

Ultrasonographic Evaluation of Foetal Head Circumference and its Correlation with Gestational Age

MOHAMMAD SAIFUL HOQ IBNA MAJIB¹, A.K.M. ANOWAR HOSSAIN², MOHAMMAD SHAHIDUL ALAM³, SULTANA AMENA FERDOUCY⁴, MD. SHAHIDUL ISLAM⁵, BANAJABA⁶

Abstract

Background: Accurate knowledge of the Gestational Age (GA) is the key for the good antenatal care and successful deliveries of babies. Menstrual history can be unreliable or misleading at many times. So, there is a need of a parameter for supplementing the gestational age estimation with minimal error.

Objective: To find out the role of sonographically measured head circumference for determination of gestational age in 2nd and 3rd trimester of pregnancy.

Method: This cross sectional study was carried out on 100 normal pregnant women with apparently normal fetuses between 13 to 42 weeks of gestation referred to the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University and Dhaka Medical College Hospital for ultrasonic evaluation of pregnancy profile. Fetal head circumference was measured sonographically and gestational age was determined on the basis of BPD, FL and HC. The parameters were correlated with gestational age determined on the basis of LMP. A p value of <0.05 was taken as level of significance.

Result: More than half of the study subjects were in the age group of 21 – 25 years and mean age of

the study subjects was 24.6 ± 5.2 years in this study. Maximum study subjects were housewife (65.0%) followed by 19.0% student and 16.0% service holder. A positive correlation was found between the head circumference and gestational age ($r=0.991$, $p < 0.001$) which is more significant than BPD ($r=0.986$, $p < 0.001$) and FL ($r = 0.989$, $p < 0.001$).

Conclusion: Foetal head circumference can be an additional parameter for estimation of the gestational age as it almost corresponds with the gestational age in second and third trimesters.

Keywords: Ultrasonography, foetal head circumference, gestational age.

Introduction

A healthy new born is the goal of every expectant mother and her obstetrician. Gestational age, synonymous with menstrual age, is defined in weeks beginning from the first day of the last menstrual period (LMP) prior to conception. Accurate prediction of the gestational age (GA) is very important in the management of obstetric patients for planning a timely and uneventful outcome.

Clinical dating of a pregnancy is usually based on the patient's recollection of the first day of her last menstrual period and on physical examination of uterine size. Unfortunately, both these methods are subject to imprecision, leading to inaccuracies in gestational age assignment. Dating by last menstrual period may be inaccurate because of variability in length of menstrual cycle, faulty

Author of correspondence: A.K.M. Anowar Hossain, Assistant Professor, Department of Radiology & Imaging, Bangladesh Medical University, Dhaka, Bangladesh. Email: drakmanowar@gmail.com

1) Associate Professor (Radiology), Department of Radiology & Imaging, National Institute of Disease of the chest & Hospital (NIDCH), 2) Assistant Professor (Radiology), Department of Radiology & Imaging, Bangladesh Medical University, 3) Assistant Professor (Radiology), Department of Radiology and Imaging, National Institute of Laboratory Medicine and Referral Center, NILMRC, Abdur Rahim Medical College, Dinajpur.

4) Associate Professor (Radiology), Department of Radiology and Imaging, Dr. MR Khan Sishu Hospital & IDH, Mirpur, Dhaka, 5) Associate Professor (Radiology), Department of Radiology and Imaging Sheikh Hasina Medical College, Tangail, 6) Associate Professor (Radiology), Department of Radiology and Imaging, Shaheed Suhrawardy Medical College & Hospital.

Received: 287 November 2024 **Revised:** 10 December 2024

Accepted: 26 December 2024

Published: 1 March 2025

memory, recent exposure to oral contraceptives, or bleeding during early pregnancy. Determining the gestational age from the palpated dimension of the uterus may be affected by uterine fibroids, multiple pregnancy, and maternal body habitus.

As the clinical estimation of gestational age to assess fetal growth is not reliable, prenatal ultrasonography provides an opportunity to more accurately assess fetal growth. Ultrasound biometry of the fetus is now the gold standard for assessing the fetal growth¹. Since its introduction in the late 1950's ultrasonography has become a very useful diagnostic tool in obstetrics. Ultrasound scan currently considered to be a safe non-invasive, accurate and cost-effective investigation in the fetus.^{2,3} It has progressively become an indispensable obstetric tool and plays an important role in care of every pregnant woman. Unlike x-rays, ionizing radiation is not present and embryo toxic effects with such irradiation should not be relevant.⁴

Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) are considered reliable predictors in the estimation of fetal age in patients whose fundal height on abdominal examination does not corresponding to the last menstrual period (LMP).^{5,6} The purpose of this study was to determine the GA using sonographic measurement of the fetal head circumference (HC) and to correlate fetal head circumference with gestation age by using real time ultrasonogram in Bangladeshi population.

Methods:

This cross sectional study was carried out on 100 normal pregnant women with apparently normal fetuses between 13 to 42 weeks of gestation referred to the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University and Dhaka Medical College Hospital for ultrasonic evaluation of pregnancy profile. Pregnant woman with known diabetes, hypertension, multiple pregnancy, oligo or polyhydramnions, intrauterine growth retardation, unreliable LMP were excluded from this study. Only single tone fetus with complete visualization of fetal head circumference were included. At first all subjects were evaluated by detailed history and clinical examination with

special emphasis on obstetrics. Feta head circumference was measured sonographically and gestational age was determined on the basis of BPD, FL and HC. The parameters were corelated with gestationa age determined on the basis of LMP. Measure of dispersion and the test of significance (Pearson's correlation co-efficient test) were performed to detect statistical significance of the study. P value of <0.05 was taken as level of significance.

Results:

Table-I

Age distribution of the subjects (n=100)

Age in years	Frequency (n)	Percentage (%)	Mean±SE
18-20	12	12	
21-25	54	54	24.6±5.2
26-30	19	19	
31-35	15	15	

More than half of the study subjects were in the age group of 21 – 25 years and mean age of the study subjects was 24.6±5.2 years.

Table-II

Occupation distribution of subjects (n=100)

Occupation	Number of subjects	Percentage %
House wife	65	65.0
Student	19	19.0
Service Holder	16	16.0

Maximum study subjects were housewife (65.0%) followed by 19.0% student and 16.0% service holder.

Table-III

Relationship of foetal HC, BPD and FL with gestational age (n=100)

	Pearson's correlation coefficient (r)	P value
Foetal head circumference (HC)	0.991	<0.001
Foetal biparietal diameter (BPD)	0.986	<0.001
Foetal femoral length (FL)	0.989	<0.001

A strong positive correlation was found between foetal head circumference and gestational age.

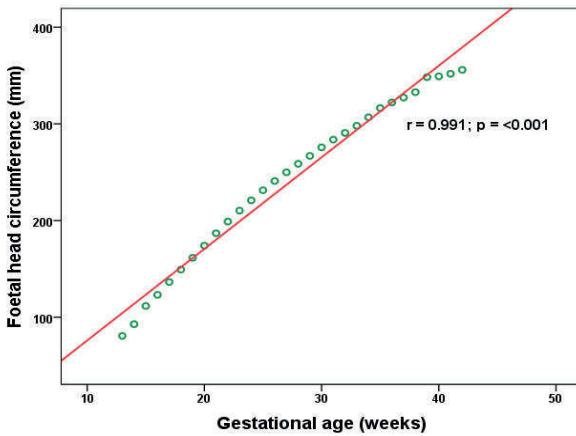


Figure 1: Relationship of mean foetal head circumference with gestational age

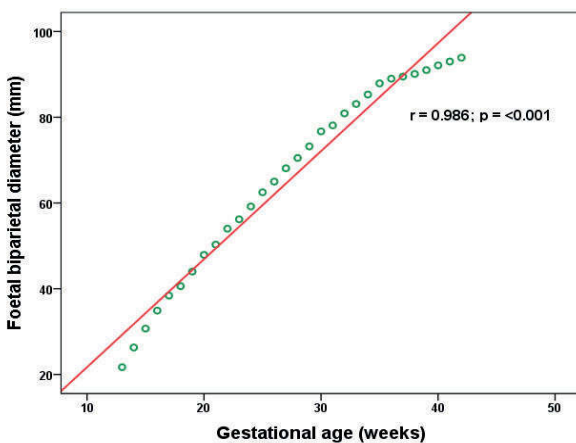


Figure 2: Relationship of mean foetal biparietal diameter with gestational age

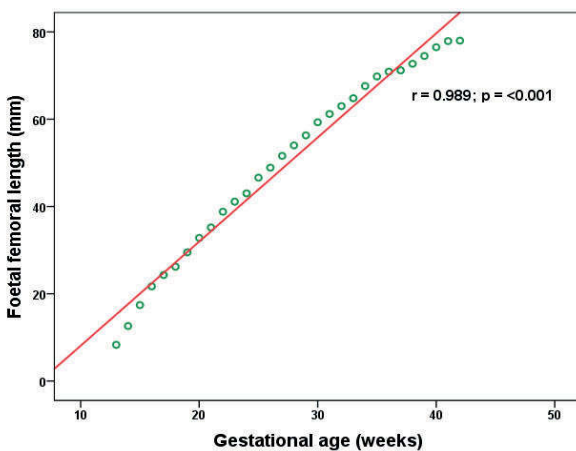


Figure 3: Relationship of mean foetal femoral length with gestational age

Discussion:

It is important to determine the gestational age and the expected date of delivery in a more accurate manner which would eventually determine the management, with regards to mode of delivery either in the form of planned induction of labour or for caesarean section.

In a study, Hadlock et al.⁷ revealed head circumference as a useful parameter in predicting menstrual age estimating fetal weight and detecting intrauterine growth retardation. In another study, Hadlock et al.⁸ defined the boundaries of the cephalic index at which the head circumference is consistently more accurate than the BPD in establishing gestational age.

More than half of the study subjects were in the age group of 21 – 25 years and mean age of the study subjects was 24.65.2 years in this study. Maximum study subjects were housewife (65.0%) followed by 19.0% student and 16.0% service holder.

In this study positive correlation was found between the head circumference and gestational age ($r=0.991, p < 0.001$) which is more significant than BPD ($r=0.986, p < 0.001$) and FL ($r = 0.989, p < 0.001$).

In a study, Doubilet and Greens⁹ estimated gestational age based on biparietal diameter alone was compared with three approaches to age prediction that consider head shape: area-corrected biparietal diameter, circumference-corrected biparietal diameter, and head circumference. They concluded that head shape was more precise than biparietal diameter alone. Law and Merare¹⁰ concluded that the head circumference is a more accurate index of the age of the fetus and its growth potential. Head Circumference may have an advantage over BPD in situations where head shape is significantly altered.¹¹

In second trimester corrected biparietal diameter and head circumference more accurate predictors of gestational age than were biparietal diameter femoral lengths and abdominal circumference. In 3rd trimester, the corrected biparietal diameter head circumference and femoral length were best predictors, significantly better than biparietal diameter and abdominal circumference.¹²

Chervenak et al.¹³ revealed that head circumference was the best predictor of gestational age than BPD, abdominal circumference and femur length.

Conclusion:

Foetal head circumference is well related to gestational age. If head circumference is measured accurately with high resolution ultrasound scanner it can be used reliably as an additional parameter at 2nd and 3rd trimester of pregnancy in conjunction with other established parameters or when other method fails to contribute to assess the gestational age.

References:

1. Peleg D, Kennedy CM, Hunter SK. Intrauterine growth restriction: identification and management. American family physician. 1998;58(2):453-60.
2. Andersen HF, Johnson TR Jr, Barclay ML, Flora JD Jr. Gestational age assessment. I. analysis of individual clinical observations. Am J Obstet Gynecol. 1981;139:173-7.
3. Beazley JM, Underhill RA. Fallacy of the fundal height. Br Med J 1970;4:404-6.
4. Woo J. Ultrasound in pregnancy. Obstetric ultrasound. A comprehensive guide. ACOG Practise Buletine, 2005; 58
5. Buckshee K, Arora V, Hingorani V. Evaluation of fetal development by real time sonar cephalometry in Indian pregnant women. India J Obstet Gynaecol. 1983;33:284
6. Campbell S. An improved method of fetal cephalometry by ultrasound. J Obstet Gynaecol Br Commonw. 1968;75:568-76.
7. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal head circumference: relation to menstrual age. American Journal of Roentgenology. 1982;138(4):649-53.
8. Hadlock FP, Deter RL, Carpenter RJ, Park SK. Estimating fetal age: effect of head shape on BPD. American Journal of Roentgenology. 1981;137(1):83-5.
9. Doubilet PM, Greenes RA. Improved prediction of gestational age from fetal head measurements. American journal of roentgenology. 1984;142(4):797-800.
10. Law RG, MacRae KD. Head circumference as an index of fetal age. Journal of Ultrasound in Medicine. 1982;1(7):281-8.
11. Ott WJ. Use of Ultrasonic Fetal Head Circumference for Predicting Expected Date of Confinement. Journal of clinical ultrasound. 1984;12(7):411-5.
12. Benson CB, Doubilet PM. Sonographic prediction of gestational age: accuracy of second-and third-trimester fetal measurements. AJR. American journal of roentgenology. 1991;157(6):1275-7.
13. Chervenak FA, Skupski DW, Romero R, Myers MK, Smith-Levitin M, Rosenwaks Z, Thaler HT. How accurate is fetal biometry in the assessment of fetal age? American journal of obstetrics and gynecology. 1998;178(4):678-87.