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A Radiological Valuation on Role of Colour Doppler Values as Predictors of Preeclampsia in 18-24 Weeks of Gestational Life

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ABSTRACT
In theory, an excessive increase in placental vascular resistance might be identified using aberrant Doppler flow tests of the maternal uterine vessels. This has the potential to identify women who are at risk for conditions like as preeclampsia. The objective of this study is to investigate if conducting a uterine artery Doppler examination during the second trimester can serve as a dependable screening test for predicting preeclampsia in both our high-risk (HR) and low-risk (LR) pregnant women. Approval was acquired from the institutional ethics committee and written consent was collected from all the patients after discussing the complete research methodology in detail. A total of 25 patients with a gestational age ranging from 18-24 weeks were included in the current study. A comprehensive medical checkup was conducted on all the patients. Doppler imaging was performed in all the patients. Patients were monitored until delivery and the neonate was examined. In this investigation a total of 35 patients were examined. The average gestational age was determined to be 20.2 weeks, while the average age was determined to be 24.1 years. Among the 7 patients who had abnormal Doppler findings, 3 patients were diagnosed with pre-eclampsia, while 4 patients did not have pre-eclampsia. If the test results are abnormal, it is important to closely monitor and provide care in a well-equipped facility to minimize difficulties for both the mother and the baby. Colour doppler, preeclampsia, predictors.

INTRODUCTION

In women who experience preeclampsia, there is a lack of successful invasion of the trophoblast into the muscular wall of the uterus. As a result the spiral arteries maintain their muscular elastic coating and there continues to be resistance to blood flow[1-3]. In theory, an excessive increase in placental vascular resistance might be identified using aberrant Doppler flow tests of the maternal uterine vessels. This has the potential to identify women who are at risk for conditions like as preeclampsia[4]. Preeclampsia is a condition that can occur during pregnancy. It is characterized by high blood pressure (systolic blood pressure above 140 mm Hg and diastolic blood pressure above 90 mm Hg on two separate occasions at least 4 hrs apart or in severe cases systolic blood pressure above 160 mm Hg and diastolic blood pressure above 110 mm Hg) and the presence of protein in the urine (protein/creatinine ratio above 0.3 or protein above 5 g in a 24 hrs urine sample or above 3 g in two samples taken 6 hrs apart from a patient on bed rest). This condition typically occurs after 20 weeks of pregnancy and resolves before the end of the 6th week after giving birth[2-5]. The uterine artery Doppler ultrasound can be done using either the transvaginal or transabdominal method during the first or second trimester. Uterine artery waveforms are said to be easily accessible in over 95% of cases. The uterine artery is detected using color doppler ultrasonography. Next, pulsed-wave Doppler ultrasonography is utilized to acquire waveforms. Different measures can be computed and evaluated[6,7]. The main reason for preeclampsia is believed to be the irregular flow of blood between the uterus and placenta, which happens when the second wave of trophoblastic invasion into spiral arterioles fails. This will lead to higher resistance to blood flow in the uterine arteries and reduced blood supply to the placenta. The notion has resulted in the suggestion of utilizing Doppler evaluation of blood flow velocity waveform in the uterine artery as a screening method for predicting preeclampsia. The continued presence of excessive resistance to blood flow in the uterine arteries is an indirect indication of faulty placenta development.

The objective of this study is to investigate if conducting a uterine artery Doppler examination during the second trimester can serve as a dependable screening test for predicting preeclampsia in both our high-risk (HR) and low-risk (LR) pregnant women.

MATERIALS AND METHODS

Approval was acquired from the institutional ethics committee and written consent was collected from all the patients after discussing the complete research methodology in detail. A total of 25 patients with a gestational age ranging from 18-24 weeks were included in the current study. Full demographic information of all the patients was acquired. A comprehensive medical checkup was conducted on all the patients. Color doppler was performed on all the patients. Patients were monitored until delivery and the neonate was examined.

The following criteria, adapted from Zimmermann *et al*., are used to determine membership in the HR group. History of chronic high blood pressure, diabetes, kidney disease overweight (body mass index (BMI) over 30) between the ages of 20 and 35 (in first-time pregnancies) previous complications in pregnancy include preeclampsia, intrauterine growth restriction (IUGR) and intrauterine fetal demise (IUFD) family history of preeclampsia or IUGR in mother or sister.

At 24-26 weeks a Doppler ultrasonography (with a 3.5 MHz curved probe) was used to examine the velocity waveform of the uterine artery in a woman. The ultrasound machine used was manufactured by Shimadzu India Ltd. The woman was assessed in a partially reclined position after 10 min of resting in bed. Using real-time ultrasonography the uterine artery on each side was located at the point where the uterus meets the cervix and it seemed to pass over the external iliac artery. Flow velocity waveforms of both uterine arteries were obtained using color Doppler imaging. An aberrant flow velocity waveform was defined as the presence of a persistent early diastolic notch in the major uterine artery, either unilateral or bilateral or an elevated resistance index (RI) of 0.6 or both. An early diastolic notch is characterized as a v-shaped deviation towards the baseline during the early phase of diastole. The formula for the resistance index (RI) is calculated by subtracting the diastolic peak velocity from the systolic peak velocity and then dividing the result by the systolic peak velocity, expressed as (S-D)/S.

Data analysis: For data analysis, we utilized SPSS Statistics Version 26.0 (IBM Inc., Armonk, NY). By employing cross-tabulation the sensitivity, specificity, as well as positive and negative predictive values (PPV and NPV) were documented for Doppler U/S.

RESULTS

In this investigation a total of 35 patients were examined. The average gestational age was determined to be 20.2 weeks, while the average age was determined to be 24.1 years. Among the 7 patients who had abnormal Doppler findings, 3 of them were diagnosed with pre-eclampsia, while the remaining 4 patients did not have pre-eclampsia.

DISCUSSIONS

Uterine artery Doppler ultrasound meets these requirements and can be reasonably simple to perform

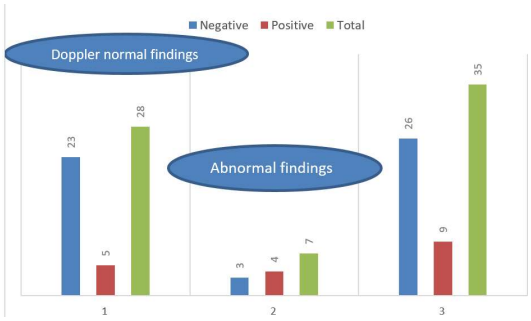

Fig. 1: Doppler findings

Table 1: Gestational age

Gestational age (weeks)	Number of cases	Percentage of cases
18-20	19	54.2
21-24	16	45.7
Total	35	100

Table 2: Age-wise distribution of patients

Age group (years)	Number of patients	Percentage of patients
Less than 22	9	25.7
22-27	16	45.7
More than 27	10	28.5
Total	35	100

with proper training and experience. Based on the findings of Cnossen and colleagues, this treatment might be performed with regular ultrasound imaging of the anatomy at 18-20 weeks of pregnancy. Moreover, atypical uterine artery Doppler examinations during both the first and middle stages of pregnancy have been found to be linked to future perinatal problems [8-9]. Therefore, this study was done to evaluate the role of Colour Doppler readings in predicting preeclampsia during the 18-24 weeks of pregnancy.

In this investigation a total of 25 patients were examined. The average gestational age was determined to be 19.7 weeks, while the average age was determined to be 23.8 years. Padmalatha and colleagues shared their experiences using Doppler in the second trimester of women who visited a hospital in the outskirts of Bangalore city, located in the state of Karnataka, India. The researchers determined that a combination of factors is the most reliable predictor for predicting Pre-eclampsia and fetal growth limitation. The diastolic notch in the uterine artery as a single measure is preferable to the separate Doppler indices. Elevated resistance to blood flow in the uterine artery during pregnancy, regardless of the level of risk, is linked to the likelihood of developing Pre-eclampsia and fetal growth limitation. Additionally, it is a more accurate indicator for high-risk individuals[10]. In this study, pre-eclampsia was observed in 4 individuals (16% of patients). However, aberrant Doppler findings were observed in 4 cases, whereas it was observed in 21 patients. Among the 4 patients who had abnormal Doppler findings, 2 patients were diagnosed with pre-eclampsia, while the other 2 patients did not have pre-eclampsia. Razieh and colleagues conducted a prior study to assess the prognostic significance of Doppler investigations on the uterine circulations between 14-16 weeks of pregnancy in relation to the occurrence of preeclampsia and/or intrauterine growth restriction (IUGR) in the study participants. This observational study was conducted at a university hospital. During the period from October 2011-2012, a total of 456 pregnant women were referred to the hospital. At 14-16 weeks of gestation, ultrasonography sonography was performed on these ladies. The average ratio between the peak systolic (S) and end-diastolic (D) values, computed using electronic calipers, was found to be 3-5 cardiac cycles. The resistance index (RI) was then calculated as (S-D/S). A total of 456 expectant mothers with an average age of 26.8±5.3 years were enrolled in the study. The uterine vascular resistance index (RI) at 14-16 weeks was noticeably greater in 27 women who later developed preeclampsia (mean RI = 0.7526±0.039) compared to 429 pregnancies with normal outcomes (mean RI = 0.6440±0.059, p = 0.001). The uterine artery resistance index (RI) was also considerably greater in 36 women who had intrauterine growth restriction (IUGR) (RI = 0.7244±0.04730) compared to 420 women with normal pregnancies (RI = 0.6505±0.06043, p = 0.001). Konchak *et al*.[11] Indicated that a higher uterine resistance index and the presence of a uterine artery notch were both linked to an increased relative risk of preeclampsia. The study indicated that the uterine notch had a sensitivity of 83.3%, specificity of 95.6%, positive predictive value (PPV) of 55.6% and negative predictive value (NPV) of 98.9%.

Coleman *et al*.[12] In their research on uterine artery Doppler screening in high-risk women, the study found that the sensitivity and specificity of the resistance index (RI) for predicting preeclampsia were 91% and 42%, respectively. Among women with a renal index (RI) of 0.7-58% had the development of preeclampsia. Schwarze *et al*.[13] Discovered that in low-risk pregnancies the accuracy of uterine artery notching in predicting pre-eclampsia was 88%. In our research, in the LR group the accuracy and precision of elevated uterine artery RI in predicting preeclampsia were 70% and 94.87%, respectively.

In this investigation, when the Doppler index of unilateral/bilateral RI was greater than 0.58 the sensitivity, specificity, PPV and NPV were 26-74% and 24% respectively. For bilateral RI greater than 0.58 the corresponding values were 41-63-77% and 27% respectively. Regarding the condition of the uterine artery notch the percentages for unilateral/bilateral cases were 71-89-95% and 52% and for bilateral cases the percentages were 32-79-84% and 28% respectively. In comparison to our investigation a different study found that the positive predictive value (PPV) in the

Table 3: Doppler findings

	Doppler findings		
Pre-eclampsia	Doppler Normal findings	Doppler abnormal findings	Total
Negative	23	3	26
Positive	5	4	9
Total	28	7	35

notch of the uterine artery was 25%, with a reported frequency of pulmonary embolism (PE) at 18%. The sensitivity, specificity, PPV and negative predictive value (NPV) for a resistance index (RI) greater than 0.58 were 41-96-70% and 88%, respectively. Similarly the percentages for bilateral uterine artery notching were 62-89-47% and 94%, respectively.

Several studies have indicated that the positive predictive value (PPV) of diagnosing or predicting pulmonary embolism (PE) using Doppler ultrasound ranges from 35-60% while the negative predictive value (NPV) ranges from 70-95%. These findings are based on the use of Doppler ultrasound instead of clinical assessment to evaluate the risk of PE[14]. A research found that 58% of high-risk moms who acquired hypertension had PE[15]. In another study, abnormal Doppler ultrasonography results were seen in 11.3% of mothers. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for preeclampsia (PE) were reported as 36-90-11% and 98%, respectively[16]. Like our research, other studies have also found that a history of PE, smoking, not having given birth before, having a BMI over 30 kg m^2 in the first trimester and having a family history of PE are all factors that increase the risk of PE. Furthermore, with the implementation of Doppler ultrasound as a screening examination for predicting pulmonary embolism, it has now gained significant significance as a test[17].

Drawbacks of this study involve the limited number of participants the study's retrospective nature and the reliance on data from a single institution. Thus, we suggest doing extensive future investigations to gain a better understanding of the significance of Doppler ultrasound in predicting pulmonary embolism.

CONCLUSION

Therefore to summarize, we determine that the examination of mid trimester uterine artery Doppler velocimetry can serve as a dependable screening tool for predicting preeclampsia. If the test results are abnormal, it is vital to closely monitor and provide care in a well-equipped facility to minimize difficulties for both the mother and the baby. Nevertheless, this research was conducted with a limited number of women, hence another investigation with a larger sample size is required to confirm the findings of this study.

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