 1.80 mm, antero-posterior diameter 14.28 ± 0.86 mm, transverse diameter 15.21 ± 0.93 mm and volume 3.23 ± 0.45 cm³. In late third trimester i.e. between 31-35 weeks; mean kidney length is 33.95 ± 1.73 mm, antero-posterior diameter 18.54 ± 0.68 mm, transverse diameter 20.14 ± 0.56 mm and volume 6.34 ± 0.42 cm³ and > 35 weeks; mean kidney length is 38.41 ± 1.24 mm, antero-posterior diameter 20.63 ± 1.01 mm, transverse diameter 22.41 ± 0.71 mm and volume 8.88 ± 0.65 cm³. **Conclusion:** Fetal kidney length can be use as a primarily parameter for estimation of gestational age in pregnant female who have forgotten their last menstrual period. This study provides normogram of fetal kidney size beyond 20 weeks of gestation in North Indian Population.

KEYWORDS : Fetal Kidney Length, Gestational age, Ultrasound

INTRODUCTION

Assessment of accurate gestational age of fetus is of utmost importance for proper obstetric management.¹ Ultrasonography has become a routine investigation for assessing fetal maturity and calculation of expected date of delivery (EDD). The parameters routinely used for this purpose are biparietal diameter, femur length, head circumference and abdominal circumference. Fetal kidney length (FKL) has emerged as a new parameter for fetal age assessment.²

Kidney is an important abdominal organ not just after the birth but also during fetal development. It plays major role in amniotic fluid production and in lung maturity. Knowledge of fetal kidney size is also helpful in earlier diagnosis of various kidney anomalies. Usually, fetal kidneys are visible on transabdominal ultrasound after 13-14 weeks.^{3,4}

Detailed anatomical configuration is well seen at 20 weeks. The increase in number of nephrons results in increase in size of kidneys progressively through out the pregnancy. This can be used to provide a normogram of fetal kidneys. FKL is also helpful in assessment of gestational age when LMP (last menstrual period) is not known.⁵

This study was aimed to establish fetal kidney normogram for North Indian population and assess the correlation between fetal kidney measurements and gestational age.

MATERIALS AND METHODS

A prospective observational study was carried out in the Department of Radiodiagnosis in 270 pregnant female from

January 2021- September 2022 in FH Medical College and Hospital, Agra attending outdoor and indoor clinics. The pregnant women with a history of more than 20 week of amenorrhoea were included in this study. The exclusion criteria were multiple gestations, gestational diabetes mellitus, pre-eclampsia, intrauterine growth restriction and fetuses with other congenital anomalies as these are known to alter renal size.

Each fetus was divided into four gestational age groups: Group 1: gestational age from 20 -25 weeks, Group 2: gestational age from 25 -30 weeks, Group 3: gestational age from 30 -35 weeks, and Group 4: gestational age more than 35 week. Curvilinear probe was used to assess renal measurements transabdominally on GE Voluson S8 ultrasound machine.

The fetus was scanned in fetal sagittal section until the right and left kidney was visualized below the liver and stomach respectively as landmarks. FKL was measured from outer edge of upper pole to outer edge of lower pole (Cranio-caudal length) as depicted in Figure 1. Adrenal gland measurement was not included.

The probe was then rotated through 90 degree to outline the kidneys. Transverse (TD) and antero-posterior (AP) diameter of kidneys was measured in transverse fetal section rather than transverse section of kidneys as depicted in Figure 2.

Fetal kidney volume (cm³) was calculated by using formula for an ellipsoid shape ($FKL \times TD \times AP \times 0.52$).



Figure 1: Fetal Kidney Length



Figure 2: Fetal Kidney Transverse and AP Diameter

RESULTS

A total of 270 pregnant female and 540 fetal kidneys were examined and the study cases were divided into four gestational age groups from 20 week to beyond 35 weeks. Then we observed the Mean size of kidney including FKL, transverse, antero-posterior size and volume in each groups as depicted in table 1. It clearly revealed that in group 4 (>35 weeks) the parameters were higher than group 1 (20-25 weeks) and the difference was statistically significant ($p < 0.001$).

Table 1 and figure 3 depict the mean fetal kidney dimensions with standard deviation in late second trimester i.e. between 20-25 weeks, length 24.05 ± 2.23 mm, antero-posterior diameter 11.25 ± 1.70 mm, transverse diameter 12.47 ± 1.31 mm and volume 1.72 ± 0.47 cm³ and between 26-30 weeks length 29.62 ± 1.80 mm, antero-posterior diameter 14.28 ± 0.86 mm, transverse diameter 15.21 ± 0.93 mm and volume 3.23 ± 0.45 cm³. In late third trimester i.e. between 31-35 weeks mean kidney length is 33.95 ± 1.73 mm, antero-posterior diameter 18.54 ± 0.68 mm, transverse diameter 20.14 ± 0.56 mm and volume 6.34 ± 0.42 cm³ and > 35 weeks mean kidney length is 38.41 ± 1.24 mm, antero-posterior diameter 20.63 ± 1.01 mm, transverse diameter 22.41 ± 0.71 mm and volume 8.88 ± 0.65 cm³.

No statistically significant difference ($p > 0.05$) was observed between right and left kidneys mean parameters on paired sample 't' test. Hence, following table and graph have included single renal measurements.

Table 1: Distribution Of Length (in mm), AP (in mm), Transverse (in mm) And Volume (in cm³), According To Different Gestational Age Groups For Kidneys

Gestational Age (in Week's)	Number of Observation	Length (in mm)	AP (in mm)	Transverse (in mm)	Volume (in cm ³)
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD

20-25	434	24.05 $\pm$ 2.23	11.25 $\pm$ 1.70	12.47 $\pm$ 1.31	1.72 $\pm$ 0.47
26-30	498	29.62 $\pm$ 1.80	14.28 $\pm$ 0.86	15.21 $\pm$ 0.93	3.23 $\pm$ 0.45
31-35	540	33.95 $\pm$ 1.73	18.54 $\pm$ 0.68	20.14 $\pm$ 0.56	6.34 $\pm$ 0.42
>35	124	38.41 $\pm$ 1.24	20.63 $\pm$ 1.01	22.41 $\pm$ 0.71	8.88 $\pm$ 0.65
F Value		2907.561	3975.68	6479.55	11843.60
P Value		<0.001	<0.001	<0.001	<0.001
Total	1596	29.99 $\pm$ 4.94	15.16 $\pm$ 3.44	16.44 $\pm$ 3.60	4.16 $\pm$ 0.34

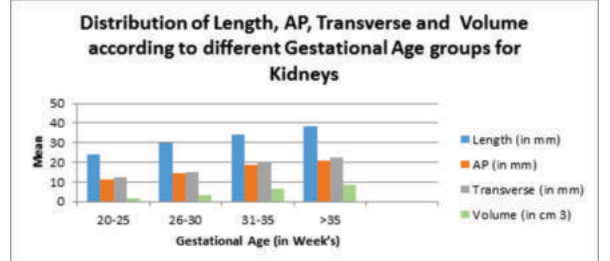


Figure 3: Distribution of Length (in mm), AP (in mm), Transverse (in mm) and Volume (in cm³), according to different Gestational Age groups for Kidneys

DISCUSSION

With high resolution real time ultrasound, identification of fetal kidneys should be possible in large percentage of cases after 20 post-menstrual weeks. As the pregnancy advances, increased echogenicity from increasing perinephric fat, make them more visible from surrounding soft tissue.^[6] By 30 weeks, their size is adequate to accentuate the normal renal parenchyma and to make identification relatively simple.^[7] Fetal kidney size (length, TD, AP) increase throughout the pregnancy. Hence, fetal kidney length predict gestational age better than other dimension of kidney. An often quoted "Rule of Thumb" is that renal length in millimeters approximates gestational age in weeks from 24 to 40 weeks.^[8]

This study demonstrates a linear relation between increase in fetal renal measurements (FKL, renal volume) with advancing gestational age in weeks. This has previously been postulated by several other studies like Konje JC et al. Nahid et al, Aremu OA. et al, and Kansaria JJ et al.^[9,10,15,16] Konje JC et al., and Kansaria JJ et al. reported as the MKL is an accurate single parameter for predicting GA than other fetal biometric parameters such as BPD, HC, FL and AC.

No statistically significant difference is observed in growth velocity or dimensions of both kidneys ($p > 0.05$). Similar observations also reported by many other authors like Kalpana purohit et al, J.C Konje et al and Nahid et al.^[3,9,10]

However, study conducted by Indu Kaul et al (2012). revealed that left fetal kidney length was slightly but significantly longer than right FKL at each gestational period.^[11] This was also corroborated by Fitzsimons RB et al. Duval JM et al, and Sampaio FJ et al.^[12,13,14]

CONCLUSION:

Fetal kidney length can be use as a primarily parameter for estimation of gestational age in pregnant female who have forgotten their last menstrual period. This study provides normogram of fetal kidney size beyond 20 weeks of gestation in North Indian Population.

REFERENCES

- Pernoll ML, Taylor CM. Normal pregnancy and prenatal care. In: Decherney AH, Pernoll ML(eds). Current Obstetric and Gynecologic Diagnosis and Treatment. 8th edition. Fast Norwalk: Appleton and Lange, 1994, p. 183-201.
- Sagi J, Vagman I, David MP, Van Dongn LGR, Goudie E, Jacobson MJ, et al.

- Fetal kidney size related to gestational age. *GynecolObstet.*,1987; 23: 1-4.
3. Kalpana purohit, Anita Purohit, et al. The study measure fetal kidney size at 30 and 38 weeks of gestation in singleton pregnancy. 2018; 5(3) : 331-336.
 4. Cohen HL, Cooper J, Eisenberg P, Mandel FS, Gross BR, Goldman MA, Barzel E, Rawlinson KF. Normal length of foetal kidney: Sonographic study in 397 obstetric patients. *American Journal of Roentgenology.* 1991;157: 545-548.
 5. Ahmadi F, Taqi Dizaj AV, Akhbari F et al. Fetal kidney measurement in 26-39 weeks gestation in normal fetuses of iranian pregnant women. *J preg child health* 2015;2:139.
 6. Sato A, Yamaguchi Y et al. Growth of fetal kidney assessed by real time ultrasound. *Eur Urol* 1990; 17:62-5.
 7. Fong KW, Ryan G. Fetalurogenital tract. In: Rumack CM, Wilson SR, Charboneau JW (editors). *Diagnostic ultrasound. Vol II, 2nd ed.* New York : Mosby Year Book inc., 1998, pp. 1069-92.
 8. Bertagnoli L, Lalatta F et al. Qualitative characterization of the growth of fetal kidney. *J. Clin. Ultrasound.* 1983;11(7):349-56.
 9. J.C Konje, et al. Evaluate the application of fetal kidney length measurement to the determination of gestational age between the 24th and 38th weeks and to compare its accuracy with that of the other fetal biometric indices. 2002;19: 592-597.
 10. Nahid Yusuf, et al. This study was to establish a correlation between the fetal kidney length and gestational age in 3rd trimester. 2007; 20(2) :147-150.
 11. Indu karl, Vinay Menia, et al. Evaluate role of FKL in estimation of gestational age in late 2nd and 3rd trimester. 2012; vol.14 No.2.
 12. Fitzsimons RB et al, Kidney length in newborn measured by ultrasound. *Acta Paediatr Scand* 1983; 72:885-87.
 13. Duval JM et al, Ultrasonographic anatomy and physiology of fetal kidney length. *Anat Clin.* 1985;7(2):107-23.
 14. SampaioFJ et al, Allometric study of renal growth in human fetus. *Surg Radiol Anat.* 1989;11(1):29-31.
 15. Aremu OA. Correlation of Feoptal Renal Length with Estimated Gestational Age in University of Ilorin Teaching Hospital. Dissertation Submitted to the National Postgraduate Medical College of Nigeria; 2005.
 16. Kansaria JJ, Parulekar SV. Normogram for fetal kidney. *Bombay Hosp J* 2009;51:155-62.