Cerebroplacental Ratio and Cerebrouterine Ratio In Predicting Neonatal Outcome In Preeclamptic Pregnant Women

Thesis

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Contents

List of abbreviations

ARDEV	Absent or Reversed End Diastolic Velocity
ACOG	American Collage of Obstetrics
CP	Cerebroplacental
CU	Cerebrouterine
DIC	Disseminated Intravascular Coagulation
EDV	End Diastolic Velocity
EFW	Expected Fetal Weight
FGR	Fetal Growth Restriction
HELLP	Haemolysis ,Elevated Liver Enzymes and Low Platelets
IUGR	Intra Uterine Growth Restriction
MCA	Middle Cerebral Artery
MCA\UA RI	Middle Cerebral\Umbilical artery Resistance Index
NPV	Negative Predictive Value
PPV	Positive Predictive Value
PI	Pulsatility Index
PW	Pulsed Waves Doppler
RI	Resistance Index
US	Ultrasound
UA	Umbilical Artery
Um.A	Umbilical Artery
Ut.A	Uterine Artery
VEGF	Vascular Endothelial Growth Factor

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ABSTRACT

Background: Doppler ultrasound velocimetry of uteroplacental umbilical and fetal vessels has become an established method of antenatal monitoring, Cerebroplacental and Cerebrouterine ratios have been studied to predict neonatal outcomes.

Aim of the Work: To assess if Cerebrouterine Ratio would be complementary to cerebroplacental Ratio in predicting adverse neonatal outcome in preeclamptic pregnant women.

Patients and Methods: The current study was carried out at Ain Shams University Maternity Hospital on (250) pregnant women with singleton pregnancies who were admitted to the Ain shams maternity Hospital presented with preeclampsia 34-37 weeks gestation, during a period from July 2017 to March 2018.

Results: The current study showed that among patients with abnormal CP ratio 35 case (47%) had fetal distress, 13 case (17.6%) were small for gestational age, 55 cases (47.3%) had APGAR 1 min < 7, 44 cases (59.5%) had APGAR 5 min < 7, 57 case (77%) admitted to NICU, and 9 cases (12.2%) suffered from Neonatal death, while among patient with abnormal CU ratio 49 case (45.8%) had fetal distress, 14 case (13.1%) were small for gestational age, 73 cases (68.2%) had APGAR 1 min < 7, 59 cases (55.1%) had APGAR 5min < 7, 79 case (73.8%) admitted to NICU, and 15 cases (14%) suffered from Neonatal death. In our study, Abnormal CP ratio and CU ratio are related to unfavorable pregnancy outcome. CU ratio had higher sensitivity and negative predictive value than CP ratio in prediction of APGAR 5 min, foetuses small for gestational age, foetal distress, NICU admission and neonatal death, while CP ratio had higher specificity and positive predictive value than CU ratio in prediction of APGAR 5 min, foetuses small for gestational age, foetal distress, NICU admission and neonatal death. Combining both ratios improved the specificity and prediction characteristics of neonatal outcomes compared to any of the ratios used alone.

Conclusion: Cerebrouterine ratio and cerebroplacental ratio were complementary to each other in predicting the adverse neonatal outcomes, than any of the ratios alone.

Recommendations: Cerebrouterine and cerebroplacental ratios should to be used complimentary to each other to predict neonatal outcome in cases of preeclampsia. The value of CP and CU ratios in smaller gestational ages should be investigated to predict neonatal outcome.

Keywords: Cerebroplacental ratio; Cerebrouterine ratio; Neonatal outcome; Preeclampsia

Introduction

Pre-eclampsia is one of the leading causes of maternal and fetal morbidity and mortality. It affects 2-5% of pregnancies. Preeclampsia is a specific syndrome characterized by reduced organ perfusion secondary to vasospasm and endothelial pathophysiology ***(Mohan et al., 2017).***

Preeclampsia contributes greatly to IUGR (intra uterine growth restriction), preterm labour through affecting development of uteroplacental and fetoplacental circulation necessary for a normal pregnancy outcome (***Smitha et al., 2014).***

Doppler velocimetry is a non-invasive technique that evaluates abnormal fetal hemodynamics that take place in response to changes in placental resistance ***(Yalti et al., 2004)***.

Doppler studies of multiple feto-placental vessels can be used to monitor compromised fetus predicting adverse perinatal outcome and assisting in optimal time of delivery ***(Piazze et al., 2005).***

The objective of fetal Doppler is to detect any hemodynamic changes at the earliest and to assess the

placental dysfunction and the consequences of this on fetal growth and well-being ***(Sumangali et al., 2017) .***

Umbilical artery and middle cerebral artery Doppler ultrasound clearly depict the information about placental resistance and the changes in the fetal hemodynamics in response to it. Umbilical artery Doppler reflects the maldevelopment of the placental tertiary stem villi which increases the placental resistance ***(Mohan et al., 2017).***

Fetal middle cerebral artery (MCA) resistance in combination with umbilical artery (UA) resistance as the cerebroplacental ratio (CPR) is more reflective of fetal hypoxia and acidemia, and therefore better prediction of perinatal outcome which also aid in the prediction of both SGA and adverse perinatal outcome ***(Oros et al., 2011) .***

Uterine artery Doppler might be expected to reflect placental perfusion, while umbilical Doppler reflects placental pathology, therefore The Cerebrouterine ratio (CU Ratio) could have a better predictive value for unfavorable outcome ***(Simanaviciute and Gudmundsson, 2006).***

Aim of the Work

The aim of the study is to prove that (CU) ratio increase predictive value of (CP) ratio for the prediction of adverse perinatal outcome in women with preeclampsia.

Research Question:

In pregnant women with preeclampsia does performing cerebrouterine ratio (CU) increase predictive value of cerebroplacental ratio (CP) for neonatal outcome **?**

Research Hypothesis:

In pregnant women with preeclampsia performing cerebrouterine ratio (CU) increases predictive value of cerebroplacental ratio (CP) for neonatal outcome.

Doppler Ultrasounds

Introduction:

In 1842, an Austrian professor of mathematics and geometry Christian Johann Doppler first described in detail the effect that now bears the name. Satomura was the first to describe the clinical application of Doppler ultrasound technology in 1959 ***(Strigini et al., 1997).***

The width of the Doppler spectrum is dependent upon the flow velocity profile. Two distinct types of flow exist; the plug flow is the type of flow which happens in systole, where contraction of the heart moves, all the red blood cells rapidly producing a narrow spectrum and parabolic flow which happens in diastole, where there is greater variation in the velocity between the red cells producing a wider spectrum ***(Gagnon and Vanden- Hof, 2003).***

Doppler signals may be obtained by three types of devices:

1. Continuous wave.
2. Pulsed wave.
3. Color flow mapping.

1- Continuous wave Doppler ultrasound equipment:

This can measure a wide range of velocities without limit. The transducer contains two piezo-electric crystals

(Fig. 1). One transmits the ultrasound beam continuously and the second receives the back scattered echo. The advantage of continuous-wave equipment is that it is relatively inexpensive and portable ***(Fahemi et al., 2001).***

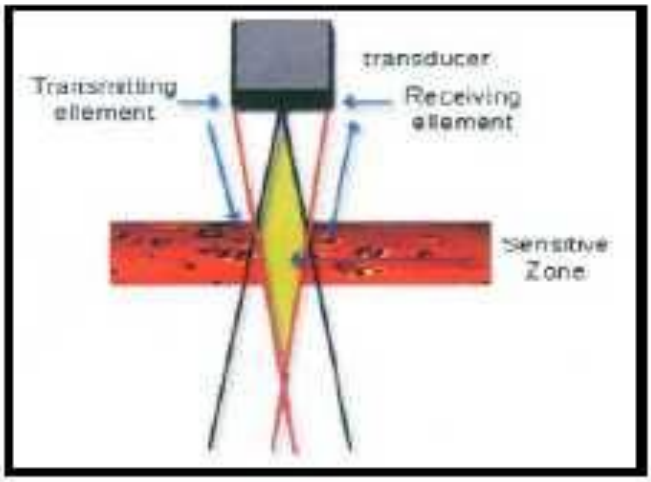

Fig. (1): Continuous wave Doppler ultrasound***.(Rourke et al., 1992)***

The main disadvantage is that the vessel being studied can not be simultaneously visualized ***(Baschat et al., 2006).***

2- Pulsed Doppler ultrasound:

Most of the initial work on blood flow as quantitative and used pulsed Doppler ultrasound. The same transducer is used to transmit and then to listen for the returning signal ***(Baschat et al., 2006).***

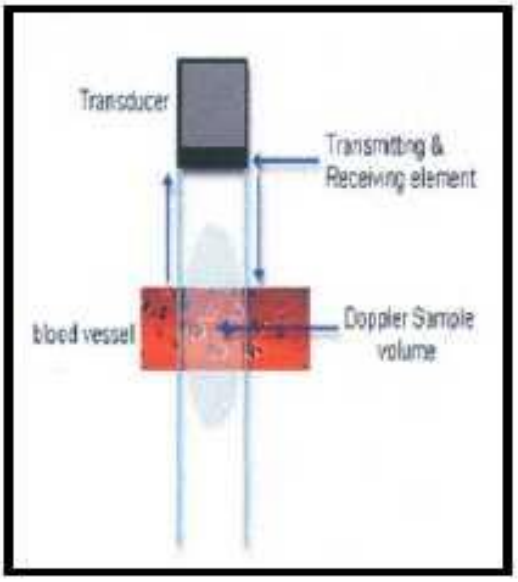

Fig. (2): Pulsed Doppler Ultrasound Wave ***(Rourke et al., 1992)***

3- Colour flow equipment:

This is the most recently developed method utilizing Doppler ultrasound. Conventional real-time images are superimposed with blood flow information, coded in colour to indicate the direction and velocity of flow. Color flow mapping displays the direction of blood flow, in three different formats: blue, indicating flow away from the transducer, red-orange, indicating flow towards the transducers; and a mosaic pattern of red-orange or bluegreen which represents flow in several direction, suggesting turbulence ***(Zhang et al., 2006)***.

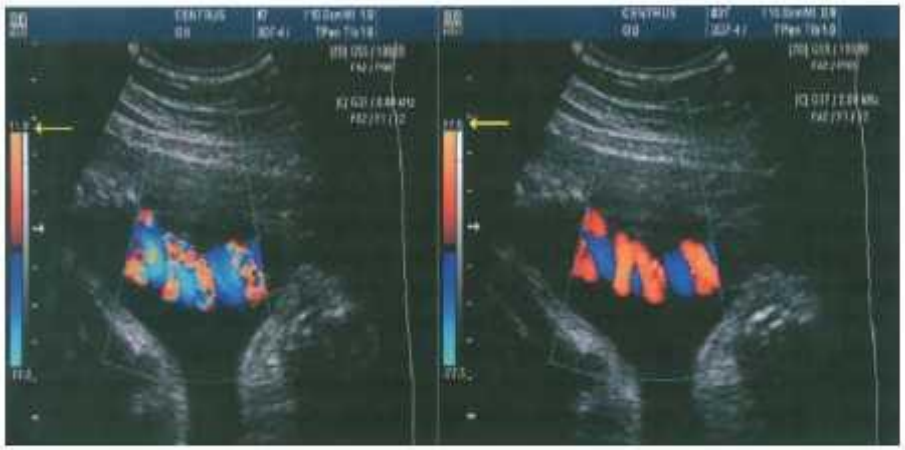

Fig. (3): Color flow imaging effects of pulse repetition frequency or scale (left) the pulse repetition frequency or scale is set low (yellow arrow). The color imaging shows ambiguity within the umbilical artery and vein and there is extraneous noise (b) The pulse repetition frequency or scale is set appropriately for the follow velocities ((right). The color image shows the arteries and vein clearly and unambiguously ***(Thompson et al., 1986)***.

Doppler arterial waveforms in non-pregnant humans are characterized by high systolic velocity and little or no diastolic velocity. Exceptions are the carotid and cerebral vessels which have continuous diastolic blood flow seen on waveform analysis. During pregnancy maternal and fetal vessels perfusing the placenta assume waveforms indicative of continuous diastolic flow (***Niebyl, 2005).***

Doppler waveforms of vessels have been described in a variety of ways, but all are based upon the relationship between systole and diastole. The most common measurements are some variation of the Systolic Diastolic