SONOGRAPHIC ASSESSMENT OF THE UMBILICAL CORD DIAMETER (UCD) TO DETERMINE THE GESTATIONAL AGE AMONG PREGANT WOMEN IN A HEALTHY NIGERIAN POPULATION

Abstract

Background: The knowledge of the exact gestational age of a foetus is required for comprehensive pregnancy care.

Objective: The aim of this study is to assess the umbilical cord diameter in order to determine foetal gestational age using ultrasonography.

Methods: A purposive sample of four hundred singleton pregnancies with gestational age of between 14 to 40 weeks were considered for this study. Transabdominal ultrasound scans were performed and measurements of the Umbilical Cord Diameter (UCD) were obtained in a cross-sectional plane of the umbilical cord at a point 2.0 cm away from the pointofinsertionintothefoetalabdomen.

Results: The UCD ranged from 5 mm to 24 mm and its mean value was 13.3 mm±6.17mm. Mean recorded value for AC, FL, HC, BPD were190 mm± 90.60 mmSD, 43.6mmmm± 18.93mm, 211.8mm ± 78,34mm, 61.32± 22.64mm respectively. Umbilical cord diameter correlated positively with the LMP and AC ($r = 0.993$, $p < 0.0001$; $r = 0.952$, $P = 0,0001$) respectively. A strong positive and significant correlation was also noted between the UCD and other dating parameters ($r = 0.925$ $P = 0.0001$; $r = 0.955$, $P = 0.0001$, $r = 0.972$, $P = 0.0001$)respectively for FL, HC and BPD.

Conclusion: The UCD can be a good alternative to determine foetal gestational age and wellbeing.

Key words; Sonography, umbilical cord, diameter, gestational age, healthy, pregnant women.

INTRODUCTION

The umbilical cord is a part of the foetus, contains two arteries and one vein that are buried in the Whatson's jelly. The developmental integrity and function of the cord are essential considerations for foetal growth and wellbeing[1]. Assessment of the morphometric

alterations of the umbilical cord by prenatal sonography at different gestational ages permits the identification of adverse perinatal outcomes[2]. Umbilical cord is sonographically visible from approximately 8 to 10 weeks of gestation and the cord diameter could be sonographic criterion for assessing maternal and fetal health**.** The Knowledge of the exact gestational age of a foetus, is required for comprehensive pregnancy care. It is anessentialcomponentofresearchevaluatingcausesofpretermbirthtochoosethe times to perform various screening tests and assessments such as serum screening, assessment of foetal maturity, and knowing if the foetus is smaller or larger than expected[3]. It is also essentialtoaiddecisionsaboutdeliverymethod,thetrialoflabourafterCaesareandelivery,inductio nof labourforpost-datepregnancies[4],andelectiveCaesareansectionforpatientssuspected ofhavingmacrosomicfoetus. Over the years, several methods have been developed to estimate gestational age. The three primary methods usedaremenstrualhistory,clinical examination,andultrasonography[5,6].

Obstetricultrasonographyisamodernmethodforassessinggestationalage,andsinceitsintroducti onin the1970s,it has been noted asthemostaccuratetechniqueforestimatinggestationalage.Ittypicallyinvolvesthe measurement of multiple biometric parameters of the foetus, which values are used to extract the estimated gestational age per trimester. Previous studies revealed that 20% to 40% of women cannot recollect their last menstrual period (LMP) with certainty[7]. Reasons for this uncertainty include oligomenorrhoea, bleeding in the first trimester of pregnancy, pregnancy following oral contraceptives or intrauterine devices, and becoming pregnant in the post-partum period. A previous study reported that menstrual historywasconsidered reliablein only 18% of women[6]. The most common biometric parametersusedaregestationalsacdiameter(GSD)andcrown-rumplength(CRL)inthefirsttrimester. The biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). These parameters of the foetal head, body, and extremities are used in the second and third trimesters. These most widely used and acceptedfoetal-derived growth parameters have potentialerrors and inaccuracies[8]. This study is therefore aimed at determining the foetal gestation age sonographically using umbilical cord diameter.

MATERIALSANDMETHODS

This was a cross-sectional study that involved healthy pregnant women who came to the antenatal clinic and were asked to perform ultrasound examination in general hospital Ogwashi-Uku, Delta State. Itwasconductedfrom June 2019 to December, 2019 and included all singleton pregnant women. Apurposivesampleof400healthywomenpregnantwithnormalsingletonfoetuseswasevaluatedinthe study.

EthicalreviewandapprovalforthestudywereobtainedfromtheResearchandEthics committee Departmentofthe FederalMedicalCentre,Asaba,DeltaState,beforethecommencementofthestudy. Informed consents were also obtained from the participants.

The study involved the determination of the gestational age of each subject using Naegele'sformulaforgestationalageestimation if the patient was sure of her date. The gestational age was then determined at prenatal sonography using the BPD, HC, AC, and FL biometric parameters. Therecentresultsofthesubject'slaboratoryinvestigationswereexaminedtoensure that thesubjectisnot suffering from any metabolic disorder. These investigations which results were scrutinised include urinalysisforthepresenceofsugarandproteinintheurine,fastingbloodsugar,randombloodsugarand 2-hour postprandial blood sugar test for screening for diabetes mellitus, serum electrolyte, urea, and creatinine(S/E/U/Cr)testandtotalbloodcholesteroltest. All who met the inclusion criteria participated in the study.

TransabdominalscanwasconductedusingaMindrayultrasound machineequippedwitha3.5MHzcurvilineartransducer. The examination was conducted at various imaging planes with the patient in the supine position. The UCD was measured vertically in the longitudinal plane, adjacent to the insertion of the foetal abdomen. The calipers for measurement were place from the outer to outer part of the cord to ensure that adequate measurements was obtained. The biparietal diameter(BPD),femurlength(FL),headcircumference(HC),andabdominalcircumference(AC), were subsequently measured and used to estimate the GA based on the nomogram produced by Hadlock et a,l[9]. To avoid errors due to measurement the examinations were conducted

by one qualified sonographer and measurements of each parameter was done twice and an average taken.

Fig.1: Sonogram showing greyscale cross-sectional measurement of the umbilical corddiameterwiththemarksshowingthepositionofthecallipersplacedontheouterpartoftheumbilical cord.

Method of Data Analysis

Data generated were transferred into a Microsoft excel for analysis using SPSS version 20. The obtained data were presented in tables with frequency.

Correlation analysis was performed to assess the strength of linear association that exists between UCD andLMPestimatedgestationalageaswellasUCDandtheestimatedgestationalageusingthe commonly used ultrasound foetal dating parameters (AC, FL, HC and BPD). The statistical significance was set at $P \leq 0.05$.

RESULTS

The gestational age of the subjects ranged from 14 weeks to 40 weeks.The mean gestational period was 24.5 ±n7.83wks. UCD ranged from 5mm to 24 mm and the average measurement

recorded was 13.3 ± 6.17mm as shown in table 1.

The abdominal circumference (AC) ranged from 43 mm to 362 mm with an average measurement of 190.1 ± 90.60 mm. The maximum GA from AC was 39 weeks and the minimum 14 weeks. Mean AC predicted GA was 24.3 ± 7.86 weeks. The mean femur length was 436 ± 18.93mm and ranged from 14 mm to 76 mm. The FL estimated GA ranged from between 13wks and 19wks with a mean of 24.3 ± 7.67wks. HC ranged from 65 mm to357 mm and the mean was 211 ± 78.34wks. The HC estimated GA ranged from 14wks to 40wks and an average of 24.3 ± 7.70wks.

The BPD ranged from 28 mm to 99 mm. Mean BPD measurement was was 61.32 ± 22.64 mm. BPD estimated age ranged from 14wks to 40wks ± 7.93wks.

In table 2, a strong positive correlation existed between the UCD and LMP ($r = 0.993$, $p < 0.0001$). UCD had a strong positive correlation with the AC and FL ($r = 0.952, 0.925$; $p <= 0.0001$, $p <= 0.0001$) respectively. There is also a strong positive correlation between the UCD and the HC ($r = 0.955$, $p > 0.0001$). The BPD also displayed a strong positive correlation with the UCD (0.972, $P <= 0.0001$).

Table 1. Mean Gestational age According to Weeks

GA (LMP)	N	Minimum (mm)	Maximum (mm)	Mean	STD Deviation	Median
14 - 20	162	49	53	50.6	1.49	50.5
21 - 27	89	92	95	82.7	1.496	94.0

28 - 34	93	126	129	128.23	1.313	129
35 - 40	56	137	139	115.5	0.884	137

Table 2. Correlation between UCD and other parameters

Parameter	Correlation coefficient (r)	P - value
LMP	0.993	< 0.0001
AC	0.952	< 0.0001
FL	0.925	< 0.0001
HC	0.955	< 0.0001
BPD	0.972	< 0.0001

DISCUSSION

The umbilical cord is a unique organ consisting of two umbilical arteries, one umbilical vein and Whartson's jelly which are sophisticated structures and performs vital functions to supply the necessary nutritional requirements to the foetus from the mother during the period of pregnancy[10]. The left and right umbilical arteries are developed from the internal iliac arteries and supplies deoxygenated blood from the foetus to the placenta[11].

Foetal gestational age estimation is very vital in the determination of foetal outcome and well being. Ultrasonography is indispensable in determination of foetal growth and general wellness of the foetus. It can determine when the growth is compromised and as such provides an early information about foetal maturity. Ultrasonography has the advantage of being readily available, has no risk of radiation and is very affordable.

Our study established the reference values for UCD during different gestational age. Weismann et al[12] did the first sonological study on umbilical cord cross sectional diameter for various gestational age. Other previous studies had also established reference values for their

population[13,14]

The present study was conducted among pregnant women from 14wks to 40wks GA. in our locality. Eze, et al[15], Zeeshan, et al,[16] also conducted a similar study within this range while Udoh et al[17], conducted their own study from 10wks to 42wks GA. This study was conducted as from 14wks GA because within this period all other foetal parameters for determining foetal gestational age such as, (BPD, HC, FL, AC) can be used to demonstrate the GA. Previous study has shown that dating pregnancies after 14 weeks is particularly relevant as for low and middle income countries where many women first seek antenatal care after 20 weeks of pregnancy[18]. In country like South Africa,53% of women receive no first trimester antenatal care and up to 20% of women attend their first antenatal visit after 20 weeks in some regions[19]. Nigeria is also a poor resource country and pregnant women may also present for antenatal care in the 14th week of their pregnancy/during the second trimester.Usually normal pregnancies last for 40 weeks and this influenced our choice of assessing the GA up to 40 weeks and not 42 weeks.

The obtained UCD in our study ranged from 5mm to 24mm while in the study done by Udoh et al[17], it ranged from 0.73cm to 1.68 cm. The variation in the range obtained in this study and that of Udoh et, al[17], may be due to the fact that our study involved pregnancy in the range of 14 weeks to 40 weeks while theirs ranged from 10 weeks to 42 weeks.

The study revealed that the mean gestational age was 24.5±7.83wksand the UCD increases as the gestational age increases. Other previous studies[15,20,21] agreed with this finding of our study.

In this study, the mean UCD was 13.3 mm ± 6,17mm. This our finding is close to that of Eze, et al[15], who stated a value of 14.5mm in their own study. In a study by Zunaira et, al [22] the mean UCD they obtained was 11.63mm ± 3.50mm. These values obtained in separate studies are very close to each other even though they were conducted in different countries.

There was direct positive relationship between the UCD and the LMP. In other words the UCD increased as the LMP increased. A linear and strong relationship also existed between the UCD and other ultrasound dating parameters (AC, FL, HC, and BPD). This is in tandem with other previous studies[15,222].

CONCLUSION: The umbilical cord diameter can be used as a parameter to determine foetal gestational age. It has a direct positive relationship with other ultrasound dating parameters.

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