Section: Obstetrics and Gynaecology

Original Research Article

EFFICACY OF UTERINE ARTERY DOPPLER IN PREDICTING PREECLAMPSIA AT 20-24 WEEKS OF PREGNANCY

T. Rajalakshmi[1], B. Arumugaselvi[2], M. Shinduja[3], M. Thanka Mithra[1]

[1]Assistant Professor, Department of Obstetrics and Gynaecology, Government Thoothukudi Medical College, Tamilnadu, India
[2]Associate Professor, Department of Obstetrics and Gynaecology, Government Thoothukudi Medical College, Tamilnadu, India
[3]Senior Resident, Department of Obstetrics and Gynaecology, Government Sivagangai Medical College, Tamilnadu, India

Received : 18/10/2023
Received in revised form : 23/12/2023
Accepted : 12/01/2024

Keywords:
Preeclampsia; Doppler Ultrasound; Pregnancy; Uterine artery.

Corresponding Author:
Dr. M. Thanka Mithra,
Email: drthankamithra@gmail.com

DOI: 10.47009/jamp.2024.6.1.314

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1582-1585

Abstract

Background: Preeclampsia (PE), which affects 5–8% of pregnant women worldwide, is the primary cause of maternal mortality. Doppler Ultrasound (USD) is considered a useful method for predicting PE. Hence, the present study aimed to investigate the efficacy of uterine artery Doppler in predicting preeclampsia at 20-24 weeks of pregnancy. **Materials and Methods:** This prospective observational study included 150 antenatal mothers with high-risk pregnancies. Written informed consent and institutional ethics committee approval were obtained before the study commenced. Doppler examination of the uterine arteries was performed in mothers at 20-24 weeks, and Doppler changes were noted in these mothers. **Result:** Preeclampsia was reported in 24 (16%) patients. All enrolled patients were mainly age group–20-24 years 52%), with a mean age of 23.967±3.623 years. The maximum of all 150 antenatal mothers was the primi gravida (70.67%). Most of the patients' gestational age at birth was 40 weeks (28%). Of the 30 patients with abnormal uterine artery Doppler indices [right and left, S/D ratio, RI (resistant index), and PI (pulsatility index]), 24 developed preeclampsia with a sensitivity of 91.67%, a positive predictive value (PPV) of 73.33%, and an accuracy of 93.3%. A persistent ED notch was reported in 14 of 24 patients with preeclampsia, with sensitivity, PPV, and accuracy of 58.33%, 87.5%, and 92%, respectively. **Conclusion:** A persistent Diastolic notch and Doppler indices in the uterine artery are good predictors of preeclampsia.

INTRODUCTION

Preeclampsia is a pregnancy-specific condition that affects 3-5% of pregnancies. Its defining characteristics are hypertension, excessive blood pressure, and endothelial dysfunction, which results in extensive end-organ damage.[1] The kidneys, brain, placenta, liver, and blood are all included in this. Preeclampsia is a major global cause of maternal morbidity and mortality, with consequences such as liver rupture, renal failure, seizures (eclampsia), and stroke. Preeclampsia is a major cause of preterm, neonatal illness, and perinatal death, with delivery being the only known treatment.[1,2]

Preeclampsia (PE) is the primary cause of foetal preterm birth, intrauterine growth retardation (IUGR), and maternal death worldwide. Clinical symptoms of PE appear after 20 weeks of gestation and impact 5–10% of pregnancies.[3,4] Although an imbalance between circulating angiogenic and anti-angiogenic factors and an excessive maternal systemic inflammatory response has been documented, the exact cause of PE remains uncertain.[5] The inability of the trophoblast to adequately infiltrate the myometrium results in a restricted remodelling of spiral arteries, which underlies the pathophysiology of PE.[6] By using Doppler ultrasound (USD), it is possible to identify the reduced placental perfusion brought on by vascular anomalies before to the clinical signs of PE. The latter approach is beneficial for predicting PE and unfavourable pregnancy outcomes.[7]

Because it indicates the mother's vascular status through the pulsatility and resistance indexes (PI and RI, respectively), as well as the presence of an early diastolic notch (N), the uterine artery is the most investigated vessel in the Doppler examination in PE.[8] The umbilical artery is often measured along with the middle cerebral artery when evaluating the foetal status, despite some studies that include it as a significant vessel in PE evaluation.[9] For every artery, there is incomplete information about the most

often changed USD parameters, separately or in combination, when utilising Doppler USD for PE assessment.

The present study aimed to investigate the role of Doppler ultrasonography in predicting preeclampsia. In addition, it is important to determine the efficacy of uterine artery Doppler in predicting preeclampsia at 20-24 weeks and then follow up on at-risk patients.

MATERIALS AND METHODS

This prospective observational study was conducted on 150 antenatal mothers with high-risk pregnancies at department of Obstetrics and Gynaecology, Government Thoothukudi Medical College,. Written informed consent and institutional ethics committee approval were obtained before the study commenced.

Inclusion Criteria

All antenatal mothers aged > 20 weeks and mothers with high-risk factors, including women with family history and previous history of GHT, eclampsia, APH, twin pregnancy, elderly primi, grand multipara, previous BOH, and SLE, were included.

Exclusion Criteria

Antenatal mothers aged < 20 weeks with chronic hypertension were excluded from the study.

Methodology: Doppler examination of the uterine arteries was performed in the mothers at 20-24 weeks, and Doppler changes were noted. Of those mothers, how many of them ended up with preeclampsia was studied. Name, age, IP Number, presenting complaints, obstetric history, menstrual history, family history, and delivery details. General examination, systemic examination, per abdomen examination, pelvic examination, and investigations (routine ultrasound, uterine artery Doppler at 20-24 weeks, follow-up BP) were carried out on enrolled subjects.

Statistical Analysis: The collected data were entered into Microsoft Excel and analysed using SPSS Version 24. Qualitative variables were expressed as percentages and proportions. Quantitative variables are expressed as means and standard deviations. The significance of the difference between two quantitative variables was calculated using the chi-square test, and a p-value of less than 0.05 was considered significant.

RESULTS

The present study reported total preeclampsia in 24 (16%) patients. All enrolled patients were mainly in the age group of 20-24 years 78(52%) had a mean age of 23.967±3.623 years. Of the 150 antenatal mothers, the majority were primi gravida, 106 (70.67%) [Figure 1]. The majority of patients (126 [84%]) had <140/90 BP and 54 (36%) had a gestational age of 20 weeks [Table 1, Figure 2]. The gestational age at birth was 40 weeks in patients 42 (28%).

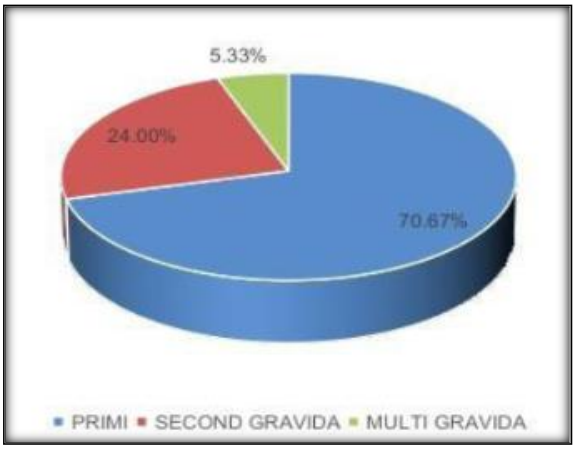

Figure 1: Observation of antenatal mothers as per parity

Among the 150 mothers studied, seven had developed preeclampsia at 32-36 weeks, 16 had preeclampsia at 36-40 weeks, and one mother developed preeclampsia postnatally. Of all deliveries, 28 (18.67%) were admitted to the NICU. Among the 150 mothers studied, a persistent early diastolic notch was present in 16 (10.67%) mothers and absent in 134 (89.33%) mothers [Table 1].

The mean value of the right uterine artery S/D ratio was 2.628± 1.538, whereas that of the left side S/D ratio was 2.387±1.378. The mean RI value of the right uterine artery RI is 0.506 ± 0.226, and that of the left uterine artery was 0.5178± 0.203 [Table 2].

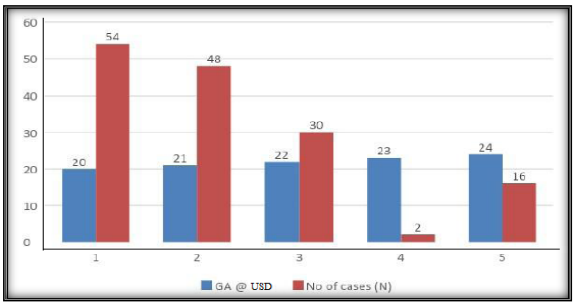

Figure 2: Distribution of subjects according to gestational age at which USD was done

Of the 30 patients with abnormal uterine artery Doppler indices (RT and LT S/D, RT and LT RI, RT, and LT PI), 24 developed preeclampsia with a sensitivity of 91.67%, positive prediction value of 73.33% and an accuracy of 93.3%. A persistent ED notch was reported in 14 of the 24 patients with preeclampsia with a sensitivity, positive predictive value, and accuracy of 58.33%, 87.5%, and 92%, respectively [Table 3].

Table 1: Observations of demographic and other subject parameters

Parameters		Frequency (%)
Age group	<20 years	15 (10%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

	20-24 years	78 (52%)
	25-30 years	52 (34.67%)
	>30 years	5 (3.33%)
Mean Age (Years) (Mean± SD)		23.97± 3.63
Parity	Primi Gravida	106(70.67%)
	Second Gravida	36 (24%)
	Multi Gravida	8(5.33%)
Blood pressure (BP)	<140/90	126 (84%)
	≥140/90	24 (16%)
Gestation age at USD (weeks)	20	54 (36%)
	21	48 (32%)
	22	30 (20%)
	23	2 (1.33%)
	24	16 (10.67%)
NICU Admission	Yes	28 (18.67%)
	No	122 (81.33%)
Persistent ED notch	Present	16 (10.67%)
	Absent	134 (89.33%)
Preeclampsia (N=24)	32-36 weeks	7 (29.16%)
	36-40 weeks	16(66.67%)
	Postnatal	1(4.16%)

Table 2: Observation of Doppler Indices in all subjects

Doppler Indices	Mean± SD
Right S/D ratio	2.628±1.538
Left S/D ratio	2.387± 1.378
Right RI	0.506± 0.226
Left RI	0.5178± 0.203
Right PI	2.1± 1.171
Left PI	1.7± 0.928

Table 3: Observation of persistent ED notch versus presence of preeclampsia

Persistent ED notch	Preeclampsia		Grand Total	P-value
Present	14	2	16	<0.001
Absent	10	124	134	
Grand Total	24	126	150	

DISCUSSION

Campbel first studied uteroplacental circulation using Doppler Ultrasound.10 Most studies were based on alterations in the uterine artery waveform, mainly bilateral diastolic notching with the onset of complications. Doppler studies are commonly performed for notching, PI, and RI in uterine arteries.2 Hypertensive disorders are associated with 5-10% of all pregnancies and contribute to about 20% of maternal mortality.[2,3] It is a progressive disease, and finally, it stops only after delivery of the placenta, so early diagnosis and appropriate management may improve the outcome of the mother and foetus. As per WHO, 16% of maternal deaths were due to hypertensive disease, which is preventable.[11]

All the enrolled patients were mainly in the age group of 20-24 years 78(52%) with a mean age of 23.967±3.623 years, whereas Fleisher et al. reported most patients aged 20 to 35 years.[12] Of all 150 antenatal mothers, the maximum was in primi gravida, 106 (70.67%). Girija and Sanjula, in their study, reported higher patients in second gravid.[13]

In our study, 126 (84%) patients had <140/90 BP and 54 (36%) had a gestational age of 20 weeks. The gestational age at birth was 40 weeks in patients 42 (28%). These findings in the present study follow those of earlier reported studies. In the present study, total preeclampsia was reported in 24 (16%) patients, similar to the findings of Irion et al. 1998.[14] Of the 150 subjects, seven mothers had developed preeclampsia at 32-36 weeks, 16 had preeclampsia at 36-40 weeks, and one mother developed preeclampsia postnatally. Lopez-Mendez et al., in their study, reported preeclampsia in 34 patients (n=65) at the gestation age range of 24.5 to 37 years.[15]

In our study, 30 patients with abnormal uterine artery Doppler indices and 24 patients developed preeclampsia with a sensitivity of 91.67%, positive predictive value of 73.33%, and accuracy of 93.3%. A persistent ED notch was reported in 14 of the 24 patients with preeclampsia with a sensitivity, positive predictive value, and accuracy of 58.33%, 87.5%, and 92%, respectively. The results of the present study are similar to the findings obtained by Kurdi et al.[16] The specificity and positive prediction values were 93.65% and 73.33%, respectively, for abnormal uterine artery Doppler indices. Specificity and positive prediction values of 98.41% and 87.5%, respectively, were reported for the ED notch.

CONCLUSION

Doppler ultrasonography is one of the breakthroughs in obstetrics and foetal medicine. Doppler indices of the uterine artery are the best indicators for predicting preeclampsia and intrauterine IUGR. Persistent

ISSN (O): 2687-5365; ISSN (P): 2753-6556

diastolic notch and Doppler indices in the uterine artery are better predictors of preeclampsia and are useful in preventing adverse maternal and perinatal outcomes. Uterine artery Doppler should be performed along with an anomaly scan in all antenatal mothers to identify mothers who are at risk of developing preeclampsia and reduce maternal morbidity and mortality.

REFERENCES

1. Grab D, Hütter W, Sterzik K, Terinde R. Reference values for resistance index and pulsatility index of uteroplacental Doppler flow velocity waveforms based on 612 uneventful pregnancies. Gynecol Obstet Invest 1992;34:82–7. https://doi.org/10.1159/000292732.
2. Kaunitz AM, Hughes MJ, Grimes DA, Smith JC, Rochet RU, Kafrissen ME. Causes of maternal mortality in the United States. Obstet Gynecol 1985; 65:605-12. https://pubmed.ncbi.nlm.nih.gov/3982738/.
3. Crispi F. Predictive value of angiogenic factors and uterine artery Doppler for early- versus late-onset preeclampsia and intrauterine growth restriction. Ultrasound Obstet Gynecol 2008; 31:303–9. https://pubmed.ncbi.nlm.nih.gov/18058842/.
4. Baumwell S, Karumanchi SA. Preeclampsia: Clinical manifestations and molecular mechanisms. Nephron Clin Pract 2007;106:c72–81. https://doi.org/10.1159/000101801.
5. Molvarec A, Szarka A, Walentin S, Szűcs E, Nagy B, Rigó J Jr. Circulating angiogenic factors determined by electrochemiluminescence immunoassay in relation to the clinical features and laboratory parameters in women with preeclampsia. Hypertens Res 2010;33:892–8. https://doi.org/10.1038/hr.2010.92.
6. Davison JM, Homuth V, Jeyabalan A, Conrad KP, Karumanchi SA, Quaggin S, et al. New aspects in the pathophysiology of preeclampsia. J Am Soc Nephrol 2004;15:2440–8. https://doi.org/10.1097/01.asn.0000135975.90889.60.
7. Yu J, Shixia CZ, Wu Y, Duan T. Inhibin A, activin A, placental growth factor and uterine artery Doppler pulsatility index in the prediction of preeclampsia. Ultrasound Obstet Gynecol 2011;37:528–33. https://doi.org/10.1002/uog.8800.
8. Schwarze A, Nelles I, Krapp M, Friedrich M, Schmidt W, Diedrich K, et al. Doppler ultrasound of the uterine artery in the prediction of severe complications during low-risk pregnancies. Arch Gynecol Obstet 2005;271:46–52. https://doi.org/10.1007/s00404-004-0646-6.
9. Divon MY, Guidetti DA, Braverman JJ, Oberlander E, Langer O, Merkatz IR. Intrauterine growth retardation: A prospective study of the diagnostic value of real-time sonography combined with umbilical artery flow velocimetry. Obstet Gynecol 1988; 72:611–4. https://pubmed.ncbi.nlm.nih.gov/3047612/.
10. Campbell S, Griffin DR, Pearce JM, Diaz-Recasens J, Cohen-Overbeek TE, Willson K, et al. New Doppler technique for assessing uteroplacental blood flow. Lancet 1983;321:675–7. https://doi.org/10.1016/s0140-6736(83)91970-0.
11. Martin JN Jr, Owens MY, Keiser SD, Parrish MR, Tam Tam KB, Brewer JM, et al. Standardised Mississippi protocol treatment of 190 patients with HELLP syndrome: Slowing disease progression and preventing new major maternal morbidity. Hypertens Pregnancy 2012;31:79–90. https://doi.org/10.3109/10641955.2010.525277.
12. Fleischer A, Schulman H, Farmakides G, Bracero L, Grunfeld L, Rochelson B, et al. Uterine artery Doppler velocimetry in pregnant women with hypertension. Am J Obstet Gynecol 1986;154:806–12. https://doi.org/10.1016/0002-9378(86)90462-x.
13. Kempasiddaiah GM, Sanjula Gayathri R. Role of uterine artery Doppler in prediction of preeclampsia and its foetal outcome. IOSR J Dent Med Sci 2021:20; 08-10. https://doi.org/10.9790/0853-2009130810.
14. Irion O, Massé J, Forest J-C, Moutquin J-M. Prediction of Preeclampsia, low birth weight for gestation, and prematurity by uterine artery blood flow velocity waveform analysis in low-risk nulliparous women. BJOG 1998;105:422–9. https://doi.org/10.1111/j.1471-0528.1998.tb10128.x.
15. Lopez-Mendez MA, Martinez-Gaytan V, Cortes-Flores R, Ramos-Gonzalez RM, Ochoa-Torres MA, Garza-Veloz I, et al. Doppler ultrasound evaluation in preeclampsia. BMC Res Notes 2013;6:477-9. https://doi.org/10.1186/1756-0500-6-477.
16. Kurdi W, Campbell S, Aquilina J, England P, Harrington K. The role of colour Doppler imaging of the uterine arteries at 20 weeks gestation in stratifying antenatal care. Ultrasound Obstet Gynecol 1998;12:339–45. https://doi.org/10.1046/j.1469-0705.1998.12050339.x.

ISSN (O): 2687-5365; ISSN (P): 2753-6556