

Ultrasound Assessment of Gestational age with Fetal Biparietal Diameter, Femur Length and Abdominal Circumference in Normal Pregnancy

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Abstract: Gestational age is defined as the age of pregnancy which is measured in weeks, from the first day of the woman's last menstrual cycle to the current date. It may involve the measurement of fetal parameters. Fetal parameters are antenatal ultrasound measures that are used to assess the growth and well-being of the fetus. A normal pregnancy can range from conception (0 week) to 42 weeks. The aim of this study was to assess the correlation between some fetal parameters and gestational age in Delta North region of Nigeria (Agbor). Fetal biometrics such as abdominal circumference, biparietal diameter, and femur length were assessed. An ultrasound scan device was used to measure the fetal parameters. A total of 8970.5mm PBD, 3173.5mm AC and 6947.6mm FL measurement were obtained from these fetuses. The correlation between fetal parameters and gestational age was strongly positive (BPD with GA, $r=0.92$; AC with GA, $r=0.95$ and FL with GA, $r=0.91$) and this association was significant ($p<0.001$). Hence, this study validates the concept of using multiple fetal parameters to improve the accuracy and precision of fetal dating in third trimester and provides a tool for better care and management of the mother and fetus in Nigeria condition.

Keywords: Fetal biparietal diameter, Abdominal circumference, Femur length, Gestational age, Ultrasound.

Introduction

Gestational age is the age of pregnancy. It is measured in weeks, from the first day of the woman's last menstrual cycle to the date at presentation. A normal pregnancy can range from conception to 42 weeks, infants born before 37 weeks are considered premature while those delivered after 42 weeks are described as post mature. Gestational age may also be determined before or after birth utilizing certain landmarks [1]. Ultrasonography is a medical diagnostic technique in which very high frequency sound waves are directed into the body and at the tissue interfaces the sound is reflected. The resulting pattern of sound reflection is processed by computer to produce a photograph or a moving image on a television. The sound waves used in the ultrasound beam are produced by rapidly oscillating crystals in a device called a transducer. The transducer must be in close contact with the skin and a jelly-like substance is smeared on the skin to improve the transmission of sound [2].

Ultrasonography can be used to assess many parts of the body but its best-known application is in obstetrics for the determination of pregnancy and assessment of gestational age of the fetus. Gestational age is ultrasonically determined by measuring various fetal parameters. Fetal parameters are antenatal ultrasound measurements that are used to indirectly assess the growth and well-being of the fetus. The four standard biometric parameters commonly used to determine gestational age in the second and third trimesters and femur length (FL), biparietal diameter (BPD), head circumference (HC), and abdominal circumference (AC) [3]. Ultrasound is safe, non-invasive, accurate, and also the most effective means of examination of the fetus with no risk to either the fetus or the mother [2]. An ultrasound examination is medically indicated throughout pregnancy for the confirmation of first trimester assessment of pregnancy viability, estimation of gestational age by measuring the gestational sac diameter or the crown-rump length, assessment of abnormal gestation, and confirmation of molar or ectopic pregnancies.

In the second trimester, USS may assist with identification of Down syndrome (weeks 13-14), assessment for gross congenital malformation from 18 to 20 weeks, reification of date and growth, and confirmation of intrauterine fetal death.

In the third trimester, this procedure is used to detect structural abnormalities, localization of the placental site in the case of placenta praevia, confirmation of fetal presentation, and diagnosis of uterine and pelvic abnormalities during pregnancy [4].

Appropriate assessment of gestational age is paramount in obstetric care. Uncertain gestational age has been associated with adverse pregnancy outcomes including low birth weight, spontaneous preterm delivery, and prenatal mortality, independent of maternal characteristics. Making appropriate management decisions requires accurate appraisal of gestational age. For example, proper diagnosis and management of preterm labor and post-term pregnancy require an accurate estimation of fetal age [5-6]. According to Campbell et al [7] this process is carried out by clinical means alone is difficult and inaccurate, but ultrasound scan has been shown to simplify the evaluation of and provide accurate gestational age and, with corresponding optimal obstetric management, reduce perinatal mortality. Gestational age is also crucial for counseling patients regarding the option of pregnancy termination [8]. This study is therefore carried out to assess the correlation between selected fetal parameters and fetal gestational age amongst pregnant women in Agbor Central Hospital, Delta State, Nigeria.

Materials and Methods

This is a prospective study which involved one hundred and ten (110) pregnant women who enrolled for antenatal care at Central Hospital Agbor, Delta State, Nigeria between July 2013 to March 2014. Prior to data collection, ethical approval was obtained from the management and staff of Central Hospital, Agbor, Delta State, Nigeria which was in accordance with the code of Declaration of Helsinki in 1995. Consent was also obtained from each participant before commencement of the investigation. All women with term pregnancy had an ultrasound scan to measure the fetal parameters and the gestational age. The fetal biometric parameters (Biparietal diameter, Abdominal circumference, and femur length) were obtained for each of the fetuses.

The scan was performed with a real-time scanner with 3.5MHz focused transducer (Probe) and a scanning machine (model, Toshiba Aplio 500 PVT-375BT). The following parameters were measured:

Biparietal Diameter (BPD): was measured in a circular/transverse diameter from the leading edge of the proximal parietal bone to the upper edge of the distal parietal bone.

Abdominal Circumference (AC): was measured with an oval diameter starting from the upper abdominal wall to the lower abdominal wall.

Femur Length (FL): was measured from the lateral part of the femur bone starting from the greater trochanter to the lateral condyle of the femur. The lateral part of the femoral bone was used so as to have accurate result.

Gestational age was obtained with summation of the three-fetal parameters measured. Data analysis was done via the Statistical Package for Social Sciences (SPSS). Multivariate analysis was done to determine the correlation between gestational age and biometric parameters.

Results

Table 1: Correlation between biparietal diameter, femur length, abdominal circumference and gestational age of third trimester

S/N	V	M(mm)	SD	N	r	SEM	P-value
1	BPD	81.55	7.91	110	0.92	0.75	0.001
2	FL	63.16	6.93	110	0.91	0.66	0.001
3	AC	28.85	33.19	110	0.95	0.33	0.001

From the result above, the mean biparietal diameter was 81.55 ± 7.91 with a correlation value with gestational age of 0.92 with an association level of 0.001. This therefore depict that there was a strong positive correlation. Femur length and abdominal circumference was given at 63.16 ± 6.93 and 28.85 ± 33.19 respectively. There was also a strong positive correlation with gestational age (0.91; 0.95) respectively.

Discussion

This was a prospective study involving one hundred and ten cases of normal pregnancies, over a period of one year (July 2013 – March 2014) in the Department of Radiology, Ultrasound Unit, Central Hospital Agbor, Delta State, with biparietal diameter, femur length and abdominal circumference accounting for the most used fetal parameters in gestational age determination.

In this study, a strong correlation was observed between biparietal diameter (BPD) and gestational age (GA). This was similar to previous studies in Thailand, Pakistan, Punjab and Nepal where it was found that BPD correlated positively with GA but that it was important to use it with AC and FL as multiple fetal parameters. This was however different from a study conducted at Jos in Nigeria where biparietal diameter (BPD) better correlated gestational age. The reason for the difference was that they used BPD (biparietal diameter) as a single fetal parameter in gestational age determination unlike in this study where three fetal parameters were used. Another difference was seen in Degani's [9] study in India where it was found that BPD correlated strongly with GA. Reason being that two fetal parameters, biparietal diameter and crown-rump length (BPD and CRL), were used in this study as the only fetal parameters in gestational age assessment.

It was observed in this study that there was a strong correlation between femur length (FL) and gestational age (GA). This was identical to previous studies in Thailand, Pakistan, Punjab and Nepal where it was found that FL correlated positively with GA but that it was important to use it with AC and BPD as multiple fetal parameters. This was however different from studies conducted in Malaysia, Bangladesh, and Jos in Nigeria where femur length produced a good correlation with gestational age. This was because only femur length (fetal parameter) was used as the only single fetal parameter in determining gestational age. Another difference was observed in a study by Mukta et al [10] in an Indian population where it was observed that fetal femur-to-foot length ratio was used as the only fetal parameter for the assessment of gestational age.

In this study, a strong correlation was observed between abdominal circumference (AC) and gestational age (GA). This was similar to previous studies in Thailand, Pakistan, Punjab and Nepal where it was found that AC correlated strongly with GA but that it was important to use it with BPD and FL as multiple fetal parameters. This was different from a study conducted in India by Bhusari et al [11] who found that fetal age can be estimated with the range of \pm five (5) days by using first trimester parameters other than third trimester parameters.

As observed in this study, proper assessment of gestational age was essential in pregnancy dating. In accordance with Mamerhi et al [12] it was suggested that accurate pregnancy dating could assist obstetricians in appropriately counseling women who were at risk of preterm delivery, evaluation of fetal growth, and the detection of intrauterine growth restriction.

Conclusion

In this study, it was observed that ultrasound assessment of biparietal diameter, abdominal circumference, and femur length (BPD, AC and FL) in normal pregnancy correlated well with gestational age. In our country where most of the women may not keep menstrual record properly and who present late in third trimester for first time ultra sonogram (USG) assessment, gestational age by multiple fetal growth parameters can be of immense value. Hence this study no doubt validated the concept of using multiple parameters to improve the accuracy and precision of fetal dating in the third trimester and provides a tool for better care and management of the mothers and fetuses in Nigerian conditions. Ultrasonic fetal biometric measurement has been proven to be a useful and accurate method of determining gestational age of the fetus and the last menstrual period (LMP) of the mother.

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