ROLE OF UTERINE ARTERY DOPPLER ULTRASOUND IN PREDICTING PRE-ECLAMPSIA IN PRIMIGRAVIDA

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ABSTRACT

Objective: To find the accuracy of uterine artery diastolic notching during the second trimester of pregnancy in predicting pre-eclampsia in primigravida patients.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: Armed Forces Institute of Radiology & Imaging (AFIRI) Rawalpindi; six months duration from 30 Nov 2012 to 31 May 2013.

Material and Methods: This study included 199 primigravida women with singleton pregnancy having diastolic notch in uterine arteries between 20 to 23 weeks of gestation. All patients were examined by both grey scale and doppler ultrasonography. Uterine arteries were evaluated with doppler near the point where they crossed the external iliac arteries. The patient was included in study if the presence of diastolic notch was demonstrated. Clinical follow up in gynae & obs department continued throughout the pregnancy to see if they developed pre-eclampsia. The data were recorded on a previously prepared proforma and analyzed with SPSS 21.

Results: The accuracy of uterine artery doppler ultrasound in identifying women who later developed pre-eclampsia was 48.24%. The frequency of pre-eclampsia with bilateral notch was significantly high in the primigravid of younger age as compare to the primigravid of the older group (p=0.001). The difference in frequency of developing pre-eclampsia with bilateral notch when compared among 20 to 21 week gestational age and 22 to 23 weeks gestational age was statistically insignificant.

Conclusion: Uterine artery diastolic notching between 20 and 23 weeks of gestation is an important risk factor for developing pre-eclampsia. This doppler parameter should, therefore, be included in the risk evaluation for gestational hypertension.

Keywords: Diastolic, doppler, notch, pre-eclampsia, prenatal, ultrasonography, uterine arteries.

INTRODUCTION

Worldwide, pre-eclampsia affects 2%-5% pregnant women and makes an important cause of maternal morbidity and mortality[1,2]. In Pakistan, only postpartum haemorrhage takes a lead from pre-eclampsia as a cause of maternal death[1]. Patients having pre-eclampsia in early pregnancy have worse disease as compared to those presenting later in pregnancy[2]. Many factors have been identified playing role in the pathophysiology of pre-eclampsia which include very low density lipoprotein toxicity, immune mal-adaptation, utero-placental ischemia, increased trophoblast necrosis/apoptosis, genetic imprinting, and an accentuated maternal inflammatory response to trophoblast deportation[3]. However pre-eclampsia is most commonly associated with a failure of the trophoblastic tissue invading spiral arteries. Patients with persistent increased uterine arteries resistance as shown by the presence of a diastolic notch are at greater risk of subsequently developing preeclampsia. Doppler evaluation of uterine arteries is a non invasive and acceptable technique for predicting hypertension in pregnancy[4]. Abnormal uterine artery doppler in second trimester has been shown to be an appropriate test to identify pregnancies that could be at high risk for developing pre-eclampsia[5]. Persistence of diastolic notch on uterine artery doppler between 20 to 23 weeks of gestation helps to predict pre-eclampsia and

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improves the pregnancy outcomes by adopting timely prophylactic measures[6].

The objective of this study was to find the accuracy of uterine artery diastolic notching during the second trimester of pregnancy in predicting pre-eclampsia in primigravida patients in our own setup. The findings could lead to inclusion of the doppler study of uterine arteries in routine anomaly scan for timely diagnosis of pre eclampsia, thus reducing perinatal morbidity and mortality.

MATERIAL AND METHODS

This study was carried out in Armed Forces Institute of Radiology and Imaging Rawalpindi from 30 Nov 2012 to 31 May 2013. Primigravida women with persistent diastolic notch on uterine arteries doppler examination between 20 to 23 weeks of gestation were included in the study. Sample size was calculated by WHO sample size calculator using confidence Level (%) of 95%, anticipated population proportion of 0.526[2] and absolute precision of 0.07 giving a sample size of 199. Sampling technique used was non probability consecutive sampling. Subjects with multiple pregnancies, prior or current history of hypertension, generalized disorders affecting maternal haemodynamics (like anemia, obesity, thyrotoxicosis, diabetes mellitus), congenital and acquired heart diseases or previous history of pelvic surgery were excluded.

The diastolic notch referred to the dip occurring between the systolic and diastolic phases on colour doppler. Pre-eclampsia was said to be present when newly occurring increased blood pressure (in excess of 140/90 mmHg) was detected after 20 weeks of pregnancy along with proteinuria of either 2 + or more than 300 mg in a 24-hour urine sample[7].

Approval of institutional ethical committee was obtained before starting the study. Before including in study, informed consent was obtained from the participants.

The ultrasound examination was performed after five minutes of rest with patient in semi recumbent position using both grey scale and doppler techniques. A 3.5 MHz convex probe was used to identify uterine artery in an oblique plane of the pelvis about 1cm above the point of crossing with the external iliac artery. Doppler trace was obtained using a sample gate of 2mm and was checked for a persistent diastolic notch. Good quality waveform was obtained by using an angle of insonation <60°. The findings were confirmed by another radiologist having an experience of at 5 years in doppler ultrasound. All patients included in the study had a follow up in the department of gynaecology and obstetrics

Table-I: Doppler ultrasound in predicting pre-eclampsia based on the presence of persistent diastolic notch in uterine arteries with respect to age groups.

Age groups (years)	Diastolic notch with subsequent pre-eclampsia	Diastolic notch with no subsequent pre-eclampsia	Total
19 to 20	30 (93.8%)	2 (6.3%)	32
21 to 30	49 (41.2%)	70 (58.8%)	119
31 to 38	17 (35.4%)	31 (64.6%)	48

Chi-Square= 32.08; $p<0.001$

Table-II: Doppler ultrasound in predicting pre-eclampsia based on the presence of persistent diastolic notch in uterine arteries with respect to gestational age.

Gestational age (Weeks)	Diastolic notch with subsequent pre-eclampsia	Diastolic notch with no subsequent pre-eclampsia	Total
>20 <21	45 (50%)	45 (50%)	90
>21 <23	51 (46.8%)	58 (53.2%)	109

Chi-Square= 0.204; $p=0.65$

of Military Hospital to see whether pre-eclampsia developed. A proforma had been developed for data entry. Data analysis was carried in SPSS 21.

Mean and standard deviation for age and gestational age were calculated. Frequency and percentages were computed for accuracy; true positives being patients diastolic notch of uterine artery who developed pre-eclampsia. Confounders like age and gestational age were controlled by stratification techniques. Chi-square test was used for comparison. A $p \leq 0.05$ was considered to be statistically significant.

RESULTS

A total of 199 primigravida women having persistent diastolic notch in uterine arteries between 20 and 23 weeks of gestation were included in the study with age distributed as shown in fig-1. The average age of subjects was 26.19 ± 5.19 years with 95% CI for the mean from 25.46 to 26.92. Minimum age was 19 years while maximum age was 38 years. Gestational age of subjects ranged from 20 to 23 weeks (fig-2). Average gestational age was 21.69 ± 1.23 weeks with 95% CI for the mean ranging between 21.52 to 21.87.

Accuracy of doppler ultrasound in identifying women who would develop preeclampsia based on the presence of a persistent diastolic notch in uterine arteries was 48.24% (fig-3). In table-I shows that the frequency of pre-eclampsia with bilateral notch was significantly high in 19 to 20 years as compared to the older age groups. The difference in frequency of developing preeclampsia with bilateral notch when compared among 20 to 21 week gestational age and 22 to 23 weeks gestational age was statistically insignificant (table-II).

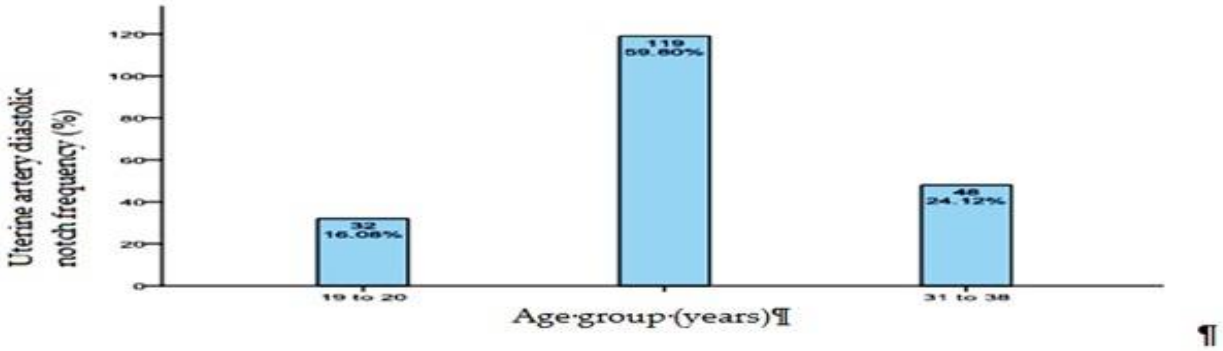

Figure-1: Age distribution of patients (n=199).

DISCUSSION

Pre-eclampsia along with intrauterine growth retardation (IUGR) are important causes of maternal and neonatal morbidity and mortality[8]. Abnormal placental development with abnormal relation between trophoblast and the spiral uterine arteries resulting in increased vascular resistance in the utero-placental circulation is considered to be important causative factor[9].

Abnormal placental development in early pregnancy plays important role in the etiology of pre-eclampsia and IUGR. It should, therefore, be possible to identify women at risk of developing placental complications like pre-eclampsia and IUGR at 20 to 23 weeks of gestation by performing a uterine doppler examination[10]. The CLASP study showed that it was difficult to separate a true high risk group of women from a low risk group early in pregnancy[11]. It is imperative to identify these high risk patients for better clinical outcomes and for assessing treatments which could improve this outcome in high risk cases. Our study demonstrates the possibility of identifying these high risk cases by using a simple non invasive doppler ultrasound

of the uterine arteries between 20 and 23 weeks of gestation. These high risk cases can then be followed and put on treatment for a more favourable clinical outcome both for the mother and the neonate[12].

Screening for pre-eclampsia and the delivery of a small-for-gestational-age (SGA) neonates has been performed by noting increased uterine artery resistance to blood flow on doppler evaluation in the second trimester of pregnancy[13,14]. However this screening method has a low positive predictive values (PPVs) no matter which doppler parameter is used to assess the vascular impedance in the utero-placental circulation. In practical terms this would mean that most patients with a positive test might not ultimately develop the disease[15,16]. Our study confirmed this finding as only 48.24% of pregnant females who had bilateral diastolic notches on uterine artery doppler evaluation developed pre-eclampsia. Therefore prophylactic therapeutic intervention in all patients having bilateral diastolic notch on uterine artery doppler evaluation would not benefit a large number of patients. Because of the subjectivity in deciding the presence of early diastolic notch and its limited association in the screening of patients for these complications, some authors favour its restricted use[17].

For low prevalence diseases like pre eclampsia and IUGR a useful clinical test should have a high positive likelihood ratio of >10 and a low negative likelihood ratio (<0.10). Reviews suggest that bilateral diastolic notching and pulsatility index are more promising doppler parameters to fulfill these pre requisites[6]. Therefore these should be used in our day to day clinical practice.

Doppler evaluation is a simple non invasive test with high patient acceptance though the examination is highly operator dependent and requires expertise in the field for more reliable results. In developed countries, doppler evaluation can be made part of the routine anomaly scan; however in developing countries like Pakistan, its inclusion in routine antenatal checkups would be difficult both because of lack of equipment and expertise.

Our study suggests that the findings of bilateral uterine artery diastolic notching on doppler ultrasound indicator for developing pre-eclampsia which is consistent with a recent report where ultrasound along with demographic, and clinical parameters were combined to predict occurrence of pre-eclampsia[17]. However this three parameter model was basically used for screening purposes with no reporting of positive predictive and negative predictive values.

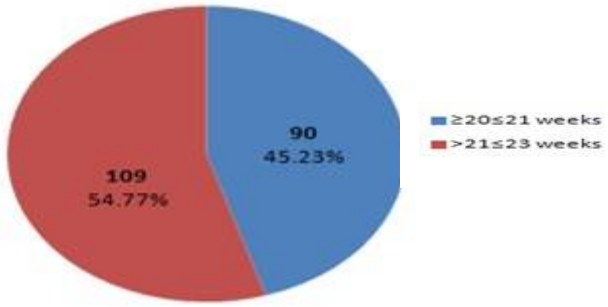

Figure-2: Gestational age (n=199).

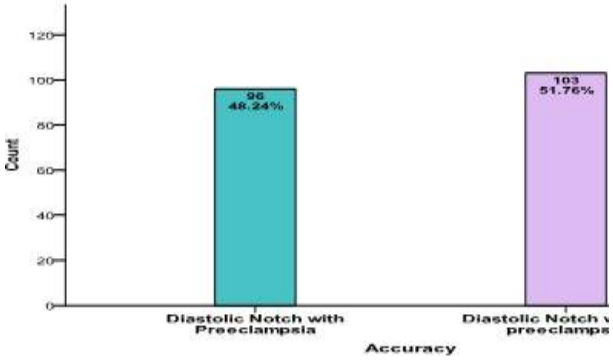

Figure-3: Accuracy of doppler ultrasound in identifying women who developed pre-eclampsia based on identifying persistent diastolic notch in uterine arteries.

Note: true positives were patients having diastolic notch of uterine artery who developed pre-eclampsia = 48.24%

Another study however showed doppler ultrasound carried out in second trimester to have poor sensitivity for predicting in nulliparous, low risk population[18].

As not all patients having diastolic notching on uterine artery doppler develop pre-eclampsia

and there can be false positive tests. However we need to weigh the importance of not giving a false negative report by balancing the potential hazards in such a report.

Early pre-eclampsia is known to be associated with increased maternal and neonatal morbidity and mortality[19]. Screening of uterine arteries with doppler ultrasound found to be beneficial in identifiying the pre-eclampsia cases.

CONCLUSION

Uterine artery diastolic notching between 20 and 23 weeks of gestation is an important risk factor for developing pre-eclampsia. This doppler parameter should, therefore, be included in the risk evaluation for gestational hypertension.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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