Power Doppler study of uteroplacental blood flow and 3D ultrasound measurement of placental volume in pre-eclampsia

Thesis

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Abstract

In the present study, there was a significant difference between the studied groups, severe pre-eclamptic cases had significantly higher Doppler velocimetry indices for RI (0.82±0.08) compared to mild pre-eclamptic group (0.56±0.07) ,and control group (0.45±0.05). Also, mild cases of pre-eclampsia had significantly higher Doppler velocimetry indices than control group for RI Although severe pre-eclamptic group had higher indices for S/D ratio and PI than mild pre-eclamptic group and normal control group, no significant difference was observed. This is also the situation for mild pre-eclamptic group versus normal control group.

Key word:

pre-eclampsia, uteroplacental, 3DPD, Cardiotocography

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List of Abbreviations

3DPD: Three dimensional power Doppler.

AC : Abdominal circumference

ACOG : American college of obstetricians and Gynecologist

AF : Amniotic fluid

AFI : Amniotic fluid index

AGA : A verage for gestational age

BP : Blood pressure

BPD : Biparietal diameter

BUN: Blood Urea nitrogen.

CS : Cesarean section.

CST : Contraction stress test

CTG : Cardiotocography

DM : Diabetes mellitus

DNA : Deoxyribonucleic acid

EDF : End diastolic flow

EFW : Estimated fetal weight

F/A ratio: Femur - to - abdomen ratio

FBPP : Fetal biophysical profile

FDMC : Fetal daily movement count

FGR : Fetal growth restriction

FL : Femur length

FVW : Flow velocity waveform

G : Grade

HC : Head circumference

IUFD: Intrauterine fetal death

IUGR: Intrauterine growth retardation

MBPP: Modified biophysical profile

MVP : Maximum vertical pocket of amniotic fluid

NICU: Neonatal intensive cart; unit.

NND : Neonatal death

NST : Nonstress test

PAF: Platelet activation factor.

PI : Pulsatility index

PIH : Pregnancy induced hypertension

PT : Placental thickness

PUBS: Percutaneous umbilical blood sampling

PV : Probability value

PW : Pulsed wave

RDS : Respiratory distress syndrome

Rh : Rhesus factor .

RI : Resistance index

S/D : Systole / Diastole ratio

SD : Standard deviation

SGA : Small for gestational age

TNF: Tumour Necrosis Factor

UA : Uterine artery

UPD : Uniparental disomy

UPI : Uteroplacental insufficiency

VAST : Vibroacoustic stimulation test

Aim of the work

The aim of the work is to study the utero-placental blood flow by 3D power Doppler and the placental volume in relation to severity of Pre-eclampsia and fetal outcome.

Introduction

Hypertensive disease with pregnancy is one of the obstetric problems in which the fetus as well as the mother are at risk **(Robson, 1999).**Varity of techniques that has been used for appraising the health of the embryo and fetus in utero.

Although Intra uterine growth retardation (IUGR) is a usual finding in pre-eclampsia, little is known about the value of placental volume measurement and it's relation to the IUGR in cases of pre-eclampsia.

Determination of placental size is a part of the overall assessment of intrauterine environment, placental growth can be estimated by either measuring the thickness or estimating its volume **Geirsson et al., (1985).**Longitudinal sonographic studies of the placental volume have shown wide variation in each stage of gestation **Bleker et al., (1977).**

There is some evidence that IUGR is preceded by reduced placental volume in the first half of pregnancy. The development of 3D ultrasound has improve the clinical value of placental volume measurement **Jurkovie et al., (1994).**

Doppler velocimetry is the ideal clinical tool to assess placental performance in high-risk pregnancies. It also has value in predicting later complications and outcome in pregnancies which appear uncomplicated. **(Matijevic R,and Kurjak A.2002)**. All three circulations (fetal, placental and maternal) may be interrogated by Doppler technology.

The assessment of umbilical blood flow provides information on blood perfusion of the fetal-placental unit. The diastolic blood flow velocity component in

umbilical artery increases with advancing gestation. In pregnancies complicated by placental dysfunction, there may be a reduction in the number of functional villi and/or small blood vessels with, as a result, increased impedance, reflected, mainly, by a decrease in end-diastolic velocity. When the resistance increases even more, there is no diastolic forward velocity (absent end-diastolic velocity). Further increase in the resistance causes reversed end-diastolic velocity, which is considered a late step in the cascade of events leading to intrauterine fetal demise. **Zalud I et al., (2007).**

Doppler assessment of the umbilical arteries was found to improve outcome of high-risk pregnancies, and reduce hospital admissions. On the contrary, routine Doppler ultrasound in low risk or unselected populations does not seem to confer benefit on mother or newborn.

Three-dimensional power Doppler sonography can provide new insights into placental pathophysiology.(**Zalud I. 2006).**

Hypertention is the most common medical disorder with pregnancy and pre-eclampsia constitutes two thirds of cases of hyperention with pregnancy **Seligman et al., (1994).** It complicates 5-10% of all pregnancies and is a strong indication of women at risk of perinatal complications and poor pregnancy outcome **Acromite et al., (1999).** In earlier studies, **(Dawn 1995) and Theam et al. (2001)** described the positive predictive value of a small second-trimester placental volume as measured by U/S in prediction of the fetal outcome. While, **Hafner et al. (1998)** and **Hanfer et al. (2001)** found poor correlation between placental volume (measured by 3D U/S in the second trimester) and, the fetal size with poor prediction of IUGR.

The uterine and placental vascularizations are important for normal pregnancy development **Brosens et al., (2002)** Abnormal vascularization can produce increased resistance to flow through the uterine circulation, and the resulting placental insufficiency can significantly reduce the delivery of oxygen to the fetus. Abnormal placental development is associated with fetal and neonatal morbidity, growth impairment, incidence of major congenital anomalies, increased incidence of preterm birth, fetal non-reassuring status in labor, neonatal intensive care admissions, and overall mortality. Early studies suggested that Doppler ultrasound held great promise as a non-invasive, repeatable, and simple method of predicting hypertension in pregnancy and identifying those pregnancies at high risk for maternal and fetal complications **Bower et al., (1993)** and **Steel et al.,(1990).**

Correlation between the placental volume estimation using 3D ultrasound and power Doppler study of uteroplacental blood flow in cases of pre- eclampsia (P.E.)

With the introduction of three-dimensional (3D) sonography, volume calculation was simplified considerably. The 3D size of structures such as the placenta and the fetus can be easily observed over a specific period of time. **Hafner et al. (2001)**

The physiological knowledge may be expanded and the pathophysiological mechanisms better understood.

Evaluation of fetal status with the purpose of intervening when appropriate in order to avoid fetal morbidity or mortality is a main goal of maternal fetal medicine. Doppler ultrasound waveform analysis of the maternal–fetal circulation has emerged to add useful information in the determination of fetal well being. One of potential application of 3D Doppler could be in the study of vascular changes in

patients with pre-eclampsia. It is a known fact that preeclampsia is commonly associated with deficient trophoblastic invasion of the maternal spiral arteries during the first and second trimester **Brosens et al.,(2002).**

This problem can produce abnormally increased resistance to flow through the uterine circulation, and the resulting placental insufficiency can significantly reduce the delivery of oxygen to the fetus. Abnormal placental development is associated with fetal and neonatal morbidity, growth impairment, incidence of major congenital anomalies, increased incidence of preterm birth, fetal non-reassuring status in labor, neonatal intensive care admissions, and overall mortality. Early studies suggested that Doppler ultrasound held great promise as a noninvasive, repeatable, and simple method of predicting hypertension in pregnancy and identifying those hypertensive pregnancies at high risk of maternal and fetal complications **Fleischer et al.,(1986)**and **Gudmundsson et al., (1988).** However, subsequent studies have emphasized the complexity of factors that may influence the pulsed Doppler waveform analysis **(Fairlie FM 1991)** . It is hoped that 3D Doppler ultrasound could uphold the original promise.

Three-dimensional (3D) ultrasonographic measurement of placental volume and vascularization as defective trophoblast invasion could result in reduced placental growth and size, and eventually IUGR. **(Alin B.Y. et al., 2011)**

Hypertensive Disorders In Pregnancy

Elevated blood pressure during pregnancy is a challenging clinical problem for which the approach to evaluation and treatment differs substantially from that employed in non-pregnant patients.

Thus, the accurate diagnosis of IUGR in severe preeclampsia is important to ensure proper clinical management while simultaneously minimizing the risk of the preterm delivery of an infant incorrectly diagnosed with growth restriction.**(Jamie A. et al., 2009).**

First, the diagnostic spectrum is broader since in addition to various forms of chronic hypertension, the patient may have a short-lived, pregnancy specific form of hypertension, i.e. preeclampsia. The latter disorder is accompanied by substantially greater maternal and fetal risks than in uncomplicated essential hypertension, a fact of central importance to clinical decision making. **(Barron et al.,1995).**

Preeclampsia / eclampsia have been recognized as a clinical entity since the times of Hippocrates **(Chesley et al., 1998).** In 1916, Zweifel first termed 'toxaemia' the disease of theories. Many of the causal theories attributed to preeclampsia / eclampsia described pathological features of the clinical presentation which are the result rather than the cause of the disease process (**Chesley, et al.,1998)**.

It has been called many things and has been thought to be a neurological renal, hepatic, hypertensive and more recently a placental disorder. The truth is that it is probably all these things in different people and is certainly more than just hypertension in pregnancy **(Roberts and Redman, 1993).**