ORIGINAL RESEARCH

The Diagnostic Accuracy of Humeral Length in Assessing Gestational Age

[1]Dr. Neeti Chaturvedi, [2]Dr. Pratima Sharma

[1]Assistant Professor, Deptt. of Obstetrics and Gynaecology National Capital Region Institute of Medical Sciences Meerut
[2]Assistant Professor, Deptt. of Obstetrics and Gynaecology National Capital Region Institute of Medical Sciences Meerut

Corresponding author
Dr. Pratima Sharma
Assistant Professor, Deptt. of Obstetrics and Gynaecology National Capital Region Institute of Medical Sciences Meerut

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ABSTRACT

Background:It is indeed possible to estimate fetal age by combining measurements of various fetal bones such as the femur, humerus, tibia, and ulna. The objective of this study was to evaluate the diagnostic accuracy of using sonographic measurements of fetal humeral length as a means to estimate gestational age. This approach can provide valuable information for tracking the development and growth of the fetus during pregnancy.

Methods: The study involved the analysis of ultrasound data from 240 healthy pregnancies. A 3.5MHz probe and standard obstetric practices were employed to assess the biometrics of the fetal skeleton. Specifically, the length of the fetal humerus was determined by measuring its diaphyseal apophysis, which involves assessing the length from the apex to the apophysis of the bone. This method allowed for the collection of data on fetal skeletal development, which can be instrumental in estimating gestational age and monitoring the health and growth of the fetus during pregnancy.

Results: In the current study, a total of 240 pregnant females were included. Among them, 44.33% were nulliparous, meaning they were experiencing their first pregnancy, while 55.66% were multiparous, indicating they had previous pregnancies.The study examined the mean humerus length in relation to the Period of Gestation (POG) calculated by the Last Menstrual Period (LMP). These results provide insights into how fetal humerus length varies throughout pregnancy, which can be useful for estimating gestational age and monitoring fetaldevelopment.

Conclusion: Based on the findings of the present study, it is suggested that the length of the fetal humerus can serve as a reliable indicator of gestational age. This measurement can be a valuable tool for healthcare providers in estimating the stage of pregnancy and monitoring fetal development, ultimately contributing to better prenatal care and management.

Keywords::humeral length, gestational age, Diagnostic accuracy

INTRODUCTION

Certainly, let's expand on the topic of ultrasonography in monitoring fetal development throughout pregnancy and the various biometric markers used for assessment:Ultrasonography plays a pivotal role in the field of obstetrics and gynecology, serving as the gold standard for closely tracking the progress of fetal development during pregnancy[1]. This non-invasive imaging technique employs a transducer equipped with piezoelectric crystals, which play a dual role of emitting ultrasound beams and capturing the reflected signals. These high-frequency sound waves, typically falling within the range of 3.5 to 7.5 MHz, are characterized by low-intensity, making them perfectly safe for the developing fetus[2].The primary objective of ultrasonography in pregnancy is to gain valuable insights into the well-being of the growing fetus. Through the ingenious use of these ultrasound beams and the interpretation of reflected signals, grayscale visuals are generated and displayed on a screen, offering a real-time window into the womb. This technology allows healthcare professionals to closely monitor fetal growth and development, assess vital parameters, and detect any potential concerns[3].Ultrasonography in pregnancy can be performed in two primary ways: transabdominally and endo-vaginally. Transabdominal ultrasound involves placing the transducer on the mother's abdomen, while endo-vaginal ultrasound utilizes a specially designed transducer inserted into the vaginal canal. The choice between these methods depends on various factors, including the stage of pregnancy, the specific information required, and the individual circumstances of the patient.One of the most critical aspects of ultrasonography during pregnancy is the utilization of sonographic measurements to determine

important parameters. These measurements provide essential information, such as fetal gestational age and growth patterns, allowing healthcare providers to make accurate assessments. Notably, they can estimate gestational age, determine the expected due date (EDD), evaluate fetal weight, and diagnose any potential growth disturbances or abnormalities.Fetal biometry is a crucial method that comes into play during ultrasound assessments[4]. It involves using a range of biometric markers to calculate these critical parameters, including the crown-rump length, biparietal diameter (head size), femur length, and abdominal circumference. These measurements offer valuable data about the developing fetus, enabling healthcare providers to monitor and assess the overall health and growth trajectory of the fetus throughout the initial four trimesters of pregnancy. By employing these biometric markers, ultrasonography contributes significantly to the comprehensive care and well-being of both the pregnant individual and the unborn child.When the expectant mother is unable to recall the first day of her last menstrual cycle, or if there is a discrepancy between the fundal height measured during an abdominal examination and the estimated gestational age derived from the prenatal multiplier approach for limb length prediction, healthcare professionals can resort to alternative methods for estimating fetal age. One such approach involves utilizing femoral and humeral lengths as key indicators.These measurements, including femoral length, humeral length, tibia, and ulna, are considered in combination to provide a more accurate assessment of fetal age. They become especially valuable when traditional measurements like biparietal diameter (BPD) are either difficult to obtain, unreliable, or present abnormal values[5]. In cases where biparietal diameter measurements may not be feasible, femoral and humeral lengths offer a dependable alternative.Furthermore, these measurements are also employed in the calculation of ratios, such as the BPD/FL (biparietal diameter to femoral length) ratio and the BPD/HL (biparietal diameter to humeral length) ratio[6]. These ratios, when used as categorical variables, can play a significant role in the evaluation of fetal development and the assessment of potential chromosomal abnormalities, such as Down syndrome.In summary, when traditional methods for estimating fetal age encounter challenges, femoral and humeral lengths, in conjunction with related measurements, provide a reliable alternative. Additionally, the calculation of ratios involving these lengths serves as a valuable tool in the diagnosis and evaluation of fetal well-being, particularly in cases where biparietal diameter measurements are inconclusive or unavailable.

MATERIALS AND METHODS

This current study took the form of a descriptive observational investigation and involved a cohort of 240 pregnant women who were carefully selected for participation[7]. The study spanned a duration of six months. Prior to commencing the study, ethical clearance was diligently obtained from the Ethics Committee of the institute to ensure that the research adhered to the highest ethical standards.Subsequently, the study's objectives and procedures were explained to the pregnant women, and their informed consent was obtained in writing[8]. This consent was acquired from either the pregnant women themselves or their legal guardians, with the investigator being responsible for this crucial step in the research process. The emphasis on obtaining informed consent underscores the commitment to ensuring that the study was conducted in an ethical and responsible manner, prioritizing the rights and well-being of the participants.

Criteria for Acceptance:

1. **Amenorrhea's Past:** The absence of menstrual periods in the past is a key criterion for acceptance.
2. **Knowledge of the Exact Day of the Previous Menstrual Period:** Knowing the specific date of the previous menstrual period is essential for accurate assessment.
3. **Regular Menstrual Cycles:** The presence of regular and consistent menstrual cycles is an important consideration for acceptance.
4.

Conditions of Rejection:

1. **Twin Pregnancies:** Cases where the individual is carrying twins or multiple fetuses may not meet the acceptance criteria.
2. **Pregnancies Involving Anomalies:** Pregnancies associated with fetal anomalies, such as anencephaly (absence of a major portion of the brain), hydrocephalus (build-up of fluid in the brain), short limb dysplasia (abnormal development of limb bones), and intrauterine growth restriction (IUGR, when a fetusdoesn't grow at the expected rate), are typically rejected as they may require specialized care and monitoring outside the scope of this study.

The humerus scanning technique applied in this study involved a systematic approach to examining fetal anatomy. It commenced with a meticulous assessment of the fetal ribs, thorax, and the shoulder girdle, providing essential anatomical context. The key aspect of this technique was the skillful rotation of the transducer to visualize the entire length of the fetal humerus, from end to end[9]. To ensure precision, a minimum of three measurements were taken during each examination, strategically covering both ends of the humerus shaft. These multiple measurements were used to calculate an accurate mean value for the humerus length, providing a reliable assessment. This thorough and methodical approach not only ensured accurate humerus measurements but also allowed for the detection of the fetal heart within the chest, a vital component of prenatal assessment.

RESULTS

In the current study, a total of 240 pregnant females were carefully chosen as participants. Within this group, 44.33% were categorized as nulliparous, signifying that they were experiencing their first pregnancy, while the remaining 55.66% were identified as multiparous, indicating that they had experienced previous pregnancies. The study's findings regarding humerus length in relation to the Period of Gestation (POG) calculated by the Last Menstrual Period (LMP) revealed specific trends. The mean humerus length was observed to be highest in the 37 to 40-week POG category, signifying the late stages of pregnancy. In contrast, the lowest mean humerus length was recorded in pregnancies with a POG of less than 20 weeks, representing the early stages of pregnancy. These observations provide valuable insights into how humerus length varies throughout different stages of pregnancy.

Table1: Distribution of parity

Parity	N(%)
Null	108(43.33%)
Multi	136(56.66%)
Total	240(100%)

Table2:Humerallengthwrttogestationalage

Gestational age by LMP(weeks)	Humeral length Mean± SD
<20	26.21±5.43
21-24	38.35±2.34
25-28	38.58±2.78
29-32	51.45±2.36
33-36	54.31±2.11
37-40	58.99±2.65

DISCUSSION

During the initial trimester of pregnancy, ultrasound has supplanted alternative methods as the preeminent means of estimating the age of the developing fetus[10]. In this critical phase of pregnancy, healthcare professionals employ both transvaginal and transabdominal probes to achieve a higher level of precision in determining the gestational age of the fetus. However, it is important to note that, in the first trimester, transvaginal ultrasound is typically considered the method of choice, as supported by numerous studies. This preference for transvaginal ultrasound during the early stages of pregnancy underscores its effectiveness in providing accurate and reliable assessments of fetal development. In the present study, a total of 240 pregnant females were meticulously chosen as the study's participants. Among this group, 44.33% were categorized as nulliparous, signifying that they were experiencing their first pregnancy, while the remaining 55.66% were identified as multiparous, indicating that they had previous pregnancy experience. The study's results concerning humerus length in relation to the Period of Gestation (POG) calculated by the Last Menstrual Period (LMP) revealed distinct patterns. The mean humerus length was found to be highest in the 37 to 40-week POG category, measuring 58.99 ± 2.65 mm. This corresponds to the late stages of pregnancy when fetal development is more advanced[11]. In contrast, the lowest mean humerus length was recorded in pregnancies with a POG of less than 20 weeks, measuring 26.21 ± 5.43 mm. This category represents the early stages of pregnancy when fetal development

is in its initial phases. These findings provide valuable insights into how humerus length varies throughout different stages of pregnancy and underscore the significance of accurate gestational age estimation. Differences in the measurement of fetal femur length (FL) and humerus length (HL) become particularly evident during the first trimester of pregnancy, a period in which accurately measuring these upper and lower limb bones can be challenging. This observation, as reported by Rosati et al. (2002), helps to explain the variations in precision when calculating bone length using formulas based on early pregnancy data.In a related study, Roberto et al. (2005) investigated the connection between humerus length and the likelihood of diagnosing Down syndrome in an unborn child. Their findings revealed no significant difference in the detection rate or the false-positive rate when focusing solely on humerus length. However, when femoral and humeral lengths were considered together, there was a substantial reduction in the number of false positives[12]. These results suggest that combining both femoral and humeral lengths in ultrasonography assessments may be a more effective approach than relying on either measurement alone when screening for Down syndrome, potentially enhancing the accuracy of prenatal diagnostics.For the purpose of estimating the gestational age of a developing fetus, the Australian Society for Ultrasound in Medicine (ASUM) has taken significant steps. They have issued a statement on "Normal Ultrasonic Fetal Measurements," which

serves as a guideline or reference for healthcare professionals conducting ultrasound examinations during pregnancy. Additionally, ASUM has developed a specific chart for humeral length. This chart is a valuable tool used by healthcare providers to assess and monitor fetal development, especially when estimating gestational age. These resources and guidelines provided by ASUM play a crucial role in ensuring accurate and standardized prenatal assessments through ultrasound technology.

CONCLUSION

According to the findings of the current study, it is evident that the length of the fetal humerus can serve as a reliable and valid indicator of gestational age. This conclusion underscores the significance of humeral length as a valuable metric in estimating the developmental stage of the fetus during pregnancy. These findings contribute to the growing body of knowledge in the field of prenatal assessment, where accurate gestational age determination is essential for providing optimal care to both the pregnant individual and the developing fetus.

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