International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

An Ultrasonographic Study on Correlation of Fetal Kidney Length with the Gestational Age in Third Trimester

Dr. Amera Afroz[1], Dr. Aparna Vedapriya[2]

[1]Assistant Professor, Department of Anatomy, GMC, Suryapet, Telangana State, India
[2]Associate Professor and HOD, Department of Anatomy, Osmania Medical College, Hyderabad, Telangana State, India

Abstract: ***Introduction:*** ***Accurate assessment of gestational age is pivotal to the quality of antenatal care. Failure of accurate gestational age assessment can result in iatrogenic prematurity or post-maturity, those are associated with increased perinatal mortality and morbidity. Scanty bleeding in early pregnancy and occurrence of irregular menstrual cycles in mothers on oral contraceptives may interfere with proper recording of last menstrual period, further many women in rural India fail to remember their last date of menstrual period accurately.*** ***Methods:*** ***Present study was conducted with an objective of evaluating the correlation of gestational age with the fetal kidney length in Gandhi Hospital, Musheerabad, Secunderabad from the month of July 2016 to September 2016 i.e. for a period of 3 months in which 85 pregnant ladies between age groups of 18 to 32 years were included who visited the hospital for routine antenatal ultrasound scan. All the routine fetal biometric parameters and kidney length of the fetuses were measured. Uncomplicated pregnancies, pregnancy with single fetus were included and pregnancy with multiple fetuses and all complicated pregnancies were excluded from the study.*** ***Result:*** ***The study found a strong Pearson's correlation (r=0.52, P=0.03) for kidney length vs gestational age.*** ***Conclusion:*** ***Fetal renal lengths can aid in estimating gestational age when the other standard biometric parameters cannot be measured (low head position), or are not reliable (E.g.: in IUGR abdominal circumference), if patients report in late second or third trimester when the standard fetal biometric parameters are not reliable.***

Keywords: Gestational age, bi-parietal diameter, femur length, head circumference, abdominal circumference, kidney length

1. Introduction

Gestational Age is measured in weeks and days from the first day of the woman's last menstrual cycle to the current date. The estimation of gestational age is important to know when to expect the birth of the baby, and for the health care providers, so that they may choose the times at which to perform various screening tests and assessments.[1] Accurate dating improves obstetric care allows to perform prenatal screening tests at the earliest the possible time so that early diagnosis followed by appropriate intervention can be done. Gestational age is sometimes used post-natally to estimate various risk factors. The three basic methods used to help estimate gestational age (GA) are menstrual history, clinical examination, and ultrasonography. The first two are subject to considerable error and should only be used when ultrasonography facilities are not available. The 95% confidence interval of menstrual dates is -27 to +9 days[2]**.** Approximately 18% of women with certain menstrual dates have significant differences between menstrual and ultrasonographic dating[3]. Since the introduction of diagnostic ultrasonography, more reliable methods to date the pregnancy have been developed. The American College of Obstetricians and Gynecologists (ACOG) and the Society of Obstetricians and Gynaecologists of Canada recommend ultrasound measurement of the crown rump length (CRL) of the embryo or fetus as the most accurate method to establish or confirm gestational age. If a second- or third-trimester scan is used to determine gestational age, a combination of multiple biometric parameters (bi-parietal diameter, head circumference, abdominal circumference and femur length) should be used to determine gestational age, rather than a single parameter.[4]

Since estimation of gestational age in last trimester shows a greater error, dating scan should always be done as early as possible and it may not be feasible in every case. Due to this reason, need for alternate parameters which can reduce the errors in estimating gestational age, especially in third trimester has come up and research for the same was going on globally. One such alternate parameter found was fetal kidney length. Fetal kidney has been shown a steady growth rate of 1.7mm fortnightly and is unaffected by growth abnormalities.[5]

Embryological Basis:

The urogenital system develops from the intermediate mesoderm which forms a urogenital ridge on either side of aorta. The urogenital ridge develops into three sets of tubular nephric structures (from cranial to caudal) the pronephros, the mesonephros, the metanephtros. The metanephros appears last in lumbosacral region & persist as permanent kidney. It Consists of Collecting part called Ureteric bud and excretory part called Metanephric blastema.

2. Materials and Methods

Ultra sonographic reports of pregnant women attending maternity hospital for their routine ultrasound test in their third trimester.

Sample:

Method of Sample Collection: After obtaining informed consent, 85 pregnant ladies of gestational age 28-40 weeks were recruited in the study.

Subjects with uncomplicated pregnancy, who were certain of their LMP, whose difference between LMP and ultrasound calculated GA by CRL measurements was < 5 days were considered.

Ultra sonographic fetal kidney length measurements are taken using an ultrasound machine as shown in Fig. 1. Lengths in longitudinal axis of both the kidneys of each fetus are measured and mean is calculated. Standard fetal biometric parameters like bi- parietal diameter, femur length, head circumference, abdominal circumference are recorded and gestational age is analyzed and compared.

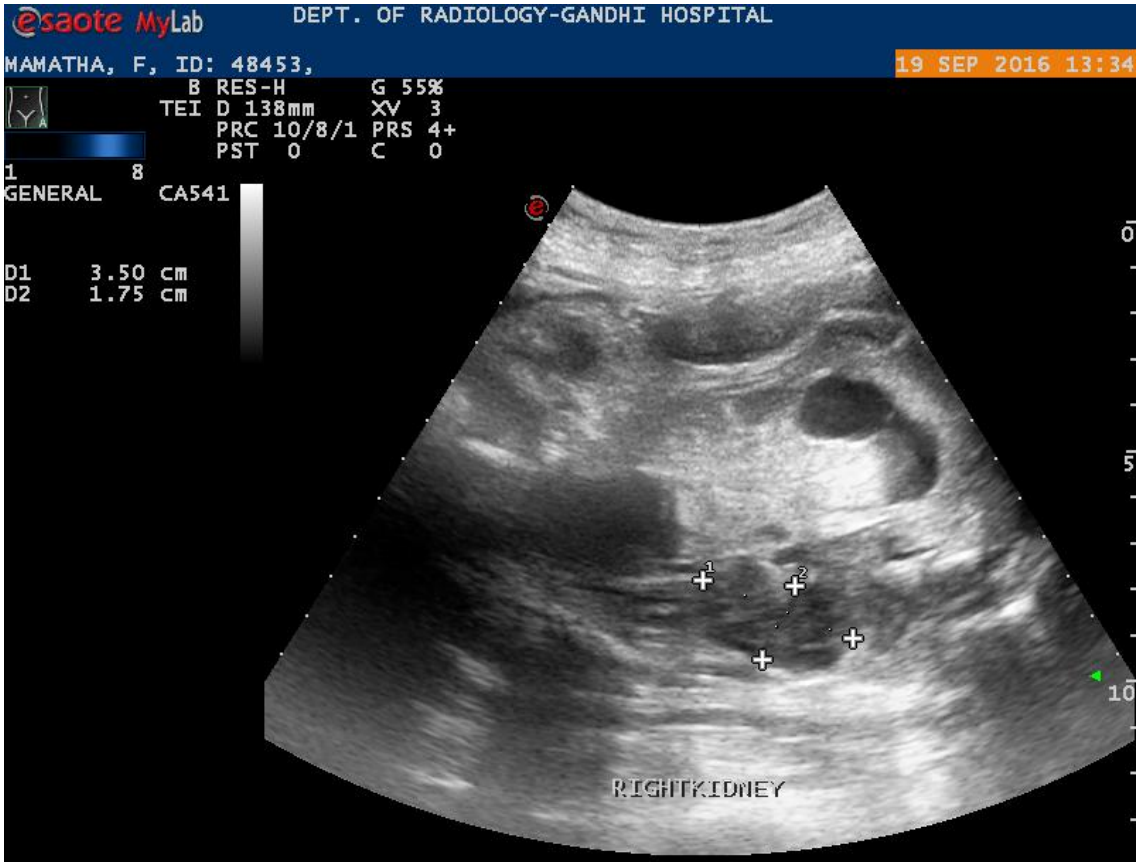

Figure 1: Measurement of fetal kidney. In this figure longitudinal as well as antero-posterior diameters of fetal kidney were made.

3. Results

In the present study, a total of 85 cases are included and are divided into ten gestational groups constituting one week each.
Earliest gestational age being 28weeks, 0 days and the maximum gestational age is 37 weeks and 6 days in the study. The smallest mean bi-parietal diameter being 6.85 centimeters (cms) measured at 28-29 weeks of gestation and maximum mean bi-parietal diameter is 9.07 cms at above 37 weeks of gestation. The present study showed a strong correlation between bi-parietal diameter and gestational age. (The $p < 0.00001$).

The lowest mean femur length is 5.23 cms, measured at 28-29 weeks of gestational age. The maximum mean femur length is 7.33 cms, found in subjects at above 37 weeks of gestational age. The study showed a strong correlation between femur length and gestational age. ($p = 0.000024$).

The lowest mean abdominal circumference is 22.95 cms, found in 28-29 weeks of gestational age group fetuses. The maximum abdominal circumference is 34.02 cms, found in fetuses at above 37 weeks of gestational age. 0.090957. This study did not show a significant correlation between abdominal circumference and gestati9onal age ($p=0.090957$).

The lowest mean head circumference is 25.50 cms at 28-29 weeks of gestational age. The maximum mean head circumference is 33.71 cms found in subjects at above 37 weeks of gestational age. This study did not show a significant correlation between head circumference and gestational age.($p=0.098404$).

The mean kidney length is calculated at each week of gestational age for cases included in the study.

The lowest mean kidney length recorded at the gestational age of 28-29 weeks is 3.0 cms and the highest mean kidney length recorded at above 37 weeks of gestational age is 3.74 cms. The study found a strong Pearson's correlation ($r=0.52$, $P=0.03$) for kidney length vs gestational age.

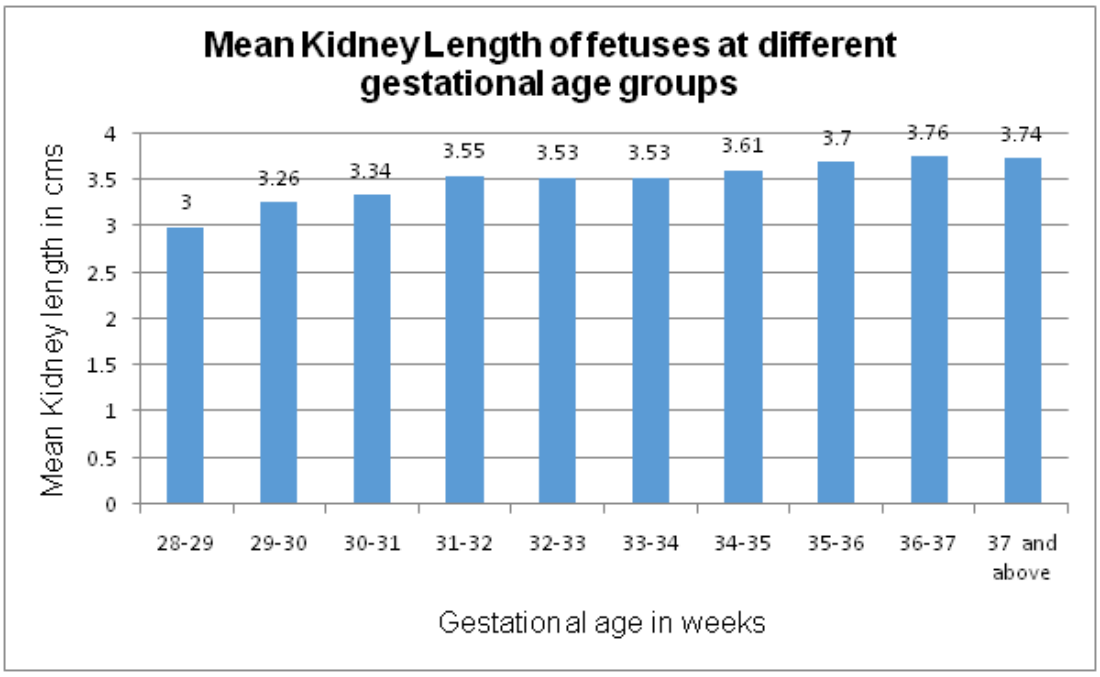

Figure 2: Mean kidney length of fetuses at different gestational age groups

4. Discussion

The present day challenge in dating pregnancy is to find a method which is simple, easy to define and reproducible. An accurate estimation of gestational age is fundamental for better management of pregnancy, especially in case of high-risk pregnancy[6]. It is helpful in pregnancy to know the approximate date of conception[7]. Prior to the widespread use of ultrasound, caregivers relied on a combination of history of last menstrual period and physical examination to clinically determine the gestational age. Ultrasound gave clinicians a method to measure the fetus and therefore to estimate the gestational age.Age of gestation can be accurately estimated by diameter and volume of gestational sac and measuring the length of fetal crown-rump throughout the early pregnancy. Also, fetal bi-parietal diameter and length of the femur can be used during the later gestational stages. Gestational age can also be determined accurately by gestational sac diameter and volume, fetal crown–rump length[8] and much later with the help of bi-parietal diameter and femur length measurements[9,10], abdominal circumference, head circumference and a combination of these. However, when women book late and in particularly those who are uncertain of their last menstrual period, it is often difficult to date pregnancies. In addition, ultrasonography fails in accurate determination of fetal age in the third trimester due to a large variability in the biometric parameter readings. Although these biometric indices are inaccurate in late stages of pregnancy, they are continued to be used among women with uncertain LMP in late stages. So, several studies were performed to determine an accurate estimation of GA by ultrasonic investigation during the late second and third trimesters. ***Ozat et al***, carried out a study on 2,184 pregnant women and established a nomogram of fetal sacral length in different fatal ages for assessment of GA[11]. They found sacral length as an easily acquired and valuable index with a direct and strong correlation with GA as well as other fetal biometry parameters. ***Sherer et al***, in a study on 602 pregnancies, used fetal hard palate width, length and area as indicators of GA with relative ease between 15 and 41 weeks of gestational age and showed that hard palate parameters were well correlated with GA, BPD, AC, FL and ultrasonic estimated fetal weight[12]. Many researches have been conducted to determine a precise estimation of GA using ultrasonic measurements throughout the second and the third trimester. Various parameters have been studied for dating pregnancies which include floating particles in the amniotic fluid,[13] transcoelomic diameter,[14] transcerebellar diameter,[15] ossification centres of the long bones,[16] clavicular length, foot length, thoracic abdominal diameter ratios,[13] scapular measurement,[17] fetal renal volume.[18] Several other studies have been made on this issue, but nevertheless none of their methods are practically used for gestational dating, because the ultrasound dating method should be simple, easy to define and reproducible.

Growth variation in the fetus affects all organs including the kidney but only in the antero-posterior and transverse diameter, not the length.[19,20] Earlier work found fetal kidney is easy to identify[19,20] and sex of the fetus do not alter the measurements of the fetal kidney.[21]

Fetal kidney growth is constant, increases 1.7 mm fortnightly throughout pregnancy and unchanged by growth disorders[22], which makes using it more reliable than other parameters in complicated pregnancies. ***Witzani et al***[22] suggested that renal length measures obtained by MRI are close to those obtained by ultrasound.

There was no problem in identifying, measuring and reproducing the measurement of fetal kidney length in the present study. A little manipulation of the transducer position and angle of insonation relative to the kidney plane allowed easy identification of both the kidneys in the fetuses. The sonographic measurements were performed

by three radiologists; it was a random study, the ultrasound machine was Prosound 6 ALOKA and MyLab40 ESAOTE and the subjects included in the study are from Secunderabad city attending Gandhi Hospital for routine antenatal ultrasonography.

According to the present study and also other studies the socio-economic status and the placental position did not have any effect on fetal kidney length.

5. Conclusion

Estimation of gestational age and fetal maturity is a key factor in antenatal care.

- Fetal renal lengths can aid in estimating gestational age when the other standard biometric parameters cannot be measured (low head position), or are not reliable (Eg: in IUGR abdominal circumference), if patients report in late second or third trimester when the standard fetal biometric parameters are not reliable.
- Thus fetal kidney length in addition with other standard fetal biometric parameters can give the estimation of gestational age more accurately.
- Kidney length can be used as one of the parameters to determine the gestational age of the fetus as its measurement is simple, reliable and easily defined and it is also not affected by growth variations and growth of fetal kidney is constant with an increase of 1.7mm fortnightly.

6. Limitations of the Study

The limitation of this study is the disability to determine the standardized values for mean fetal kidney length per each week of GA due to the small sample size.

References

[1] Peek MJ, Devonald KJ, Beilby R, Ellwood D. The value of routine early pregnancy ultrasound in the antenatal booking clinic. Aust N Z J Obstet Gynaecol. 1994 May. 34(2):140-3. [Medline].
[2] Guerrero R, Florez PE. The duration of pregnancy. *Lancet*. 1969 Aug 2. 2(7614):268-269.
[3] Naegele FC. Lehrbuch der Beburtshilfe fur Hebammen. 3rd ed. 1836.
[4] Butt K, Lim K, Determination of gestational age by ultrasound; J Obstet Gynaecol Can. 2014 Feb;36 (2):171-83.
[5] Kansaria JJ, Parulekar SV. Nomogram for fetal kidney length. Bombay Hosp J., 2009; 51(2): 155-62.
[6] Yusuf N, Moslem F, Haque J A. Fetal Kidney Length: Can be a New Parameter for Determination of Gestational Age in 3rd Trimester. TAJ: Journal of Teachers Association. 2007; 20(2).
[7] Kim K,Park J H. Measurement of fetal kidney size and growth using ultrasonography. Korean journal of nephrology:1995;14(4).
[8] Frank Anderson H M.D. Gestational age assessment, II. Prediction from combined Clinical observations. American J Obstet Gyncecol 1981;140(7).
[9] Hodlock Frank, Horrist Ronald. Estimating foetal age using multiple parameters: A Prospective evaluation in a racially mixed population. Am JObstet Gynecol 1987; 156:955-7.
[10] Parulekar SG. Ultrasonographic demonstration of floating particles in amniotic fluid. J Ultrasound Med 1983; 2 : 107-10.
[11] Ozat M, Kanat-Pektas M, Gungor T, Gurlek B, Caglar M.The significance of fetal sacral length in the ultrasonographic assessment of gestational age. Arch Gynecol Obstet 2011;283(5):999-1004.
[12] Sherer DM, Sokolovski M, Santoso PG, Dalloul M, Abulafia O. Nomograms of sonographic measurements throughout gestation of the fetal hard palate width, length and area. Ultrasound Obstet Gynecol 2004;24(1):35-41.
[13] Goldstein J, Lockward CJ, Hobbins JC. Ultrasound assessment of foetal intestinal development inthe evaluation of gestational age. Obstet Gynecol1987; 70 : 682-6.
[14] Goldstein Israel, Reece Albert. Cerebellar measurements with ultrasonography in the evaluation of foetal growth and development. AmJ Obstet Gynecol 1987; 156 : 1065-9.
[15] Tobsh KMA. Correlation of Ultrasonic epiphyseal centres and lecithin: Sphyingomyelin ratio. Obstet Gynecol 1984; 64 : 92-6.
[16] Exacoustos C, Rosati P, et al. Ultrasound measurements of foetal limb bones. Ultrasound Obstet Gynecol 1991; 1(5) : 325-30.
[17] Dilmen G, Turhan NO, Toppare MF, Seckin N, Ozturk M, Goksin E: Scapula length measurement for assessment of fetal growth and development Ultrasound in Medicineand Biology, 1995:21 (2):139-142.
[18] Fauchonet D, Benzie RJ, Mein B, Al Balooshi S, Thavaravy R. Three - dimensional ultrasound estimation of fetal renal volumes in the second and third trimesters. ASUM Ultrasound Bulletin 2005: 8 (2): 27-28.
[19] Konje JC, Bell SC, Morton JJ, de Chazal R, Taylor DJ. Human fetal kidney morphometry during gestation and the relationship between weight, kidney morphometry and plasma active remain concentration as birth. Clin Sci. 1996;91:169-175.
[20] Konje JC, Okara CL, Bell SC, de Chazal R, Taylor DJ. A cross-sectional study of changes in fetal renal size with gestation in appropriate and small for gestational age fetuses. Ultrasound Obstet Gynecol. 1997; 9:35-7.
[21] Konje JC, Abrams KR, S. C. Bell, D. J. Taylor. Determination of gestational age after 24th week of gestation from fetal kidney length measurement. Ultrasound Obstet Gynecol. 2002; 19:592-7.
[22] Witzani L, Brugger PC, Hörmann M, Kasprian G, Csapone Balassy C, Prayer D. Normal renal development investigated with fetal MRI. Eur J Radiol 2006; 57: 294-302