First trimesteric uterine artery Doppler indices to predict pregnancy-induced hypertension

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List of figures

Contents

List of tables

List of abbreviations

A-wave: Atrial contraction wave

CW: Continuous-Wave

D-wave: Diastole wave

FIP: Frequency Index Profile

HCG: Human Chorionic Gonadotrophin

IUGR: Intrauterine Growth Restriction

PI: Pulsitility Index

PW: Pulsed-Wave

RI: Resistivity Index

S-wave: Systole wave

TAV: Time Averaged mean Velocity

β-hCG: Beta-human Chorionic Gonadotrophin

List of errata

Number of page	Line	False	Correct
Contents		Summery	Summary
List of abbreviations		Amersican	American
28	3	Diarrhaoe	Diarrhea
48	3	CRM	CRM (Cross Reactive Material)
72	Table 6	All live vaccines[3]	All live vaccines[2, 3]
76	11	Tuberculosis.	Tuberculosis of greater than
80	Table 7 (2nd row)	> 15-24	≥ 25
84	7	UNIFESP	UNIFESP (University Federation of Sao Paulo)

ABSTRACT

The Aim is to assess the role of uterine artery Doppler indices (PI, RI)in predicting pregnancy hypertensive disorders

Methods : 30 pregnant females were included; they were subjected to uterine artery Doppler in the first trimester at 11-14 weeks gestation .All pregnancies were followed until 40 weeks for development of preeclampsia.

Results:Cases that develop preeclampisia compared to those who did not develop preeclampisia already have increased prevalence of unilateral /**Bilateral diastolic** notching and higher PI and RI. All these were of statistically significant difference.

Conclusion : Use of uterine artery Doppler indices in first trimester of pregnancy is valuable in predicting development of preeclampisia.

Key Words

(uterine artery Doppler,RI, B-hCG, first trimester , Preeclampisia ,IUGR, PI)

Introduction

Hypertensive disorders during pregnancy are among the most common gestational disorders, complicating approximately 10-16% of pregnancies and accounting for nearly 25% of maternal morbidity and mortality **(Steinhard and Klockenbusch, 2004 and Cunningham et al., 2005)**.

Pregnancy is associated with physiologic changes in the uterine circulation resulting in a major increase in blood flow. This is thought to be the consequence of a decrease in downstream resistance through trophoblastic invasion of the maternal spiral arteries, a process beginning at conception and continuing until the end of the second trimester. Histological studies of the placenta have shown that incomplete spiral artery invasion is associated with preeclampsia with its potential ife threatening maternal and fetal complications as heart failure, renal failure mostly with placental abruption, hepatic rupture, consumptive coagulopathy and intracranial hemorrhage. While fetalcomplications include growth restriction, prematurity and stillbirth **(Aries et al., 2004 and Dugoff et al., 2005)**.

Thus, early recognition before fetal viability affords opportunities to direct women to regional perinatal care centers for enhanced maternal fetal surveillance. These screening programs are cost effective because existing patterns of care are utilized. This leads to the emergence of measurements in early pregnancy of a variety of biological, biochemical and biophysical markers to predict faulty placentation before actual development of hypertension and associated Intrauterine Growth Retardation (IUGR) **(Whittle et al., 2006)**.

Doppler ultrasonography, a noninvasive method for studying the uteroplacental circulation, provides the capability to qualitatively evaluate blood flow in small branches of the uterine arteries. In normal pregnancy, impedance to flow in the uterine arteries decreases with gestations. However, in cases of impairment of trophoblastic invasion, Doppler studies showed increased impedance to flow in the uterie arteries as they failed to develop into low resistance vessels **(Schuchter et al., 2001 and Dugoff et al., 2005)**.

Doppler screening studies performed at 18-20 week gestation can demonstrate an association between increased impedance to flow in he uterine arteries with subsequent development of

pregnancy related hypertensive disorders and their complications. In addition, several studies showed that elevated first trimester uterine artery mean Resistivity Index (RI) is significantly associated with fetal IUGR **(Schuchter et al., 2001 and Dugoff et al., 2005)**.

Doppler proved to be more efficient at predicting pregnancy complications in high-risk patients, including very young or old women, patients with chronic hypertension, those with history of hypertensive disorders in previous pregnancies, diabetics and with multifetal gestation. However, it is less powerful in the population at low risk **(Zimmermann et al., 2002)**.

Many authors found that serum beta-human Chorionic Gonadotrophin (β-hCG) levels in the second trimester can predict pregnancies that subsequently develop preeclampsia and associated fetalIUGR **(Ramzi et al., 2000 and Spencer et al., 2005)**.

First trimester uterine artery Doppler can identify over half of women who will develop preeclampsia and fetal IUGR. Recent studies have documented that detection rates may be increased by a combination of uterine artery Doppler with first-trimester maternal serum markers **(Campbell and Papageorghiou, 2006)**. In addition, the identification of uterine artery notching by means of Doppler

ultrasound as a component of the surveillance of women with unexplained elevated serum β-hCG levels significantly improves the prediction of preeclampsia and/or severe fetal IUGR **(Thomas et al., 2005)**.

Aim of the work

The aim of the work is to assess uterine artery Doppler indices as a predictor for pregnancy-induced hypertension.

Doppler ultrasound

Historical background:

In 1842, an Austrian Professor of Mathematics and Geometry Dr. Christian Jon Doppler first described in detail the effect that now bears his name. Dr. Doppler did not observe the effect of motion on Sound Frequences but on shifts on light **(Chudligh and Pearse, 1992)**.

In 1934, Barcroft and Associates performed radiographic studies on fetal lambs and goats to establish the circulatory pathways.

In 1957, Satamura used the Doppler to investigate the human circulation and in 1977, Fitzgerald and Drum described the fetal blood by Doppler ultrasound.

Since then, a tremendous number of comprehensive studies has been done to asses its usefulness as a non invasive access to the uteroplacental and fetal circulation **(Maulik et al., 1990)**.

Quantitative Doppler indices:

Quantitative Doppler can quantify flow disturbances estimate absolute blood flow ,assess vascular impedance and help to

characterize tissue. Quantitative Doppler indices include velocity and flow measurements. Velocity is defined as the maximum Doppler shift over a cardiac cycle; flow is defined as the average velocity times the lumen area of a vessel. If the vessel is circular the area can be determined from one diameter whereas if it is an ellipse two diameters are required **(Berman and Yankowitz, 1997)**.

Several potential errors are inherent in measuring fetal blood flow volume. One source of error is the inaccurate measurement of the angle of the vessel to the insonating ultrasound beam.

The estimate of velocity is strongly dependant on the magnitude of the angle gives an accurate measurement of the angle. If the insonating beam angle is 30 degrees, there is 3% to 4% error in the Doppler velocity measurement;a 60 degree angle produces a 15% error. But, an 80 degree angle produces 50% error.

The need to measure the angle of insonation limits this method to vessels whose axis lies in the same plane for a few centimeters of there course. The intraabdominal umbilical vein or the fetal descending aorta is suitable. Yet, another error in estimating flow volume can arise measuring the vessel diameter. Small measurement errors in vessels of small diameter create huge errors. For example, a

1 mm error in the measurement of 8-mm vessel produces a 25% error variation in the flow circutation. The diameter of the vessels especially the fetal aorta may vary 20% over the cardiac cycle. The sample volume must embrace the entire lumen, to ensure that it is uniformly insonated **(Berman and Yankowitz, 1997)**.

Qualitative Doppler indices:

Qualitative measurements of flow velocity waveforms are angle independent and are therefore easier to obtain . the A/B or S/D ratio was first described by Stuart and Colleagues in 1980. This is the ratio of the peak systolic velocity to the end-diastolic velocity In 1974, Pourcelot, first described the RI as a mathematical derivative of the simple S/D ratio. RI is the difference between systolic and diastolic pressure divided by the systolic pressure, Gosling and King in 1975, showed that time velocity waveforms are senestive to cganges in impedance when they are analaysed in a certain way, they proposed the PI, the difference between peak systolic pressure and end diastolic pressure divided by the mean maximum frequency over the entire cardiac cycle, a microcomputer is required to outline the maximum envelope of the waveform. In 1983, Campbell and Colleagues developed a new index for waveform analysis , the