Research Journal of Pharmaceutical, Biological and Chemical Sciences

Use Of Uterine Artery Doppler Ultrasound To Predict Pre-Eclampsia In High-Risk Women.

Sai Waikar[1], Prashant Padmakar Zende[2]*, and Suhas Shinde[3].

[1]Junior Resident, Department of Obstetrics and Gynaecology, DVVPF'S Medical College and Hospital, Ahmednagar, Maharashtra, India.
[2]Associate Professor, Department of Obstetrics and Gynaecology, DVVPF'S Medical College and Hospital, Ahmednagar, Maharashtra, India.
[3]Professor, Department of Obstetrics and Gynaecology, DVVPF'S Medical College and Hospital, Ahmednagar, Maharashtra, India.

ABSTRACT

A major risk factor for maternal death and disability is Pre-ecclampsia. The utility of Doppler ultrasonography (U/S) in predicting PE has not been researched extensively. This study aimed to find out the effectivity of Doppler Ultrasonography in predicting PE among high-risk patients. A study aiming to detect PE in women was conducted at Dr. Vitthalrao Vikhe Patil Foundation's Hospital and Medical College in Ahmednagar, Maharashtra, India. The sample size of the study consisted of 650 women, who were randomly chosen. Out of these,150 women were considered high risk for PE. They were periodically examined for the presence or development of BP, which upon exceeding a value of 140/90 in combination with proteinuria post 20 gestational weeks, leads to a diagnosis. The uterine artery's flow velocity waveforms were visualized with a Uterine artery Doppler U/S which was further used to determine the presence of a diastolic notch and Resistance index (RI). In our sample size, fourty two (28%) women showed normal Doppler flow of uterine arteries RI, while 108(72%) women exhibited a Uni/bilateral RI>0.58. unilateral/bilateral notching of the uterine artery was in 26.7% women while only bilateral notching was seen in 29.3% of women. Parameters of Doppler U/S for a diagnosis with PE were calculated basis the RI values and the amount of notching of the uterine artery. These parameters included the degree of sensitivity and specificity, as well as positive and negative predictive values. Further, individual Doppler U/S indices were found to be an especially sensitive parameter and corresponded to RI >0.58(uni/bilateral) in 71% of women. Abnormal Doppler Ultrasonography is a good indicator for predicting PE We found the notching of uterine arteries to be a superior parameter when comparing inter-individual Doppler indices, While a broad spectrum sensitivity was achieved by abnormal Doppler U/S.

Keywords: Doppler Ultrasound, Pre-Eclampsia, High risk pregnancy

*Corresponding author

INTRODUCTION

Pre-eclampsia (PE) is a condition in pregnancy that is characterized by high blood pressure and sometimes by fluid retention and proteinuria mostly seen in early gestational period it is responsible for a lot of maternal morbidity and casualties. However, the patho-physiology of PE has not been studied extensively as it involves not only the foetal /placental factors but also the maternal factors [1], there is abnormal development of placental vessels in early pregnancy which leads to hypo-perfusion of the placenta.

It is necessary to diagnose PE early on in the pregnancy so that the treatment can be given in time and with due care and so that any complications that may arise due to PE can be dealt with in a competent manner [3]. High BP during pregnancy can affect up to 10% of pregnant women. There are significant differences between developed and developing nations as there is a higher rate disparity between the socioeconomic classes [4]. PE along with its complications plays a major role in maternal and perinatal morbidity and mortality. If timely management and diagnosis is provided then any complications can be dealt with and may significantly improve the outcome. Hence the goal of providing better antenatal care can be achieved by developing effective methods to detect PE and it's complications.[5].

It has been seen, by using U/S and doppler scans that PE causes incomplete transformation of spiral arteries due to abnormal placentation [6]. There is increased resistance to the flow in the uterine arteries because of lesions of placental villi and abnormal vasculature. It is four to seven times more likely to be seen in PE pregnancies than in non-PE pregnancies [7]. When measuring the impedance (resistance) against the flow of the uterine arteries by Doppler-Ultrasonography, the assessment and quantification of the incomplete transformation of the spiral arteries can be performed [8,9]. The aim of this study was to determine the usefulness of Doppler Ultrasonography in predicting PE in women.

The objective of this study was to determine the role of Doppler Ultrasonography in predicting PE among women**.**

MATERIALS AND METHODS

This was a retrospective observational study conducted at the Department of Obstetrics and Gynaecology, Dr Vitthalrao Vikhe Patil Foundation's Medical College and Memorial Hospital, Ahmednagar, over a one-year period from January 2020 to December 2020, A total of 650 women were initially screened for risk factors for PE. Risk factors for PE included a prior or family history of the same, multifetal pregnancies, polyhydramnios, primigravida, interval between 2 pregnancies more than 10 years, kidney disorders, autoimmune diaseses like APLA, chronic hypertension, low-socio econimic status, BMI>30. Additionally, women with uncontrolled DM and high BP before 20 weeks of gestation were not considered in the study.

Patients' data were only obtained with their explicit consent. The study comprised 150 pregnant women in total, according to the inclusion and exclusion criteria. The mothers' full medical history was gathered. Based on the LMP or a prior U/S scan, gestational age was determined. In the department, general physical and systemic exams were performed. Complete blood counts, blood groupings, thorough urine reports, random blood sugar (RBS), two clean catches of midstream urine collected on a reagent strip more than four hours apart, and those with >2 proteinuria were noted were all part of the laboratory examinations. Women were classified as PE if, at 20 weeks of pregnancy, they began to experience proteinuria and hypertension (BP > 140/90). For Doppler Ultrasonography, mothers were positioned semi-recumbent with a probes attached to the left and right lower quadrants of abdominal wall,

Data Analysis

To analysie the data a software called SPSS Statistics Version 26.0 (IBM Inc., Armonk, NY) was used..

RESULTS

Among the total of 150 pregnant mothers included in the study,who were at high risk of developing PE, mean maternal age was 27.65 ± 4.77 years, while mean gestational age was 23.88 ± 1.82 weeks. Regarding the risk factors for PE, a history of PE was the most commonly observed factor (52, 69.3%), followed by a family history of PE (49, 65.3%), as shown in Table 1.

Table 1: Guidance criterion and risk factor of pre-eclampsia in the study group(n=75)

Variables	Values
Maternal age, years, mean ±SD	27.65 ±4.77
Gestational age, weeks, mean ±SD	23.88 ±1.82
Previous history of pre-eclampsia, n (%)	52 (69%)
Family history of pre-eclampsia, n (%)	49 (65%)
Diabetes mellitus, n (%)	13 (17%)
Urinary tract infection n (%)	09 (12%)
Polycystic ovarian syndrome n (%)	04 (5%)
Renal disease n (%)	03 (4%)

Out of 150 women who were at high risk of developing pre-eclampsia, BP of 140/90 mm of Hg along with proteinuria was observed in 112 (76.7%) cases, and were therefore diagnosed with PE.. Out of these 112 patients, 80 cases had abnormal uterine artery Doppler Ultrasonography. On the other hand, among 38 women who did not develop PE, abnormal uterine artery Doppler Ultrasonography was seen in 10 cases.

Based on the cut-off of RI and notching of the uterine artery, the sensitivity, specificity, PPV, and NPV of Doppler Ultrasonography in predicting PE were 71.4%, 26.3%, 23.8%, and 74.1%, respectively (Table 2).

Table 2: Overall sensitivity, specificity, PPV, and NPV of an abnormal Doppler ultrasound in predicting pre-eclampsia

Doppler ultrasound findings		Pre-eclampsia (blood pressure >140/90 mm of Hg and proteinuria)		Total	Sensitivity	Specificity	PPV	NPV
		Yes	No					
Abnormal	(Uni/bilateral RI >0.58 and Uni/bilateral notch)	80	28	108 (72%)	71.4%	26.3%	23.8%	74.1%
Normal	(RI ≤0.58 and absent uterine artery notch)	32	10	42 (28%)				
Total		112 (76.7%)	38 (25.3%)	150				

RI: resistance index; PPV: positive predictive value; NPV: negative predictive value

Regarding individual Doppler Ultrasonography indices, RI > 0.58 (unilateral/bilateral) was the most sensitive (71%), while the presence of a uterine artery notch (unilateral/bilateral) was most specific for predicting PE. The sensitivity of bilateral RI > 0.58 was low (41%) compared to unilateral RI > 0.58; however, the presence of a bilateral RI > 0.58 was more specific. Similarly, the presence of bilateral uterine artery notching was more specific in predicting PE (79%) compared to unilateral notching (Table 3).

Table 3: Sensitivity, specificity, PPV, and NPV of Doppler indices in predicting pre-eclampsia

Doppler indices	TP	FP	FN	TN	Sensitivity	Specificity	PPV	NPV
Uni/bilateral RI >0.58 (any RI >0.58)	80	28	32	10	71%	26%	74%	24%
Bilateral RI >0.58 (both RI >0.58)	46	14	66	24	41%	63%	77%	27%
Uni/bilateral notch (any notch)	80	4	32	34	71%	89%	95%	52%
Bilateral notch (both notch)	36	8	76	30	32%	79%	84%	28%

RI: resistance index; TP: true positive; FP: false positive; FN: false negative; TN: true negative; PPV: positive predictive value; NPV: negative predictive value

DISCUSSION

Numerous investigations have documented various PE frequencies and associated Doppler Ultrasonography results [10]. One study found that 40% of pregnant women who later experienced pulmonary embolism had high-impedance flow in the uterine artery [11]. Additionally, it has been noted that the probability of PE increases by around twofold following an ultrasound scan that shows notching or resistance of uterine artery flow. The correct identification or prediction of PE, particularly in high-risk mothers, is essential for timely intervention, which shows crucial to improving maternal and foetal outcomes [12]. PE is thought to be the main cause of maternal mortality and morbidity.

When the RI was > 0.58 and the mothers were between 18 and 24 weeks pregnant, another study revealed a PE incidence of 11.5% [13]. A PE and a RI > 0.58 were detected in 6% of mothers between the 20th and 24th week of pregnancy, according to another study [14]. However, in our study, a rate of 76.7% for PE between 20 and 26 weeks of gestation was found. Similar to our investigation, one study found that moms with bilateral uterine artery notches at 24 weeks' gestation had a 55% PE rate; this rate rose to 81% at delivery, and all of these mothers delivered their babies before 35 weeks' gestation [15].

In this investigation, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for unilateral/bilateral RI Doppler index > 0.58 were 71%, 26%, 74%, and 24%, respectively; for bilateral RI > 0.58, these were 41%, 63%, 77%, and 27%, respectively. These values were 71%, 89%, 95%, and 52% for unilateral/bilateral uterine artery notches, and 32%, 79%, 84%, and 28% for bilateral notches, respectively. Another study found that, in comparison to ours, the PPV in the uterine artery notch was 25%, the PE frequency was reported to be 18%, and the sensitivity, specificity, PPV, and NPV at RI > 0.58 were, respectively, 70% and 88%. The results for bilateral notching of the uterine artery were very similar: 62%, 89%, 47%, and 94%. Instead of clinically estimating the probability of PE, other studies have reported a PPV ranging from 35 to 60% and an NPV ranging from 70 to 95% based on PE diagnosed or predicted by Doppler Ultrasonography [16].

According to one study, 58% of high-risk moms who also had hypertension had PE [17]. In a different study, 11.3% of mothers had an abnormal Doppler ultrasonography result, with sensitivity, specificity, PPV, and NPV for PE at 36%, 90%, 11%, and 98%, respectively [18]. Numerous other research have made the same observations as our own, namely that smoking, nulliparity, a first trimester BMI > 30 kg/m2, a personal history of PE, and a positive family history of PE are all risk factors for PE. Doppler Ultrasonography has emerged as a screening test for pulmonary embolism and is currently a test of utmost significance [19].The limited sample size, retrospective study design, and reliance on a single institution as the source of the data are some of the study's drawbacks. Therefore, in order to comprehend the function of Doppler Ultrasonography in PE prediction, we advise large-scale prospective research.

CONCLUSION

Based on the results of our study, the use of Doppler Ultrasonography to help predict PE by determining the uterine artery notching and its RI with respect to abnormal uterine artery notching or high RI (>0.58) was successful and therefore resulted in the prediction of PE in a majority of the patients. However, because our study had a retrospective design with a limited sample size, large-scale prospective studies are recommended to validate these observations in our population.

REFERENCES

[1]   Mol BW, Roberts CT, Thangaratinam S, Magee LA, de Groot CJ, Hofmeyr GJ. Lancet 2016;387:999-1011.
[2]   Gathiram P, Moodley J. Cardiovasc J Afr 2016 27:71-8.
[3]   Duhig K, Vandermolen B, Shennan A. F1000Res. 2018, 7:242.
[4]   Kintiraki E, Papakatsika S, Kotronis G, Goulis DG, Kotsis V. Hormones (Athens) 2015;14:211-23.
[5]   Kane SC, Da Silva Costa F, Brennecke SP: Aust N Z J Obstet Gynaecol 2014;54:101-7.
[6]   Adekanmi AJ, Roberts A, Akinmoladun JA, Adeyinka AO. Niger Postgrad Med J 2019;26:106-12.
[7]   Falco ML, Sivanathan J, Laoreti A, Thilaganathan B, Khalil A. Ultrasound Obstet Gynecol 2017; 50:295-301.
[8]   Orabona R, Donzelli CM, Falchetti M, Santoro A, Valcamonico A, Frusca T. Ultrasound Obstet Gynecol 2016;47:580-5.
[9]   Khalil A, Garcia-Mandujano R, Maiz N, Elkhouli M, Nicolaides KH. Ultrasound Obstet Gynecol 2014;43:541-7.
[10]   Kane SC, Dennis AT. Hypertens Pregnancy 2015;34:400-21.
[11]   Casmod Y, Van Dyk B, Nicolaou E. Health SA Gesondheid. 2016;21:391-6.
[12]   Rolnik DL, da Silva Costa F, Sahota D, Hyett J, McLennan A. Ultrasound Obstet Gynecol 2019; 53:245-50.
[13]   Fatima E. JAMDSR. 2020; 8:38-41.
[14]   Gallo D, Poon LC, Fernandez M, Wright D, Nicolaides KH. Fetal Diagn Ther 2014; 36:28-37.
[15]   Litwinska M, Syngelaki A, Wright A, Wright D, Nicolaides KH. Ultrasound Obstet Gynecol 2018; 52:365-72.
[16]   Bhattacharyya SK, Kundu S, Kabiraj SP. J Obstet Gynaecol India 2012;62:297-300.
[17]   Chen CW, Jaffe IZ, Karumanchi SA. Cardiovasc Res 2014;101:579-86.
[18]   Espinoza J, Romero R, Nien JK, et al. Am J Obstet Gynecol 2007;196:326.
[19]   Musa J, Mohammed C, Ocheke A, Kahansim M, Pam V, Daru P. Afr Health Sci 2018;18:584-95.