Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 09, 2023

Original research article

Study on the correlation of gestational age based on LMP and ultrasonography in the 2nd and 3rd trimester

[1]Dr. Thatiparthi Indira, [2]Dr. G.N. Charitha, [3]Dr. G. Yamini Vishnu Priya, [4]Dr. Mohd Bahrul Islam Khan

[1,2]Assistant Professor, Department of Anatomy, S.V. Medical College, Tirupati, Andhra Pradesh, India
[3]Assistant Professor, Department of Orthopaedics, S.V. Medical College, Tirupati, Andhra Pradesh, India
[4]Post Graduate, Department of Anatomy, S.V. Medical College, Tirupati, Andhra Pradesh, India

Corresponding Author:
Dr. Thatiparthi Indira (drindiravishi@gmail.com)

Abstract

Now-a-days assessing an accurate gestational age is considered to be a crucial factor to determine fetal growth and development. Ultrasonography is known to be a common non-invasive procedure to estimate fetal biometry at different gestational weeks. Though there were many studies emphasizing the correlation between gestation age (GA) using last menstrual dates (LMP) and ultrasonography (USG), the extended investigations in the same line may help to assess accurate method of gestational age estimation. Hence, the present study was aimed to understand and identify the correlation between gestational ages determined by LMP and USG using femur length from second trimester in the local pregnant population.

The study was conducted on 504 ultrasonograms of healthier antenatal mothers. All the ultrasonography procedures were performed using ESAOTE-MY LAB 60 Machine equipped with 3.5 MHZ curvilinear transducer. Statistical analysis was conducted using SPSS software and linear regression analysis was performed to assess the interrelation of LMP and USG estimated gestational ages. The results of the study has exhibited the standard deviation of LMP and USG based gestational age as 7.8895 and 7.9775 respectively with significant P values (<0.001) and high degree of correlation (0.993). These findings has confirmed that LMP based estimation is more reliable than sonography estimated gestational age. Therefore, attention to LMP dates along with early week scanning may enable to identify an accurate gestational age and exact date of delivery. Thus, it would not only help to prevent preterm delivery but also assist to provide appropriate obstetric intervention.

Keywords: Gestational age, femur length, ultrasonogram and last menstrual period

Introduction

Assessing fetal biometric measurements during pregnancy period was considered to play a key role in anticipating a definite gestational age [1, 2]. Estimation of gestational age based on last menstrual period (LMP) is used universally to calculate the expected date of delivery. The true fetal age must be calculated from the time of conception, however it is impossible to determine the conceptional or true fetal age with few exceptions like *in-vitro* fertilization. Therefore, instead of fetal age, many studies use gestational age considering the first day of last menstrual period (LMP) though it exceeds the fetal age by 12-14 days [3, 4, 5].

Ultrasonograpy is a non-invasive technique that is commonly suggested to perform in the antenatal women reported with last menstrual period (LMP) for assessing gestational age and measuring fetal parameters. The fetal measurements thus obtained are compared with age-specific references using standard formulae. The fetal parameters that are used to assess gestational age in first trimester are the gestational sac mean diameter and crown-rump length. While in the second trimester biparietal diameter, head circumference, abdominal circumference and femur length are used in combinations [6, 7]. Due to evidenced correlation between fetal length measurements and gestational age, ultrasonography has been used to identify an accurate gestational age and to identify number of fetus, position of placenta and other fetal abnormalities.

Biparietal diameter and femur length are commonly used to assess the gestational age in second trimester. However, due to positional variations like deeply engaged head and congenital anomalies like hydrocephaly, microcephaly and anencephaly, measurement of biparietal diameter remained challenging [8]. In such cases, femur length can be an adjunct indicator of gestational age and screening parameter to rule out dwarfism and congenital anomalies of limbs due to its clear visualization since 11 weeks of gestational age [9, 10]. Hence in the present study, fetal femur length was selected to investigate the correlation of gestational age using LMP and USG from 13-40 weeks to validate gestational age (GA) and to perform further fetal growth evaluation.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 09, 2023

Material & Methods

The present study consists of ultrasonograms of healthier local antenatal mothers ranging from 13 to 40 weeks of gestation who visited for their routine antenatal checkups. A proper ethical approval was taken from institutional ethical committee before conducting the study. After obtaining committee's approval, all the sonograms were obtained with the consent of the study participants. The entire study was conducted in the department of Radiology, S.V.R.R.G.G. Hospital, Tirupati and other radiodiagnostic centers in and around Tirupati, Andhra Pradesh, India.

Inclusion and exclusion criteria

The study includes local antenatal mothers with regular menstrual cycles, known LMP, non-alcoholic and no usage of oral contraceptive pills etc., and excluded the patients with maternal diseases (maternal diabetes mellitus, hypertension), multiple gestation and dwarfism. Among 521 sonograms, 17 sonograms were excluded from the study due to conditions like asymmetric Intra Uterine Growth Retardation (IUGR), short limbs, polydactyly and intra uterine death (IUD) of fetuses and the study was carried out on the remaining 504 scans.

According to the reports, the early second trimester sonography was considered as a reliable method in predicting gestational age and date of delivery [11, 12]. Most of these studies used biparietal diameter and correlated with gestational age documented by LMP. Due to evidenced positional variations and anomalies of fetal head, femur length was preferred in the current study to estimate GA instead of biparietal diameter [13]. As per earlier reports, oblique imaging has been documented with complications of femur length shortening and overestimation with inclusion of epiphyseal portion. However, these complications could be further ameliorated by imaging the femur length in vertical orientation, excluding proximal and distal epiphyseal cartilages [14].

Though variations in type of equipment, and distance from transducer were observed, the maintenance of horizontal measurement of bones was found to be appropriate to determine accurate gestational age [15]. Hence, measurement of fetal parameters became more accessible and simple with updated versions of real-time ultrasound scanners.

In this study, femur lengths were measured using ESAOTE-MY LAB 60 Machine equipped with 3.5 MHZ curvilinear transducer. Mahoney and Hobbins technique was used to measure femur length during entire sonography procedure [16]. It involves initial identification of lie of fetus and visualization of full length of femur. After obtaining clear view of femur, freeze-frame is employed and calcified portion of femur is measured with multi-directional electronic calipers along the long axis of femur from one end to the other end excluding femoral neck and both proximal and distal epiphyseal cartilages [17] [Fig.1].

The whole data was analyzed using Statistical Package for Social Sciences (SPSS software) and estimated the mean and standard deviation values. Further, linear regression analysis was conducted to identify LMP correlation with USG estimated gestational age.

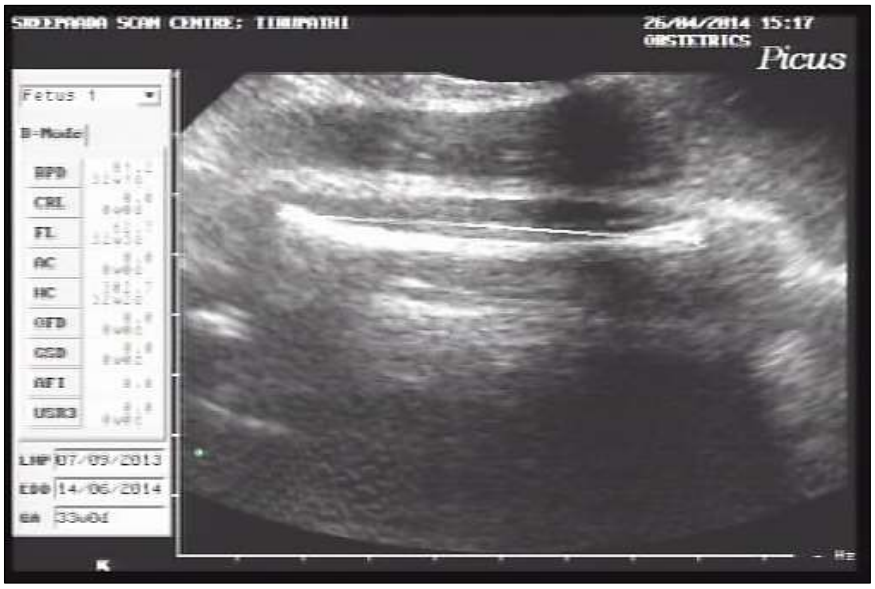

Fig 1: Femur length measurement along its long axis excluding neck and both proximal and distal epiphyseal cartilage

Results

In the present study, the gestational age of fetuses was documented based on LMP and ultrasonography (USG) using fetal femur length. The collected data was statistically analyzed by mean ± Standard deviation. The mean and standard deviation (SD) for the LMP and USG estimated gestational age in 2nd and 3rd trimester fetuses were found to be 27.346 ± 7.8895 and 28.164 ± 7.9775 respectively as shown in

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 09, 2023

the Table 1. As per the results, the standard deviation of LMP based gestational age (7.8895) was found to be comparatively less than sonography estimated age (7.9775) indicating its low variability and high accuracy than sonography estimated age. The result also affirms the positive correlation between the variables which was majorly attributed to evidenced significant P values (P <0.001) as shown in Table 1.

Table 1: Mean difference and Pearson correlation of GA based on LMP and USG

S. No.	Variable (N=504) (weeks)	Mean	Standard Deviation	Correlation Coefficient (r)	P value
1.	GA by LMP	27.346	7.8895	0.993	<0.001;S
2.	GA by USG	28.164	7.9775		

Where N = Number of ultrasonograms, GA = Gestational age, LMP= Last Menstrual Period, USG =Ultrasonography and S= Significant.

The gestational age of fetus is estimated from the first day of last menstrual period and also predicted by using sonography measurements of fetal parameters. The estimated (LMP) and predicted (USG) gestational age of fetuses of the present study were shown in Table 2. From the results, it was also found that the predicted gestational ages using femur length were proportional to the LMP estimated ages from 12 to 40 weeks with a minimum difference of two days to one week.

Table 2: GA of fetus estimated by LMP and USG using fetal femur length

GA by LMP (weeks)	Number of ultrasonograms	GA by USG (weeks)	Mean of FL (mm)
12-13.9	22	14.1	12.6
14-15.9	18	15.3	16.7
16-17.9	34	17.9	26.2
18-19.9	48	19.3	30.6
20-21.9	31	21.7	38.1
22-23.9	36	23.2	42.1
24-25.9	22	25.7	47.2
26-27.9	48	27.8	53.0
28-29.9	27	29.8	57.1
30-31.9	25	31.2	60.6
32-33.9	25	33.7	65.6
34-35.9	77	36.0	69.8
36-37.9	65	37.4	72.0
38-39.9	26	39.0	73.6

GA= Gestational age, LMP= Last Menstrual Period, USG = Ultrasonography and FL = Femur length.

Further, a graph was plotted between gestational ages of LMP and USG, that has clearly exhibited a linear relationship between them and this was further potentiated by significant r^2value, 0.986 as given in figure 2. Here these estimated results were statistically further analyzed by generating an equation Y= -0.31+0.98X, where Y= gestational age estimated by LMP and X= gestational age predicted by USG in weeks respectively, whereas -0.31, indicates Y intercept value and 0.98 represent its slope (Fig.2).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 09, 2023

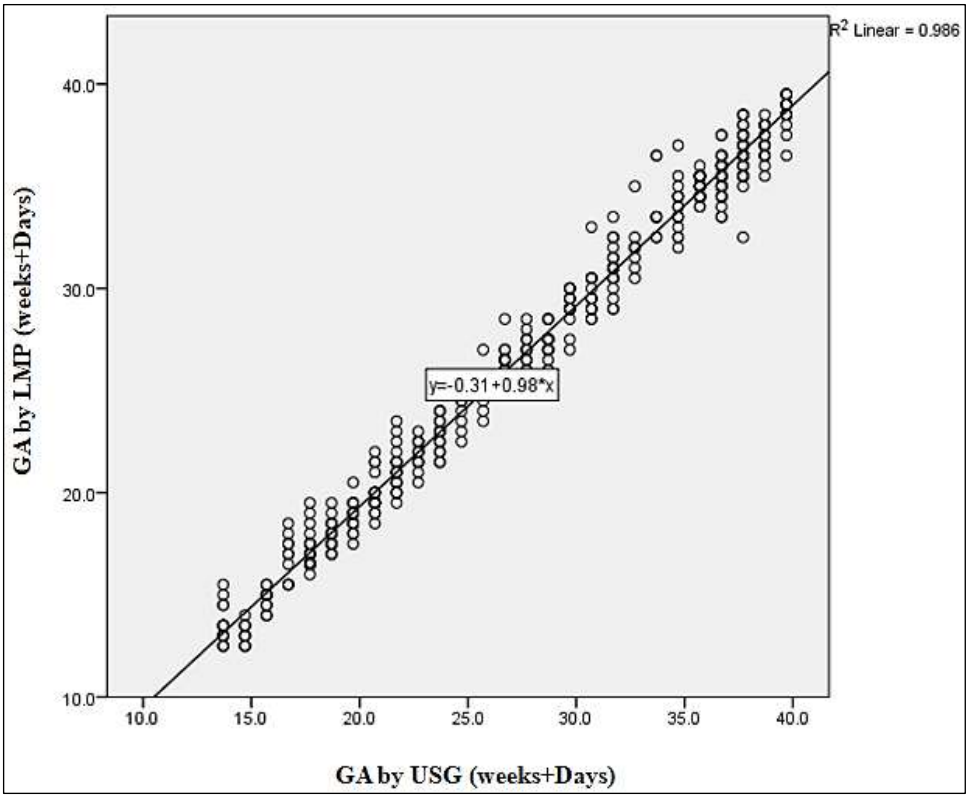

Fig 2: Scatter plot representing linear relation between LMP and USG measurements

Discussion

Conventionally, menstrual age determines the length of pregnancy and sonography measures the fetal parameters, whereas both will be considered clinically by sonologist in order to predict an expected date of delivery (EDD) and follow the 10-day rule or 7-day rule to exclude large errors from incorrect menstrual dates [18]. As per literature, the first day of known LMP reported by antenatal mothers was considered as the most readily accessible method of gestational age estimation [19]. Hence, in the current study, GA estimated by using LMP dates was considered as a reliable method to assess length of gestation as compared with USG.

Even so, there were few dating discrepancies reported with known LMP, the application of rule of eight would minimize these differences while recording sonography measurements [20]. Similarly, variability of ovulation and ultrasonography limitations were reduced by employing standard Naegele's rule based on first day of LMP for EDD calculation [11]. Majority of the studies conducted on gestational age estimation stated that ultrasonography is a reliable technique in assessing the length of gestation in antenatal women, with or without known LMP dates [21]. However, as per the results in the present study, it had clearly displayed a linear relationship between estimated (LMP) and predicted (USG) gestational age throughout second and third trimester. Hence, the results of the investigation had confirmed that LMP based estimation of gestational age could be a relevant and accessible measuring method that can be used as an adjunct to the ultrasonography in assessing fetal parameters and EDD.

Conclusion

The results of our study had clearly exhibited that LMP based gestational age estimation is highly reliable in the determination of gestational age length and EDD. In addition, these findings could be a substitute to ultrasonography measurements which are crucial in attending the antenatal needs. Further, creating awareness on regular menstrual cycles and LMP dates in the women especially residing at remote areas may assist to determine accurate gestational age based on LMP which eventually aid to predict EDD using ultrasonography.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding: None.

Acknowledgement

First author-conducted study, manuscript writing and correspondence with the journal; Second and Third author-assisted in article writing; Fourth author- supported in excelling results.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 09, 2023

References

1. O'Gorman N, Salomon LJ. Fetal biometry to assess the size and growth of the fetus. Best practice & research Clinical obstetrics & gynaecology. 2018 May;49:3-15.
2. Skupski DW, Owen J, Kim S, Fuchs KM, Albert PS, Grantz KL. Estimating gestational age from ultrasound fetal biometrics. Obstetrics and gynecology. 2017 Aug;130(2):433.
3. Kondagari L, Kahn J, Singh M. Sonography Gynecology Infertility Assessment, Protocols and Interpretation.
4. Shah S, Teismann N, Zaia B, Vahidnia F, River G, Price D, *et al*. Accuracy of emergency physicians using ultrasound to determine gestational age in pregnant women. The American journal of emergency medicine. 2010 Sep;28(7):834-8.
5. Babuta S, Chauhan S, Garg R, Bagarhatta M. Assessment of fetal gestational age in different trimesters from ultrasonographic measurements of various fetal biometric parameters. Journal of the anatomical society of India. 2013 Jun;62(1):40-6.
6. Aggarwal N, Sharma GL. Fetal ultrasound parameters: Reference values for a local perspective. Indian Journal of Radiology and Imaging. 2020 Apr;30(02):149-55.
7. Gameraddin M, Abdelmaboud S, Alshoabi S, Fadul M. The role of fetal humeral length in determination of gestational age compared with femoral length using ultrasonography. IOSR-JDMS. 2015;14(5):65-8.
8. Egley CC, Seeds JW, Cefalo RC. Femur length versus biparietal diameter for estimating gestational age in the third trimester. American journal of perinatology. 1986 Apr;3(02):77-9.
9. Honarvar M, Allahyari M, Dehbashi S. Assessment of gestational age based on ultrasonic femur length after the first trimester: a simple mathematical correlation between gestational age (GA) and femur length (FL). International Journal of Gynecology & Obstetrics. 2000 Sep;70(3):335-40.
10. Williams G, Coakley FV, Qayyum S, Glenn OA, Breiman RS, Callen PW. Evaluation of femur length during the second and third trimesters in fetuses with myelomeningocele. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2004 Feb;23(2):148-51.
11. Lynch CD, Zhang J. The research implications of the selection of a gestational age estimation method. Paediatric and perinatal epidemiology. 2007 Sep;21:86-96.
12. Olesen AW, Thomsen SG. Prediction of delivery date by sonography in the first and second trimesters. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2006 Sep;28(3):292-7.
13. Yeh MN, Bracero L, Reilly KB, Murtha L, Aboulafia M, Barron BA. Ultrasonic measurement of the femur length as an index of fetal gestational age. American Journal of Obstetrics and Gynecology. 1982 Nov;144(5):519-22.
14. Goldstein RB, Filly RA, Simpson G. Pitfalls in femur length measurements. Journal of ultrasound in medicine. 1987 Apr;6(4):203-7.
15. Gamba JL, Bowie JD, Dodson WC, Hedlund LW. Accuracy of ultrasound in fetal femur length determination ultrasound phantom study. Investigative Radiology. 1985 May;20(3):316-23.
16. Mahoney MJ, Hobbins JC. Prenatal diagnosis of chondroectodermal dysplasia (Ellis-van Creveld syndrome) with fetoscopy and ultrasound. New England Journal of Medicine. 1977 Aug;297(5):258-60.
17. Butt K, Lim K, Bly S, Cargill Y, Davies G, Denis N, *et al*. Retired: Determination of Gestational Age by Ultrasound. Journal of Obstetrics and gynaecology Canada. 2014 Feb;36(2):171-81.
18. MacKenzie AP, Stephenson CD, Funai EF. Prenatal assessment of gestational age, date of delivery, and fetal weight. Consultado 18 Abril, 2019 Apr.
19. Gernand AD, Paul RR, Ullah B, Taher MA, Witter FR, Wu L, *et al*. A home calendar and recall method of last menstrual period for estimating gestational age in rural Bangladesh: a validation study. Journal of Health, Population and Nutrition. 2016 Dec;35(1):1-9.
20. Hunter LA. Issues in pregnancy dating: revisiting the evidence. Journal of Midwifery & Women's Health. 2009 May;54(3):184-90.
21. O'Brien GD, Queenan JT. Growth of the ultrasound fetal femur length during normal pregnancy: part I. American Journal of Obstetrics and Gynecology. 1981 Dec;141(7):833-7.