

International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622
© Gynaecology Journal
www.gynaecologyjournal.com
2020; 4(2): 317-320
Received: 12-01-2020
Accepted: 14-02-2020

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Role of uterine artery doppler at 12 to 16 weeks of gestation for the prediction of preeclampsia in women: an observational study

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DOI: <https://doi.org/10.33545/gynae.2020.v4.i2f.543>

Abstract

Background: Preeclampsia is present in 2% - 5% of pregnancies and is the major cause of perinatal and maternal morbidity and mortality. Doppler studies of the uterine artery in the first trimester is a major screening parameter for determining preeclampsia in women. Doppler is a non invasive and highly sensitive method to determine the fetoplacental circulation. The parameters assessed in Doppler are a high resistance index, persistent uterine artery notching and a high pulsatility index.

Aims and objectives: To assess the role of uterine artery Doppler at 12 to 16 weeks of gestation for the prediction of preeclampsia.

Material and methods: Hundred antenatal women of 12 to 16 weeks of singleton pregnancy were selected for the study. After an informed consent and detailed examination, the women were subjected to transvaginal ultrasound. Doppler assessment of uterine circulation and the various uterine artery indices were measured. The women were further followed up clinically for development of preeclampsia.

Results: Out of 100 women, 31 patients developed preeclampsia. In our study 37% of the women had Bilateral uterine artery notching, mean RI was 0.5612, PI was 0.9104 at 12-16 weeks. Our study showed a statistically significant association between uterine artery diastolic notching, raised RI, PI and the development of preeclampsia as compared to non preeclamptic women. In our study, uterine artery notching at 12-16 weeks gestation has a sensitivity of 65.30%, specificity of 84.60%, PPV of 54.60% and NPV of 70.50%. When notch and RI >0.65 were taken together, the sensitivity changed to 82.60%, specificity to 85.40%, PPV to 37.60% and NPV to 98.40%.

Conclusion: The uterine artery notching, high Resistance Index and Pulsatility Index in uterine artery Doppler waveform at 12-16 weeks has shown as best screening test for early prediction of preeclampsia.

Keywords: Preeclampsia; uterine artery doppler; uterine artery notch

1. Introduction

Preeclampsia remains one of the leading causes of maternal and perinatal mortality and morbidity, with an estimated 10-15% of all maternal deaths being due to hypertensive diseases in pregnancy [1]. In the USA, the prevalence of obstetric hospitalizations related to hypertensive disorders increased from 67,000 to 81,000 between 1998 and 2006 [2]. The maternal and perinatal complications associated with preeclampsia are abruption placentae, thrombocytopenia, acute pulmonary edema, stroke, intrauterine growth restriction, fetal death and elective prematurity.

Pregnancy-related Hypertensive disorders are thought to be the consequence of impaired trophoblastic invasion of the maternal spiral arteries, resulting in maintenance of vessels of high resistance, inadequate perfusion of the placenta, tissue injury and increased production of vasoconstrictive substances [3].

Early screening for preeclampsia may allow vigilant antenatal surveillance and appropriate timing of fetal delivery in order to avoid serious sequelae.

Various biochemical tests used in screening of high risk population for preeclampsia have lower positive predictive values, high cost and less patient compliance [4]. Although no single efficient screening procedure for predicting preeclampsia has been adopted in clinical practice, uterine artery Doppler is the most widely studied clinical test available for this particular purpose, becoming a useful method for the indirect assessment of uteroplacental circulation in early pregnancy (11-14 weeks) [4].

Direct assessment of trophoblast invasion in human pregnancy is not possible; however, the use

of Doppler imaging permits non-invasive evaluation of the uteroplacental circulation by comparing systolic and diastolic waveforms [5]. A high Resistance Index, Pulsatility Index and persistent uterine artery notching in uterine artery Doppler wave form are the parameters assessed during this screening test [6]. Thus, we have conducted this study to find out the predictive value of transvaginal Doppler in early pregnancy at 12-16 week of gestation for the prediction of preeclampsia and sub-sequent perinatal outcome.

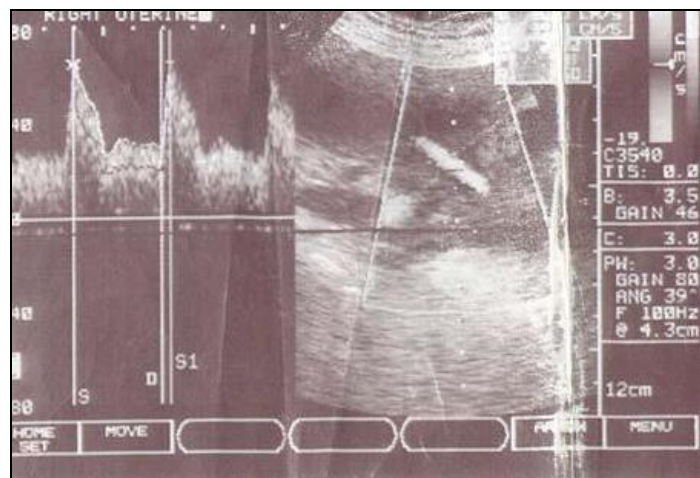


Fig 1: Presence of uterine artery diastolic notch as in preeclampsia

2. Material and methods

2.1 Source of data: An observational study was done over a period of two years among women attending the out-patient department for antenatal care at Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Mullana, Ambala between August 2013 to August 2015.

2.2 Study design: Observational Study

2.3 Sample size: 100

2.4. Statistical analysis

Statistical analysis was done using descriptive statistical methods like mean, percentages and proportions. Unpaired t-test was used to find the association between two variables. A p-value of less than 0.05 was considered to be statistically significant.

2.5 Selection of patients

Inclusion criteria

All pregnant women between 12 to 16 weeks of gestational age with singleton pregnancy.

Exclusion criteria

1. Multiple gestation.
2. Patients with congenital anomaly of fetus, chronic hypertension, renal disease, cardiac disease.

2.6 Study procedure

After assessment of inclusion and exclusion criteria, 100 antenatal women of 12 to 16 weeks of singleton pregnancy were selected for the study in the department of Obstetrics and Gynecology of MMIMSR. Women booking for antenatal care were examined and investigated. After a written informed consent, the women were subjected to transvaginal ultrasound

for dating and screening scan. Women were placed in the dorsal position with knee flexed, a transvaginal ultrasound scan was done and doppler assessment of uterine circulation for uterine artery indices using Philips USG machine with 7.5 Mhz transvaginal curvilinear transducer. After initial assessment, the cervix was identified. Uterine artery is located on one side by placement of probe in that fornix and colour flow mapping was done. The utero placental circulation was measured by various uterine artery doppler indices, Resistance Index (RI) and Pulsatility Index (PI). Increased resistance to flow in the uterine artery is associated with the appearance of diastolic notch and increase in all these indices. Same procedure was repeated on the opposite side. The whole procedure was completed within 10 minutes. These women were regularly followed up throughout the pregnancy until delivery. Blood pressures were assessed in each visit.

3. Results

The mean gestational age at the time of scan was 24.6 years.

Table 1: Systolic blood pressure in the study group in third trimester

Systolic BP (mmHg)	Frequency	Percentage
< 130	61	61
130-139	10	10
140-149	20	20
>150	9	9
TOTAL	100	100

Table 1 depicts the systolic blood pressure distribution in our study group.

Table 2: Diastolic blood pressure in the study group in third trimester

Diastolic BP (mmHg)	Frequency	Percentage
<80	52	52
80-89	25	25
90-100	23	23
TOTAL	100	100

Table 2 depicts the systolic blood pressure distribution in our study group.

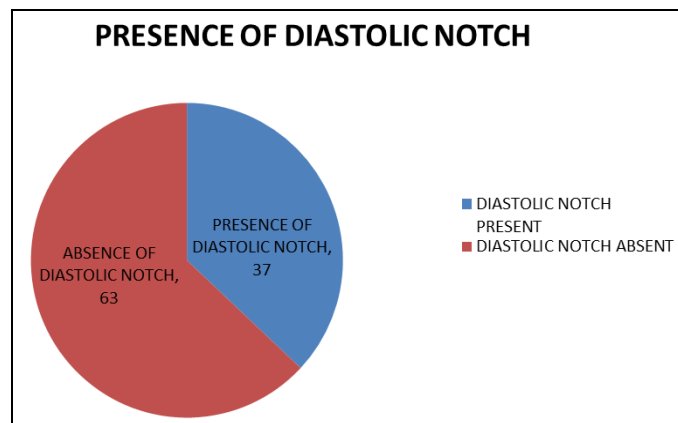


Fig 2: Presence of diastolic notch in the uterine artery on doppler studies

Figure 2 depicts the patients with diastolic notching. In 37 patients, there was the presence of diastolic notch. However, 63 patients did not show any diastolic notch.

Table 3: Correlation of uterine artery diastolic notch with preeclampsia

Parameter	Presence	Absence
Uterine artery diastolic notching	37	63
Preeclampsia	31	69
Statistical analysis: Statically significant correlation (r)=0.6698		

As depicted in Table 3, there was a statically significant correlation between preeclampsia and uterine artery diastolic notching. Out of the 100 patients, preeclampsia was present in 31 patients and diastolic notch was present in 37 patients.

Table 4: Doppler indices (Resistive and pulsatility index) of the uterine artery

Doppler indices	Number	Minimum	Maximum	Mean	Standard Deviation
RI	100	0.54	0.66	0.5612	0.03641
PI	100	0.82	1.90	0.9104	0.06155

Table 4 shows the mean of RI and PI in the study group. The mean RI was 0.5612 and mean PI was 0.9104.

Table 5: Association of resistive index in preeclamptic women and normal pregnant women

Resistive index	Resistive Index			
	In preeclamptic women		In Non preeclamptic women	
Gestational age	Mean	Standard deviation	Mean	Standard deviation
12-16 WEEKS	0.6274	0.05432	0.5566	0.2241
t=5.231 df=96 p<0.0001				

Table 5 shows that in preeclampsia mean RI at 12-16 weeks is 0.6274 which is statistically significant ($p<0.0001$) as compared to non-preeclamptic women.

Table 6: Association of uterine artery notching and RI in preeclamptic women and normal pregnant women

Pulsatility index	Pulsatility index			
	In preeclamptic women		In Non-preeclamptic women	
Gestational age	Mean	Standard deviation	Mean	Standard deviation
12-16 Weeks	0.9560	0.9014	0.8682	0.3430
t=6.3542 df=96 p<0.0001				

Above table shows that in preeclampsia, the mean PI at 12-16 weeks is 0.9560 which is statistically significant ($p<0.0001$) as compared to non-preeclamptic women.

Table 7: Role of uterine artery doppler in predicting preeclampsia

Study parameter	Sensitivity	Specificity	PPV	NPV
Diastolic notching	65.30%	84.60%	54.60%	70.50%
Diastolic notch +RI>0.65	82.60%	85.40%	37.60%	98.40%

Uterine artery notching at 12-16 weeks gestation has a sensitivity of 65.30%, specificity of 84.60%, PPV of 54.60% and NPV of 70.50%.

When notch and RI >0.65 are taken together, the sensitivity changed to 82.60%, specificity to 85.40%, PPV to 37.60% and NPV to 98.40%. This is shown in Table 7.

4. Discussion

In our study, hundred antenatal women of 12 to 16 weeks of singleton pregnancy were selected for the study. After an informed consent and detailed examination, the women were subjected to transvaginal ultrasound. Doppler assessment of uterine circulation and the various uterine artery indices were measured. The women were further followed up clinically for development of preeclampsia.

Out of 100 women studied, 31% women developed preeclampsia which is similar to the study by Gupta Shashi *et al.*^[7] and Teena *et al.* which also showed a high prevalence of 20%^[8]. As revealed by our study, diastolic notching was statistically correlated with preeclampsia. The study by Espionza *et al.*^[9] also states that the uterine artery diastolic notch was also closely

associated with the development of preeclampsia.

The mean RI in our study was 0.5612. This is similar to a study by Shashi Gupta *et al.*^[7], in which the mean RI was 0.60. The mean PI in our study is 0.9104 which is similar to the results of the study of Gomez *et al.*^[10]. In our study, there was a statistically significant association between the mean RI, PI and preeclampsia as compared to non-preeclamptic women. Our results clearly match with the study of Dugoff L *et al.*^[11] which states that raised RI and PI can be used as parameters for the detection of preeclampsia.

In our study, uterine artery notching at 12-16 weeks gestation has 65.30%, specificity of 84.60%, PPV of 54.60% and NPV of 70.50%. When notch and RI >0.65 were taken together, the sensitivity changed to 82.60%, specificity to 85.40%, PPV to 37.60% and NPV to 98.40%. The study by AM Martin *et al.*^[12] showed that when PI was taken as >95th centile, then the sensitivity was 27%, specificity was 95.4%, PPV 11% and NPV was 98.4%. A study by Shashi Gupta *et al.*^[7] states that when the notch was combined with RI, then the sensitivity was 68.7%, specificity was 66.6%, PPV 31.4% and NPV was 90.50%. These results were similar to the results we obtained in our study.

5. Conclusion

Preeclampsia is a complex clinical syndrome involving multiorgan systems and perinatal mortality and morbidity. Abnormalities in the early placental circulation, structure and impaired uteroplacental circulation have long been implicated in the pathogenesis of preeclampsia. The research for ideal predictive test and preventive measure remains challenging.

The aim of our study was to determine whether the various parameters in the uterine artery doppler like raised diastolic notch, raised PI and RI could be used as an effective screening measure to detect women who are likely to develop preeclampsia later on. In our study, the mean of all uterine artery indices showing impedance to uteroplacental circulation (RI, PI, notching) are significantly higher. This shows that the resistance to blood flow is a more important indicator than the actual blood flow.

In our study, out of 100 women, 31 patients developed preeclampsia. In our study 37% of the women had bilateral uterine artery notching, mean RI was 0.5612, PI was 0.9104 at 12-16 weeks. Our study showed a statistically significant association between uterine artery diastolic notching, raised RI, PI and the development of preeclampsia as compared to non-preeclamptic women. In our study, uterine artery notching at 12-16 weeks gestation has a sensitivity of 65.30%, specificity of 84.60%, PPV of 54.60% and NPV of 70.50%. When notch and RI >0.65 were taken together, the sensitivity changed to 82.60%, specificity to 85.40%, PPV to 37.60% and NPV to 98.40%.

Our study concluded that the uterine artery notching, high Resistance Index and Pulsatility Index in uterine artery doppler waveform at 12-16 weeks has shown as best screening test for early prediction of preeclampsia.

Uterine artery Doppler studies between 12-16 weeks also help us to categorize

our patients into low risk and high risk, so that proper vigilance may be done in high

risk women and prophylactically medications like aspirin can be started.

Doppler is a non-invasive method for evaluation of fetoplacental circulation without

any disturbance to human pregnancy. The uterine artery notching, high Resistance Index and Pulsatility Index in uterine artery Doppler waveform at 12-16 weeks has shown as best screening test for early prediction of preeclampsia.

6. References

1. Alves JA, Silva BY, de Sousa PC, Maia SB, Costa Fida S. Reference range of uterine artery Doppler parameters between the 11th and 14th pregnancy weeks in a population sample from Northeast Brazil. *Rev Bras Ginecol Obstet.* 2013; 35:357-362.
2. Ghulmiyyah L, Sibai B. Maternal mortality from preeclampsia/eclampsia. *Semin Perinatol.* 2012; 36:56-59.
3. Espinoza J, Romero R, Mee Kim Y, Kusanovic JP, Hassan S, Erez O *et al.* Normal and abnormal transformation of the spiral arteries during pregnancy. *J Perinat Med.* 2006; 34:447-458.
4. Montan S, Sjoberg O-O, Svenningsen N. Hypertension in pregnancy-fetal and infant outcome. *Clin Exp Hypertens – Hyper in Pregnancy.* 1987; B62:337-348.
5. Dascau V *et al.* Uterine Artery Doppler Flow Indices in Pregnant Women During the 11 Weeks + 0 Days and 13 Weeks+ 6 Days Gestational Ages:a Study of 168 Patients. *MAEDICA – a Journal of Clinical Medicine.* 2017; 12(1):36-41.

6. Ghadini A *et al.* Monitoring of Fetal Well-Being: Role of Uterine Artery Doppler Seminars in Perinatology. 2008; 32:258-262.
7. Shashi Gupta *et al.* Transvaginal Doppler of uteroplacental circulation in early prediction of pre-eclampsia by observing bilateral uterine artery notch and resistance index at 12-16 weeks of gestation. *J Obstet Gynecol India.* 2009; 59(6):541-546.
8. Teena *et al.* The Role of Uterine and Umbilical Arterial Doppler in High-risk Pregnancy: A Prospective Observational Study from India. *Clin Med Insights Reprod Health.* 2015; 9:1-5.
9. Espionza *et al.* Should Bilateral Uterine Artery Notching be used in the Risk Assessment for Preeclampsia, Small-for-Gestational-Age, and Gestational Hypertension? *J Ultrasound Med.* 2010; 29(7):1103-1115.
10. Gomez O, Maritinez JM, Figueras F *et al.* Uterine artery Doppler at 11-14 weeks of gestation to screen for hypertensive disorders and associated complications in an unselected population. *Ultrasound Obstet Gynecol.* 2005; 26:490-4.
11. Dugoff L, Lynch AM, Cioffi-Ragan D *et al.*; FASTER Trial Research Consortium. First trimester uterine artery Doppler abnormalities predict subsequent intrauterine growth restriction. *Am J Obstet Gynecol.* 2005; 193(3 Pt 2):1208-12.
12. Martin AM, Bindra R, Curcio P, Cicero S, Nicolaides KH. Screening for preeclampsia and fetal growth restriction by uterine artery doppler at 11-14 weeks of gestation. *Ultrasound obstet gynecol.* 2001; 18:583-586.