FETAL UMBILICAL ARTERY DOPPLER INDICES IN PREGNANT WOMEN IN YENAGOA, NIGERIA

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ABSTRACT

Introduction: The measurement of fetal umbilical blood flow using Doppler ultrasound is a well-established tool in the management of high-risk pregnancies and has resulted in improved outcome. However, there is paucity of data concerning the normal parameters in Nigeria. This study is aimed at assessing the fetal umbilical artery indices in pregnant Nigerian women. M**ethods:** This was a cross sectional prospective study carried out at the Niger delta university teaching hospital, silhouette radio diagnostic consultants Yenagoa and federal medical centre. A total of 400 pregnant women between the gestational ages of 20 – 40 weeks were evaluated within a one-year period using a 2014 Philips HD 11 ultrasound machine equipped with a 3.5Mhz curvilinear probe having colour, pulsed wave and power Doppler facilities. **Results:** The mean age and BMI were 30 ± 6 years and 29.9±5.76 kg/m^2 respectively while the mean umbilical artery systolic velocity and end diastolic velocities were 40.07± 8.99m/s and 17.44±6.37m respectively. The mean resistivity index (RI) is 0.57. There was a negative correlation of RI with Gestational age (P<0.05). **Conclusion:** Fetal umbilical artery Doppler parameters are essential tool in management of high-risk pregnancies and has resulted in an improved outcome. This study is to serve as a baseline for further studies with a larger sample size.

Keywords: Fetal; Umbilical; Artery; Doppler; Pregnancies.

INTRODUCTION

The goal of antenatal care is to identify issues that may prevent a pregnancy from ending in a favourable outcome, take steps to mitigate those risks and then deliver a healthy baby to a healthy and satisfied mother.

To monitor the wellbeing of the foetus during pregnancy, health care providers use a range of methods from those that are simple and readily available to those that involve much specialised skill and equipment that may be expensive.

The umbilical arteries carry nutrient depleted blood from the foetus to the placenta which is where oxygen and nutrients are exchanged [1]. While this process may continue unimpeded in the healthy foetus of a women with an uncomplicated pregnancy, it may not occur smoothly in a complicated pregnancy especially one in which there is affectation of the placenta [2].

The use of Doppler ultrasound to assess foetal vessels as a way of estimating foetal wellbeing is not new [2-4]. It has the advantage of not being limited by states of foetal sleep [3,4] and has the ability to demonstrate increased resistance to placental blood flow as well as absent or reversed flow within the foetal vessels [4,5].

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MATERIAL AND METHODOLOGY

Study design: This was a cross sectional prospective study

Ethics approval: approval for this study was granted by the ethical approval committee of the Niger Delta university teaching hospital and Federal, medical centre Yenagoa.

Research place: Niger Delta University Teaching Hospital, silhouette Radio Diagnostic Consultants Yenagoa and Federal Medical Centre Yenagoa.

Study period: one-year period from the 1st of January to the 31st of December 2016

Sample size: A total of 400 pregnant women

Inclusion criteria: A total of 400 pregnant women between the gestational ages of 20 – 40 weeks were evaluated by using a 2014 Philips HD 11 ultrasound machine equipped with a 3.5Mhz curvilinear probe having colour, pulsed wave and power Doppler functions.

Exclusion criteria: All patients with multiple pregnancies, maternal disease like pre-eclampsia and IUGR, heart disease etc were excluded from the study.

Methodology:

Patients height, weight, BP and BMI were all measured and recorded. All scans were carried in the supine, left lateral and right lateral positions by a consultant radiologist. The gestational age of the foetus as well as the estimated fetal weight was calculated using a combination

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of the FL, BPD, HC and abdominal circumference [3]. The probe was adjusted until a free loop of umbilical a cord was visualized close to its termination at the umbilicus. The umbilical artery was then identified with colour flow Doppler and insonated with pulsed wave Doppler as possible to 0 degrees. All Scan were done in the absence of fetal bodily and breathing movements. The spectral analysis was considered appropriate in cases where at least three similar velocity waves were observed in the same spectrum. The diastolic and systolic flow velocity as well as the pulsatility and resistivity indices were recorded.

Statistical analysis: An SPSS version 22 was used to analyse the data generated and Z Test applied.

RESULTS

A total of 400 subjects were used for this study. The average age of the study population was 30 yrs ± 6. The average weight, height and BMI were78.33 ± 14.97, 1.62±0.06 and 29.90 ± 5.75 respectively (table 1). The mean values for umbilical artery systolic and diastolic velocities were 40.07 ± 8.99 and 17.44 ± 6.36 respectively while the mean values for resistivity and pulsatility index were 0.57 ± 0.13 and0.87 ± 0.59 respectively. There was a positive correlation between systolic and diastolic velocity with maternal gestational age ($p<0.05$) while a negative correlation existed between resistivity index and pulsatility index with maternal gestational age ($P<0.05$) Table 2.

DISCUSSION

Participants in the study were within the age range of 18 -48 years with the mean age of 30± 6. Most (51.75%) of the participants were within the age range of 21-30 years while those who were <20 and >40 years accounted for 3.75% and 5% respectively. The nulliparous and primiparous patients were 47% while patients with parity >6 accounted for only 9%.

The umbilical artery systolic and diastolic velocity as well as the umbilical venous velocity increased significantly ($p<0.05$) as pregnancy progressed. Increasing from 33.76-40.47cm/s, 11.09-17.85cm/s and 13.39-16.57cm/s for second and third trimesters respectively. This increasing velocity as pregnancy progressed corresponds with the increasing metabolic activities as the foetus grows. However, in growth restricted foetuses, there is a reduction in end diastolic velocity which results in an increase in the Systolic/ Diastolic (S/D) ratio. This is a pointer to foetal hypoxia and consequent compromise [6].

The mean foetal umbilical artery Doppler indices in second and third trimester increased from 1.50 to 0.83 ($p<0.05$) for Pulsatility-index (PI), 0.66 to 0.56($p<0.05$) for Resistivity-index (RI) and 3.09 to 2.42($p<0.05$) Systolic/Diastolic Ratio(S/D) respectively (table 1). This decrease is due to decreasing placental vascular resistance as the placenta matures with increasing tertiary villi [7]. Findings in this study are in keeping with previous studies done by Adekanmi et al in Ibadan Nigeria who reported PI of 1.00 and 0.80, RI 0.60 and 0.53 and S/D of 2.59 and 2.19 in second and third trimester respectively [8]. Acharya et al in Norway reported PI 1.90 and 1.39 in second and third trimester respectively while Ferdousi et al in Bangladesh reported PI of 1.24 and 1.18 in second and third trimesters of pregnancy respectively [9,10].

Table 1: Age, Blood Pressure and anthropometric indices of subjects according to Trimesters

Parameters	All subjects N=400	2nd Trimester N=140	3rd Trimester N=260	Z Test (p<0.05)
Maternal Age (years)	30.00 ± 6.00 (18-48)	31.5 ±4.4 (25 – 40)	29.97 ± 5.97 (18– 48)	0.20
Maternal Height (m)	1.62 ± 0.06 (1.41-1.79)	1.63 ± 0.05 (1.53 – 1.75)	1.62 ± 0.06 (1.41-1.79)	0.51
Weight (Kg)	78.33 ±14.97 (49 -150)	70.96 ± 11.21 (53 -93)	78.80 ± 15.06 (49-150)	0.01 Significant
BMI (kg/m^2)	29.90 ± 5.75 (19-59.45)	26.76 ± 3.89 (19.00-36.33)	30.10 ±5.79 (19.47-59.45)	0.01 Significant
Maternal Systolic BP (mmHg)	115.7 ± 11.22 (83-135)	113.17 ±11 (91-137)	115.86 ± 11.23 (83-135)	0.35
Maternal Diastolic BP (mmHg)	69.38 ± 9.36 (43 – 88)	68.08 ± 7.98 (53-82)	69.46 ± 9.44 (43-88)	0.64
Maternal Mean Arterial Blood Pressure (MAP)	69.99 ± 9.34 (43- 116)	68.46 ± 8.01 (53-82)	70.09 ± 9.45 (43-116)	0.93

Values are given as mean ± standard deviation with range in parenthesis.
*significantly different compared with second trimester.

Table 2: Foetal and Umbilical vessels indices according to Trimesters

Parameters	All fetuses N=400	2nd Trimester N=140	3rd Trimester N=260	Z Test Significance (p<0.05)
Gestational age (wks)	32.26 ± 4.07 (20.00-40.00)	23.21+ 2.60 (20.00-26.00)	32.84+ 3.41 (27.00-40.00)	*0.01 Significant
Foetal Weight (kg)	2.37 ± 0.92 (0.90 -4.500	1.08 +0.12 (0.90-1.30)	2.45+ 0.88 (1.00-4.50)	*0.01 Significant
Umbilical Artery systolic Velocity (cm/s)	40.07 ± 8.99 (15.40-129.00)	33.76±11.26 (15.40-46.20)	40.47±8.69 (20.70-129)	*0.02 Significant
Umbilical Artery Diastolic Velocity (cm/s)	17.44 ± 6.36 (5.76-46.90)	11.09±3.58 (5.76-17.30)	17.85±6.28 (8.70-46.90	*0.01 Significant
Systolic/Diastolic (S/D) Ratio	2.46 ±0.64 (1.02-4.92)	3.09±0.73 (1.82-4.92)	2.42±0.62 (1.02-4.91)	*0.01 Significant
Pulsatility-index	0.87 ± 0.59 (0.03-1.61)	1.50±2.17 (0.61-1.61)	0.83±0.24 (0.03-1.75)	*0.01 Significant
Resistivity-index	0.57 ± 0.13 (0.02-0.86)	0.66±0.87 (0.45-0.80)	0.56±0.13 (0.02-0.86)	*0.01 Significant
Umbilical Vein Velocity (cm/s)	16.38 ± 3.07 (6.72-33.60)	13.39±2.79 (7.68-19.70)	16.57±2.99 (6.72-33.60)	*0.01 Significant

Values are given as mean ± standard deviation with range in parenthesis.
*significantly different compared with second trimester.

CONCLUSION

Doppler studies of foetal vessels have become a tool for assessment of foetal well-being. It is also an essential tool in improving the outcome of high-risk pregnancies like Pre-eclampsia and IUGR. Therefore, developing reference values for our environment is important.

Limitation of study: This study should serve as a base line and guide for further studies with a higher sample size.

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