Doppler Study of Uterine and Cubital Artery in Normal Pregnancy, Pre-eclampsia and Intrauterine Growth Restriction – Evidence for Systemic Vessel Involvement

P. L. Bhanap[1*], Prashant Ingole[2]

[1]Associate professor, Department of OBGY, IIMSR, Warudi, Badnapur, Jalna, Maharashtra, INDIA.

[2]Paripurti Nursing Home, Kalda corner, Aurangabad, Maharashtra, INDIA.

[*]Corresponding Address:

pbhanap@gmail.com

Research Article

Abstract: Hypertensive disorders are among the commonest medical disorders during pregnancy and continue to be a major cause of maternal and perinatal morbidity and mortality. In this study, 30 women with no pregnancy complication, 30 with pre-eclampsia and 30 with intrauterine growth restriction were included. The present study included 90 cases over a period of one year. Doppler sonography of placental uterine, non – placental uterine and cubital artery was carried out. It was observed that, the mean pulsatality index at the placental uterine artery, non placental uterine artery and cubital artery is significantly higher in pre-eclampsia and intrauterine growth restriction group.

Key words: Pregnancy induced hypertension, intrauterine growth restriction, Doppler velocimetry.

Introduction

Hypertensive disorders are among the commonest medical disorders during pregnancy and continue to be a major cause of maternal and perinatal morbidity and mortality. Approximately, 7-10 % of all pregnancies are complicated by some form of hypertensive disease. Incidence of pregnancy induced hypertension (PIH) in rural India is 10%. It is a cause of death in 8 % of all maternal deaths. Nearly 3 million low birth weight babies are born annually in India. It accounts for more than half of neonatal deaths. Until now, most information on fetoplacental and fetal blood flow was obtained from animal studies or by invasive technique. During normal pregnancy, physiological modifications of the uteroplacental bed (uncoiling and trophoblastic invasion of the spiral arteries) take place as a result of which , there is low resistance in the uterine arteries. Until the end of pregnancy, a tenfold higher circulating output towards fetoplacental unit is achieved. A failure of trophoblastic invasion results in the so called muscular spiral arteries. This causes a decrease in the uteroplacental capacitance and consequent increase in the uterine artery resistance. This causes fall in diastolic flow. Latest advances in Doppler sonography technology have led to the applications for non invasive assessment of maternal and fetal hemodynamics. The analysis of flow velocity waveforms is a far simpler technique which has improved by development of real time spectral analysis. The characteristic spectral wave form from the normal uteroplacental system is unidirectional, of low pulsatility. So a presence of decreased diastolic flow, presence of early diastolic notch after 24 weeks of gestation and raised indices are considered abnormal and suggestive of poor trophoblastic invasion. In this study, it was tried to evaluate whether simply measuring peripheral resistance would help us in predicting intrauterine growth restriction (IUGR).

Aims and objectives

1. To study the resistance in the placental uterine artery in normal pregnancy, in PIH and in IUGR.
2. To study the resistance in the non placental uterine artery in normal pregnancy, in PIH and in IUGR.
3. To study the resistance in the cubital artery in normal pregnancy, in PIH and in IUGR.
4. To evaluate whether peripheral resistance in pregnancies complicated by fetal IUGR shows elevated levels as complicated by PIH.

Materials and Methods

This was a prospective, randomized case control study carried on pregnant women in the Obstetrics and Gynecology department of G. R. Medical College, Gwalior from October 2007 to November 2008. Total 90 patients were enrolled in the study, they were divided into 3 groups.

Group A - Normotensive pregnant women 30
Group B - Antenatal women with PIH 30
Group C - Antenatal women with IUGR 30

Inclusion criteria

1. Pregnant women who attended outpatient department.
2. Completed 24 weeks of gestation as per last menstrual period.
3. Singleton pregnancy
4. Age between 20 and 30 years (Both Inclusive).

Exclusion criteria

1. Women with medical disorders like jaundice, diabetes or any other systemic disorder.

Group A – Normal pregnancy:

30 women with uneventful course of pregnancy were investigated.

Doppler sonography was done on placental, non placental uterine and cubital arteries.

Group B – Antenatal women with PIH

30 women with PIH – blood pressure more than 140/90 mm Hg on two occasions and proteinuria more than 300 mg per litre for the first time during pregnancy.

Doppler sonography was done on placental, non placental uterine and cubital arteries.

Group C – Antenatal women with IUGR.

30 women with IUGR – estimated fetal weight by ultrasonography below 10^{th} percentile.

Doppler sonography was done on placental, non placental uterine and cubital arteries.

The study was done using a convex array 3.5 MHz probe.

All 90 women underwent routine ultrasound examination for evaluation of gestational age .The parameters like head circumference, abdominal circumference, femur length and biparietal diameter were noted, estimated fetal weight noted , amniotic fluid index noted. This was followed by Doppler study. Doppler sonography was performed on left and right uterine arteries, but was characterized by their relation to the placenta (placental and non placental uterine artery) and on the right cubital artery.

Results

All patients were comparable regarding their age, urban or rural status and whether they were booked or not. Women with PIH and those with IUGR were more likely to be from unbooked group. Mean gestational age in group A was 30.70 weeks, in group B was 31.26 and in group C was 31.83 weeks. We found literacy in 40 % women in group A , 43.33 % in group B and 40 % in group C. Primigravidae formed 60 % share in Group A, 56 % in group B and 60 % in group C.

In group A , the mean pulsatility index (PI) value of placental uterine artery was 0.718 while that in group B was 1.33 ,thus making it clear that patients with PIH had elevated resistance in placental artery.In group B ,it was 1.004,again substantiating the claim of increased resistance. In group A, PI value in nonplacental uterine artery was 0.838, that in group B was 1.512 and Group C was 1.11, making the assumption clear that there is increased resistance in vasculature.

In group A, PI value in cubital artery was 2.273, in group B it was 3.077 and in group C it was 3.492. P-value for these observations is < 0.05, which is significant. Thus, it can be said that women with PIH and IUGR have increased resistance in peripheral vasculature.

Discussion

Campbell et al examined the arcuate arteries in 126 pregnancies at 16-18 weeks of gestation.Subsequently, 12 % cases developed preeclampsia and 12 % developed IUGR. The sensitivity of increased impendance was 67 % for PIH and 67 % for IUGR and specificity was 65 % for both. Fleisher A et al showed there is inadequate invasion leadind to increased resistance in spiral arteries. Y. F. Chaung compared brachioradial artery stiffness and systemic blood pressure among children born preterm and small for gestational age (SGA), preterm and appropriate for gestational age and born at term with weight appropriate for gestational age. SGA babies had significantly higher mean blood pressure. Kofinas AD found that unilateral placental location may predispose to development of preeclampsia and IUGR. Barbara Schiessl in a prospective study found that, systemic changes in arterial resistance correlate with uterine artery during the course of physiologic pregnancy. Similarly, in another study, they found that PI in maternal arterial system is elevated in IUGR. In the present study, it was clear that systemic circulation shows the same changes like that of uterine vasculature in normal and abnormal pregnancy and hence can be said to be mirror image. Hence it may be possible to predict IUGR by simply measuring PI at cubital artery. The limitation of this study is that women attending hospital services may not be representative of general population.

Conclusion

A prospective study of 90 women was done. Doppler velocimetry study was done in placental as well as peripheral vasculature. The PI value was higher in PIH and IUGR group. Also, in the cubital artery, values were high in these two groups. This study demonstrates elevated resistance in the uterine and cubital artery in PIH and IUGR groups. Hence it may be possible to predict IUGR by simply measuring PI at cubital artery. The limitation of this study is that women attending hospital services may not be representative of general population.

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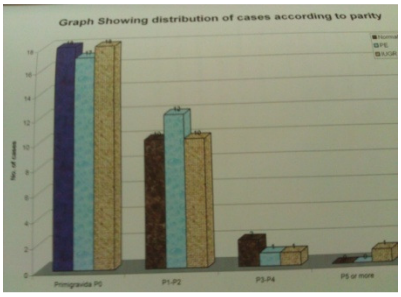

Figure 1

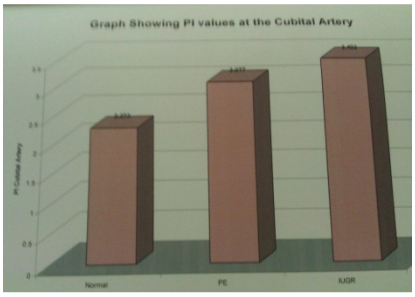

Figure 2