THE VALUE OF MIDDLE CEREBRAL TO UMBILICAL ARTERY PULSATILITY INDEX RATIO IN THE PREDICTION OF ADVERSE NEONATAL OUTCOME IN PREECLAMPSIA

A protocol of thesis submitted for partial fulfillment of Master Degree in Obstetrics and Gynecology

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Dedication

To my Father and my Mother who taught me the principles and patience

To my husband who support me

To son abd elrahman

To all my professors and colleagues

Contents

ABSTRACT

OBJECTIVE. Our aim was to assess the accuracy of the Middle cerebral to Umbilical Artery (PI) ratio in predicting fetal out come in pregnancies complicated by preeclampsia. **METHODS.** We evaluate 75 pregnant women representing clinical forms of preeclampsia. Seventy-five cases with no signs of preeclampsia were accepted as controls. Pulse wave color Doppler with 3.5MHz probe was used in the assessments of fetal and maternal circulation. Cerebral to umbilical ratio was obtained by the division of MCA PI to UA PI. Apgar score will be assessed at 5 minutes after birth. Apgar score < 7 at 5 minutes and or neonatal admission to neonatal intensive care unit (NICU) will indicate neonatal morbidity. Perinatal outcome was evaluated in relation to the indices. **RESULTS**. Umbilical artery showed elevated indices in preeclamptic patient than control group, Absent end diastolic velocity (AEDV) and reversed end diastolic velocity (REDV) were seen in 9 cases respectively and were associated with poor perinatal outcome. MCA values were decreased in preeclamptic patient and had poor perinatal outcome in terms of need for lower segment cesarean section (LSCS) for fetal distress, apgar <7 at 5minute, and admission to nursery. Cerebroumbilical (C/U) ratio of <1.1 was similarly associated with poor perinatal outcome. **Conclusions:** In normal pregnancy there is gestational age related fall in impedance in umbilical and middle cerebral arteries. cerebral–umbilical ratio is strong predictors of IUGR and of adverse perinatal outcome in preeclampsia. The MCA PI alone is not a reliable indicator. The combination of umbilical and fetal cerebral Doppler indices may increase the utility of Doppler ultrasound in preeclamptic subjects.

Key Words:

Doppler velocimetry, Preeclampsia, Methodology of Doppler assessment of placenta & fetal circulation, Doppler study in fetal hypoxic hypoxia.

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List of Abbreviations

Abbreviation	Meaning
(CW)Doppler	continuous wave Doppler
(PW)Doppler	pulsed wave Doppler
(FD)	Doppler shift
(SPTA)	Doppler spatial peak-temporal average-intensity
(CPD)	Color power Doppler
PI	Pulsatility index
RI	Resistance index
FIP	Frequency index profile
S/D Ratio	systolic/diastolic ratio
(EVT)	extravillous trophoblast
HLA	Human leucocytic antigen
(NK) cells	Natural killer cells
(TNF)	Tumor necrosis factor
(NO)	Nitric oxide
VEGF	**Vascular endothelial growth factor**
(PlGF)	**Placental Growth Factor**
FDP	Fibrin degradation products
BP	BLOOD PRESSURE
PIH	pregnancy induced hypertension
IUGR	intrauterine growth retardation
MCA	Middle cerebral artery
UA	Umbilical artery
FVW	flow velocity waveform
(AEDV)	Absent end diastolic velocity
(REDV)	Reversed end diastolic velocity
FBP	Fetal biophysical profile
C/U ratio	cerebroumbilical ratio
GA	Gestational age
DV	Ductus venosus
IUFD	Intrauterine fetal death
SGA	Small for gestational age

INTRODUCTION

Techniques of Doppler Ultrasonography **(US)** have been available to clinicians for nearly 40 years. The Doppler effects as developed by sound propagation in human tissues and with the velocities observed for the human vasculature produces shifts in the frequencies of returning echo signals. These signals can be processed in a manner that allows the observer to determine the condition of the blood flow **(Boote, 2003).**

Preeclampsia, a hypertensive disorder of pregnancy which usually develops after 20 weeks of gestation characterized by elevated blood pressure, proteinuria and /or edema**. (Maynard et al., 2008).**

Preeclampsia remains a major cause of maternal and neonatal morbidity and death **(Norwitz et al.,2008).**

In normal pregnancy impedance to flow in the uterine arteries decrease with gestation and histopathological studies suggest that this is due to trophoplastic invasion of the spiral arteries and their conversion into low resistance vessels, failure of trophoplastic invasion is associated with complications of uteroplacental insufficiency **(Papageorghiou et al., 2004).**

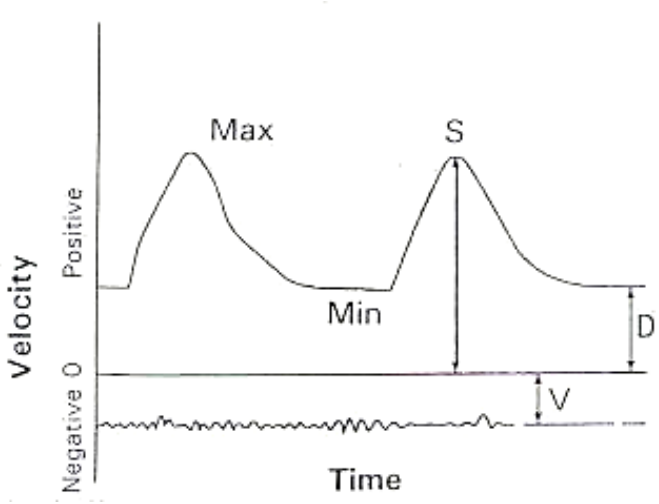
Preeclampsia is a pregnancy specific syndrome characterized by reduced organ perfusion secondary to vasospasm and endothelial pathophysiology. This condition is the leading cause of maternal

mortality and is responsible for considerable perinatal morbidity and mortality **(Lewis et al; 2001).**

Doppler velocimetry studies of placenta and fetal circulation can provide important information regarding fetal well being providing an opportunity to improve foetal outcome **(Serap et al., 2003).**

Pulsatility index:

A measure of the variability of blood velocity in a vessel, equal to the difference between the peak systolic and minimum diastolic velocities divided by the mean velocity during the cardiac cycle abnormal **MCA PI/ UA PI (CU ratio)** were defined as the ratio < 1.08 **(Mosbyet al; 2009).**



Doppler indices

Max = Maximum peak velocity in systole (S)

Min = Minimum peak velocity in diastole (D)

V = Venous velocity ("constant"). S/D = Svstolic: diastolic ratio

$\frac{(S/D)}{S}$ **Resistance index** $\frac{(S/D)}{Mean}$ **Pulsatility index**

In normal pregnancy, pulsatility index decrease with advancing gestation in Umbilical Artery. But in preeclampsia first there is decrease diastolic flow in the Umbilical Artery due to increase in the resistance that occurs in small arteries and arterioles of terminal villi. As the placental insufficiency worsen, the diastolic flow decreases, then become absent and later reverses **(Eixarch et al; 2008).**

Fetal Middle cerebral Artery (MCA) is a low resistance circulation throughout pregnancy and accounts for 7% of cardiac output. Increase in diastolic flow with decreased pulsatility index shows the brain sparing taking place in fetuses of preeclamptic patients. The ratio of PI of MCA/UA is more sensitive than MCA PI alone in predicting adverse neonatal outcome **(Gerber et al; 2006).**

Doppler screening of the fetal Middle cerebral Artery wave forms during labour can be useful in the evaluation of intrapartum hypoxia in complicated pregnancies **(Kassanos et al., 2003).**

MCA/UA ratio reflects not only the circulatory insufficiency of the Umbilical velocimetry of the placenta, manifested by alterations in the Umbilical S/D ratio,(ratio of peak systolic blood flow velocity) but also the adaptative changes resulting in modification of the Middle cerebral S/D ratio **(Sterne et al., 2001).**

(MCA/UA) ratio is a good predictor of neonatal out come and could be used to identify fetuses at risk of morbidity and mortality in this study they evaluated the predictive value of Umbilical Artery, the MCA/UA ratio and the cerebral index for foetal prognosis in the third trimester in preeclamptic women **(Sterne et al., 2001).**

Several studies have reported higher sensitivities and specificities for Middle cerebral Artery, Umbilical Artery (MCA/UA) Doppler ratio compared with Umbilical velocimetry alone for prediction of fetal prognosis (**Makhseed et al., 2000).**

As a result of impaired uteroplacental blood flow, manifestations of preeclampsia may be seen in the fetal placental unit. These include intrauterine growth restriction (IUGR), oligohydraminos, placental abruption, and nonreassuring fetal status found on antepartum surveillance by Doppler ultrasound **(ACOG ; 2002).**

High flow resistance in the capillaries of the terminal villi leads to low end diastolic velocity in the Umbilical Artery and consequent hypoxia **(Huppertz B. 2008)**

As a result of the prolonged fetal hypoxia, circulatory adaptation occurs in the form of cerebral vasodilatation, resulting in the redistribution of the cardiac output to provide an adequate oxygen supply to the brain. These changes, which help fetus to adapt to a hostile environment, may correlate with fetal neonatal health **(Mosby et al; 2009).**