Analysis of fetal circulation in umbilical artery and middle cerebral artery studied by Doppler sonography in breech versus cephalic presentation

Análisis de la circulación fetal en arteria umbilical y arteria cerebral media estudiado por ecografía Doppler en presentación de nalgas versus cefálica

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Abstract

Objectives: An exemplary method for antenatal checking is velocimetry of ultrasonic Doppler utilized to demonstrate fetus and uterine blood vessels. The present study mainly attempts to analyze the fetal circulation in the umbilical artery and middle cerebral artery studied by Doppler sonography in breech versus cephalic presentation. **Materials and Methods:** To meet the study's aim, a cross-sectional investigation is carried out incorporating eighty-six apparently healthy women with uncomplicated singleton pregnancy at 32-42 weeks of gestation split into two groups based on fetal presentation (breech =33 and cephalic =53). Doppler sonographic studies were performed for both groups for the middle cerebral artery and umbilical artery, the resistive index RI and systolic, diastolic ratio SD were compared among study groups. Meanwhile, some cases were excluded from the study, including multiple pregnancies, pregnant women with chronic systemic diseases and pregnancies with preeclampsia and intrauterine growth restriction, fetal malpresentation other than breech, those with term or preterm labor, and premature rupture of the amniotic membrane. **Results:** Based on the study's results, there is no notable difference between breech and cephalic groups concerning parity, maternal age, history of abortion, gender, and gestational age. The mean of systolic / diastolic ratio of the umbilical artery was significantly different when comparing fetuses who are presenting with breech (2.33 ± 0.32) vs those with cephalic (2.16 ± 0.34). **Conclusion:** Fetal presentation whether breech or cephalic showed no remarkable effect on some Doppler indices of the umbilical and middle cerebral arteries except for the mean of systolic / diastolic ratio of umbilical arteries was clearly higher among breech presenting fetuses

Keywords: Antenatal checking, cephalic presentation, pregnancy, velocimetry of ultrasonic Doppler.

Resumen

Objetivos: Un método ejemplar para el control prenatal es la velocimetría de Doppler ultrasónico utilizada para demostrar los vasos sanguíneos del feto y el útero. El presente estudio intenta principalmente analizar la circulación fetal en la arteria umbilical y la arteria cerebral media estudiadas por ecografía Doppler en presentación podálica versus cefálica. **Materiales y métodos:** Para cumplir con el objetivo del estudio, se llevó a cabo una investigación transversal que incorporó a ochenta y seis mujeres aparentemente sanas con embarazo único sin complicaciones a las 32-42 semanas de gestación divididas en dos grupos según la presentación fetal (presentación podálica = 33 y cefálica). =53). Se realizaron estudios de ecografía Doppler para ambos grupos para la arteria cerebral media y la arteria umbilical, el índice de resistencia IR y la relación sistólica, diastólica SD se compararon entre los grupos de estudio. Mientras tanto, algunos casos fueron excluidos del estudio, incluidos embarazos múltiples, mujeres embarazadas con enfermedades sistémicas crónicas y embarazos con preeclampsia y restricción del crecimiento intrauterino, malpresentación fetal distinta de la presentación podálica, aquellas con trabajo de parto prematuro o a término y ruptura prematura de la membrana amniótica. **Resultados:** Con base en los resultados del estudio, no hay una diferencia notable entre los grupos de presentación podálica y cefálica en cuanto a paridad, edad materna, antecedentes de aborto, sexo y edad gestacional. La media de la relación sistólica/ diastólica de la arteria umbilical fue significativamente diferente cuando se compararon los fetos que presentaban presentación podálica (2,33 ± 0,32) frente a los fetos con cefálica (2,16 ± 0,34). **Conclusión:** La presentación fetal, ya sea de nalgas o cefálica, no mostró un efecto notable en algunos índices Doppler de las arterias cerebrales umbilical y media, excepto que la media de la relación sistólica/diastólica de las arterias umbilicales fue claramente más alta entre los fetos en presentación de nalgas.

Palabras clave: Control prenatal, presentación cefálica, embarazo, velocimetría de Doppler ultrasónico.

Introduction

Velocimetric study by Doppler ultrasound used extensively in obstetrics and fetal checking since 1977[1], blood flow in vessels of the fetus and the mother (uterine arteries) is good predictor for antenatal complications. Definite waveforms of Doppler representative fluctuations of circulation used to expect adversarial perinatal consequences.

Fetal MCA had been widely utilized for assessment of placental compromise as well as anemia of fetus[2]. Breech presentation complicates 3%–4% of pregnancies at term. It may arise as a chance error of orientation or may be associated with fetal or maternal pathology. Term breech presentations are associated with relatively shorter cords, reduced fetal growth, and abnormalities of amniotic fluid (either oligohydramnios or hydramnios)[3]. Therefore, babies delivered in breech presentation have high danger to face perinatal consequences more than cephalic presentation & having low marks when assessed neurologically which could be resulted from defective neurological development inutero, and the majority are marked to be of unknown causes[4]. Sival et al in 1993 tried to correlate some ultrasounic findings to certain pathological fetal conditions like IUGR, abnormally low AFI and babies with breech presentation, they stated that fetal general movements quality which observed inutero can be linked to integrity of the central nervous system after adjusting some pre-requisites to be relied upon clinically although its clinical application is limited due to huge variability (inter & intra- individual) [5]. The aim of this study was to compare fetal circulations in middle cerebral & umbilical arteries using Doppler velocimetry in breech versus cephalic presented fetuses.

Method

A cross sectional observational study Approved by the Medical Ethical Committee of the College of Medicine/ University of Babylon, the study done at Babylon teaching hospital for maternity and children throughout period from March 2019 to November 2019 all women enrolled in this study signed informed consent before their participation. This study involved 86 women with singleton uncomplicated pregnancy at gestational age 32-42 weeks. The study group was separated into two groups according to the fetal presentation being breech and cephalic. 53 cases were identified as cephalic and 33 cases were breech presentation which determined by both abdominal and ultrasound examination. Gestational age for each pregnancy was determined depending on menstrual history & documented accurately using early dating ultrasonography. Women with multi-fetal gestations, pre-eclamptic women, and those who had chronic illnesses (vascular disease, chronic kidney disease, diabetic, hypertensive & connective tissue disorders), abnormally grown fetuses (IUGR), fetal malpresentation other than breech, those with term or preterm labor and Premature rupture of amniotic membrane were all excluded from enrollment in this study. Doppler study for both middle cerebral artery (MCA) and umbilical artery were assessed using 3-5 MHZ probe (Medison-SONOACE X8 ultrasound) by specialist radiologist, usually umbilical arterial wave assessed without angling in free part of cord then spectral analysis recorded after that indices analyzed including resistive index (RI), systolic to diastolic ratio (S/D ratio). The main outcome in this study if any differences regarding the means of resistive indices & S/D ratio in breech vs cephalic presenting fetuses in 3rd trimester. Statistical Package for Social Science; SPSS version 24 used to analyze the data Inc. continuous variables described as mean + standards deviation while the categorical variables described as frequencies and percentages. Independent samples t-test and Chi square test were used for continuous and categorical variables respectively. P- Value of 0.05 and less considered statistically significant.

Results

The distribution of pregnant women in the study groups according to study variables including (maternal age, parity, history of abortion, gender of baby and gestational age) with no significant difference between breech and cephalic groups as shown in table 1.

Table 1 women characteristics and study variables in breech and cephalic groups

Demographic data	Breech presentation		Cephalic presentation		P value
	Frequency	%	Frequency	%	
Parity					
Prime-gravida	7	21%	5	9%	0.13
Multi-parous	26	79%	48	91%	
History of abortion					
One	6	18%	5	10%	
Two	3	9%	1	2%	0.16
Three	0	0%	2	3%	
No abortion	24	73%	45	85%	
Gender of the baby					
Male	22	67%	29	55%	0.27
Female	11	33%	24	45%	
Gestational age					
<37 weeks	17	51%	21	40%	0.28
≥37 weeks	16	49%	32	60%	
Maternal mean age ± SD (years)	27.6 ± 5.5		25.7 ± 5		0.15

P-value < 0.05 (significant).

Comparing Doppler indices (RI of MCA and U.A) and S/D ratio of U.A) between fetuses in breech and cephalic presentations showed significantly higher mean values for S/D ratio of the (U.A) among babies in breech presentation with p values less than 0.05 table 2.

Table 2. Doppler indices (RI of MCA) and (RI UA (SD) ratio) between breech and cephalic fetus				
Doppler study	**Study group**	**Mean**	**SD**	**P-value**
MCA (RI)	Cephalic	0.74	0.07	0.9
	Breach	0.74	0.05	
UA (RI)	Cephalic	0.55	0.06	0.08
	Breach	0.57	0.05	
UA (SD ratio)	Cephalic	2.16	0.34	**0.031**
	Breach	2.33	0.32	

P-value < 0.05 (significant).

While after splitting the groups into subgroups according to gestational age and comparing Doppler indices (RI of MCA and U.A) and SD ratio of (U.A) among term breech and cephalic fetuses although showed little higher mean values among babies in breech presentation but not in a significant level, with p values more than 0.05. Table 3 and the same results were demonstrated among the preterm babies as shown in table 4.

Table 3. Doppler indices (RI of MCA) and (RI UA (SD) ratio) between breech and cephalic fetus at term				
Doppler study	**Study group**	**Mean**	**SD**	**P-value**
MCA (RI)	Cephalic	0.73	0.07	0.78
	Breach	0.74	0.06	
UA (RI)	Cephalic	0.54	0.06	0.36
	Breach	0.56	0.05	
UA (SD ratio)	Cephalic	2.13	0.36	0.19
	Breach	2.27	0.27	

P-value < 0.05 (significant).

Table 4. Doppler indices (RI of MCA) and (RI UA (SD) ratio) between preterm breech and cephalic fetus				
Doppler study	**Study group**	**Mean**	**SD**	**P-value**
MCA (RI)	Cephalic	0.74	0.07	0.76
	Breach	0.74	0.05	
UA (RI)	Cephalic	0.56	0.06	0.19
	Breach	0.58	0.06	
UA (SD ratio)	Cephalic	2.21	0.31	0.13
	Breach	2.38	0.36	

P-value < 0.05 (significant).

Discussion

At term 3-4% of pregnancies are complicated with breech presentation, only less than 10% of them will revert to a cephalic presentation spontaneously leaving the remaining 90% unchanged for which a planned operative delivery may be scheduled to minimize perinatal morbidity and mortality[6]. Whereas a study by Heinonen et al in 2018 showed that the planned vaginal mode of delivery had not associated with increased risk of abnormal neurodevelopemental outcome of the babies when compared with a mode of planned abdominal delivery[7]. However Y Berhan & A Haileamlak concluded in a meta-analysis that perinatal morbidity & mortality of a planned breech delivery through a vaginal route is much higher than a planned abdominal delivery and they encourage to adopt an individualized decision making practice to determine route of delivery of a breech baby at term[8]. Breech presenting fetuses are neurologically different from those with a cephalic presentation[9].

Doppler study of the fetal circulation in utero by means of assessing impedance to flow in UA and MCA was used extensively in assessing SGA and growth retarded fetuses. Resistance index (RI) and pulsatility index (PI) are the main examined indices in these vessels, more recently the (CPR) cerebro-placental ratio is extensively utilized for assessment and follow up of those fetuses who showed delayed or substandard growing rates and O2 supply through the placenta [10-12].

In the current study breech presentation was not affected by maternal age, parity or fetal gender, other studies confirmed the association between multiparty and breech presentation[13]. While another study by Wastlund et al (2019) failed to show any association of breech presentation with fetal gender [14].

Disturbed blood flow in vertebra-basilar circulation can lead to changes in intracranial blood flow with reduced Pulsatilty index < 1.2 and a systolic /diastolic ratio to less than 2.4, and lower impedance to flow in the MCA[15]. An abnormal flow in vertebral vessels was demonstrated among 38.4% of preterm babies with breech presentation between 32-34 weeks of pregnancy[15]. These findings disagree with the results of the current study which demonstrated non-significant difference between RI in MCA of both cephalic and breech presenting preterm fetuses with a P-value of 0.76. The same finding for the mean of RI of UA among the 2 groups which agree with results of a recent study by F. Louwen *et al* (2021) who found a non-significant differences between cephalic and breech presented fetuses regarding Doppler study of RI of both MCA & UA.

The current study demonstrated values of the mean of S/D ratio for UA was significantly higher for the breech presented fetuses that can be to some extent explained by the suggested disturbances of fetal vascular velocimetric indices in fetuses with breech presentation[15].

Conclusion

Doppler study (RI) of MCA and umbilical arteries of breech presented fetuses are insignificantly different from Doppler indices of fetuses with cephalic presentation whether term or preterm, except for the S/D ratio of the UA that show higher values for the fetuses with breech presentation.

Author Contributions

Concept, Al-Shaikh SF.; methodology, Hussaini HA & Gatea AK; investigation, Hussaini HA, writing—original draft preparation, Gatea AK. & Al-Shaikh SF; writing—review and editing, Al-Shaikh SF. All authors have read and agreed to the published version of the manuscript.

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Consent:

Informed written Consent Statement were obtained from all participants.

Conflicts of Interest

The authors declare no conflict of interest.

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List of abbreviations:

RI: resistance index

SD: systolic/diastolic ratio

MCA: middle cerebral artery

UA: umbilical artery

CPR: cerebro-placental ratio

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