Role of Uterine Artery Doppler in 11-14 Weeks Scan as a Predictor of Preeclampsia.

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ABSTRACT

Background: Preeclampsia (PE) is a disease in pregnancy involving interplay of multiple genetic, immunologic and environmental factors. The primary pathology of PE is related to abnormal placentation. Uterine artery doppler in the first trimester is a promising screening test for prediction of PE. Objective: To study the role of first trimester uterine artery doppler in prediction of preeclampsia. Methods: A prospective study was carried out to evaluate the role of uterine artery doppler in the 11-14 week scan for prediction of preeclampsia and associated IUGR. A total number of 200 women who met our selection criteria were included in the study. Uterine artery doppler was done as part of the 11-14 weeks scan and mean uterine artery PI was calculated. Results: Among the women in the study, PE was detected in 21 women with incidence of 11%. The sensitivity, specificity, positive predictive value and negative predictive values of mean uterine artery PI for development of PI were 76%, 86%, 39% and 96% respectively. Conclusions: Early identification of pregnancies at high-risk of early onset PE and undertaking the necessary measures to improve placentation can reduce the burden of the disease by using prophylactic aspirin. Effective screening for early onset PE can be achieved in the first-trimester of pregnancy with maternal history, uterine artery doppler and biochemical markers. Biochemical screening for preeclampsia needs to become cheaper and easily accessible for better prediction of PE in first trimester.

Keywords: Preeclampsia, Uterine artery Doppler, Early prediction.

INTRODUCTION

Preeclampsia (PE) is a disease in pregnancy, caused secondary to widespread vascular endothelial dysfunction and vasospasm which happens after 20 weeks gestation and can present as late as 4-6 weeks post partum. It is believed to have a complex etiopathogenesis involving interplay of multiple genetic, immunologic and environmental factors. It is characterised by hypertension and proteinuria, with or without pathologic edema and is a significant cause of maternal and fetal morbidity and mortality.[1] PE can involve 2–3% of pregnancies and is implicated in 10–15% of maternal or fetal mortalities and a similar share of indicated preterm births worldwide.[2] There is an association with fetal growth restriction, which is more profound in severe PE and if the disease has an onset in early pregnancy.

The primary pathology of PE is related to abnormal placentation secondary to impaired trophoblastic invasion of the maternal spiral arteries which affects their normal conversion from narrow muscular vessels in the non-pregnant uterus to wide non-muscular channels in the gravid uterus.[3,4] PE has been sub-classified by some investigators into two distinct disease entities: early-onset and late-onset PE. Early-onset PE is seen before 34 weeks of gestation, while late-onset PE manifests at or after 34 weeks of gestation. While the presenting features in them have common characteristics, the heritability, clinical features, biochemical markers and maternal and fetal outcomes are different.[5]

Screening for prediction of PE in pregnancy is highly relevant as it is a common disorder contributing towards maternal and fetal morbidity and mortality. In the recent past, a lot of research is being conducted to predict PE in the end of first trimester of pregnancy. Early prediction has an advantage of identifying the high risk women thereby increasing the surveillance for these women. Current research suggests that the primary pathology of PE sets in during the first trimester. If the disease process can be identified earlier, it may be possible to improve the outcome as well as plan newer
approaches in treatment. With the advent of 11-14 weeks scan for screening of fetal anomalies, an opportunity exists for screening these women for PE as well.\[6\]

Uterine artery doppler in the first trimester is a promising screening test for prediction of PE. The spiral arteries of the uterus undergo a series of morphological changes during the course of implantation and early pregnancy with a resultant change from high pressure to low pressure circulation. Doppler of the uterine arteries provides a noninvasive method for the assessment of this conversion of the uteroplacental circulation.\[7\]

**MATERIALS & METHODS**

A prospective study was carried out to evaluate the role of uterine artery doppler in the 11-14 week scan for prediction of preeclampsia and associated IUGR.

**Inclusion criteria**

All women who came to the antenatal OP in 11-14 week period and who underwent 11-14 week ultrasound scan with uterine artery Doppler. Cases of all age groups were included in the study.

**Exclusion criteria**

The study excluded women who did not undergo 11-14 week ultrasound scan with uterine artery Doppler and the women who could not be followed up till the time of delivery.

The study was based on patient’s clinical history, clinical examination and clinical investigations in the form of first trimester ultrasound. Informed consent was obtained. The ethical clearance for the study was obtained from the ethical committee of our institution. A total number of 200 women who met our selection criteria were included in the study. Uterine artery doppler was done as part of the 11-14 weeks scan and mean uterine artery PI was calculated.

Measurement of uterine artery PI: On doppler, the main branch of the uterine artery was visualised at the junction of the body and cervix of the uterus on real-time color imaging. Doppler spectral waveforms were obtained near to this location either transabdominally or transvaginally. Measurements in both the right and left uterine arteries were obtained and the mean PI was calculated as the average between the PI values of right and left uterine arteries.

While measuring care should be taken that the peak systolic velocity is higher than than 60 cm/s to make certain that measurement is taken in the main branch of the uterine artery and not the arcuate artery.\[7,8\]

The reference ranges for PI values for different weeks of gestation were taken as per Gomez et al.\[9\]. Values above 95th percentile were considered abnormal. Normal and abnormal doppler spectral waveforms are shown in [Image 1 and Image 2] respectively.

**RESULTS**

A total number 200 antenatal cases who presented to our department and who underwent first trimester uterine artery doppler were included in the study. These women were followed up till the entire duration of pregnancy with specific focus on diagnosis of preeclampsia.

Incidence of preeclampsia: Among the women in the study, PE was detected in 21 women. The incidence of preeclampsia was 11% in our study [Table 1].

<table>
<thead>
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<th>Table 1: Incidence of Preeclampsia.</th>
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<td><strong>Preeclampsia</strong></td>
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| Table 2: Development of preeclampsia in the women included in the study |
|------------------------------|----------------|
| **Development of PE** | **Present** | **Absent** |
| **Doppler findings** | **Positive** | **16** | **25** |
| **Negative** | **5** | **154** |

**Figure 1: Pie-chart of women in the present study**

**Figure 2: Accuracy of first trimester uterine artery doppler in prediction of PE.**

**Image 1: Normal spectral traces of the left and right uterine arteries in the first trimester with mean uterine artery PI value of 1.66**

Early onset preeclampsia: The women in whom PE was diagnosed before 34 weeks were labeled as early onset PE. Early onset PE was diagnosed in 13 women. The incidence of early onset PE was 7%. 

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*Image 1 and Image 2 are not included in the text.*
Late onset preeclampsia: The women in whom PE was diagnosed after 34 weeks were labeled as late onset PE. Late onset PE was diagnosed in 8 women. The incidence of late onset PE was 4 %. [Figure 1] 

Correlation of PE to doppler at 11-14 weeks:

Among the 200 women who were followed till term, abnormal mean uterine artery PI values in 11-14 weeks scan were seen in 41 women. These were labeled high-risk group. Of these women, 16 developed PE. Among the 159 women with low risk, 5 women developed PE. (Table 2). The incidence of PE in the high risk and low risk groups was 39% and 3.2 % respectively. The sensitivity, specificity, positive predictive value and negative predictive values of mean uterine artery PI for development of PI were 76%, 86%, 39% and 96% respectively [Figure 2]. Of the 13 women who developed early onset PE, abnormal uterine artery doppler was seen in 9 women. In the 8 women who developed late onset PE, abnormal uterine artery doppler was seen in 2 women. Intrauterine growth restriction was seen in 12 out of 13 patients with early-onset preeclampsia showing incidence of 92%. It was seen in 5 out of 8 patients with late-onset preeclampsia showing an incidence of 62%.

**DISCUSSION**

Pregnancy is a physiological condition in which most of the times the mother and the baby have a healthy outcome. In the present day scenario, antenatal care puts a special emphasis on a risk-based approach to monitor for conditions affecting the maternal and fetal wellbeing including preeclampsia, fetal growth restriction, placental abruption, and stillbirth. The impetus of present day research is on early prediction of risks which helps in early diagnosis and devising strategies to help in appropriate monitoring, follow up and minimising the risk of adverse outcome.

Incidence of PE: The incidence of preeclampsia varies greatly worldwide. Western studies show that 2–7% of pregnant women may be affected with PE while pregnant.[10] WHO estimates the incidence of preeclampsia to be seven times higher in developing countries than in developed countries.[11] The prevalence of preeclampsia in developing countries ranges from 1.8% to 16.7%. [12] The incidence of preeclampsia in the present study was 10.5 %, which is similar to the incidences reported by other studies done in India in hospital setting by Kamala Dhall (10.6%) and Gandhi MR (11.4%).[13,14] Role of uterine artery doppler: A large body of evidence exists to underline the role of uterine artery doppler in the second trimester to assess of uteroplacental perfusion and thereby predict pre-eclampsia, fetal growth restriction, placental abruption and stillbirth. However, now the focus has shifted to the prediction in late first and early second trimester in view of evidence that identifying high-risk population early in pregnancy would allow development of prophylactic strategies.[9] Our study showed lower uterine artery PI values in pregnancies with normal outcome when compared to pregnancies where PE developed. This is consistent with the theories that presence of increased resistance in the uteroplacental circulation in the late first trimester may partly predict the later development of PE and its complications. Many other studies have shown similar results.[15-18]

In the present study, a large proportion of women who were predisposed to developing PE could be predicted. However there is still a lot of scope for increasing the detection of PE. A lot of biochemical markers for prediction of PE have been developed of which Placental growth factor (PlGF) and Pregnancy associated plasma protein A (PAPP-A) have shown significant value increasing the diagnostic accuracy in synergy with maternal factors and uterine artery Doppler. [15] This assumes significance as a recent randomized control trial (ASPRE) involving 26,941 pregnant women has shown that in women at high-risk for PE, giving Aspirin (150mg/ day) when compared to placebo reduced the risk for development of early onset PE by 62%, thus significantly reducing maternal and fetal complications.[19]

The biochemical markers for predicting PE are costly and are not widely available, limiting their use. In addition there is limited awareness of the role of first trimester screening for PE. An effort is required to educate the treating physician as well as the women of childbearing age regarding this screening and to make the screening cheap and widely available. This will significantly help in reducing the burden of PE, especially early onset PE, thereby improving maternal and neonatal outcomes.

**CONCLUSION**

Preeclampsia has its origin in early pregnancy and is an important cause of maternal and fetal morbidity and mortality. Early identification of pregnancies at
high-risk of early onset PE and undertaking the necessary measures to improve placenta can reduce the burden of the disease by using prophylactic aspirin. Effective screening for early onset PE can be achieved in the first-trimester of pregnancy with maternal history and uterine artery doppler with the detection rate rising significantly with the use of biochemical markers. Biochemical screening for preeclampsia needs to become cheaper and easily accessible for better prediction of PE in first trimester.

REFERENCES