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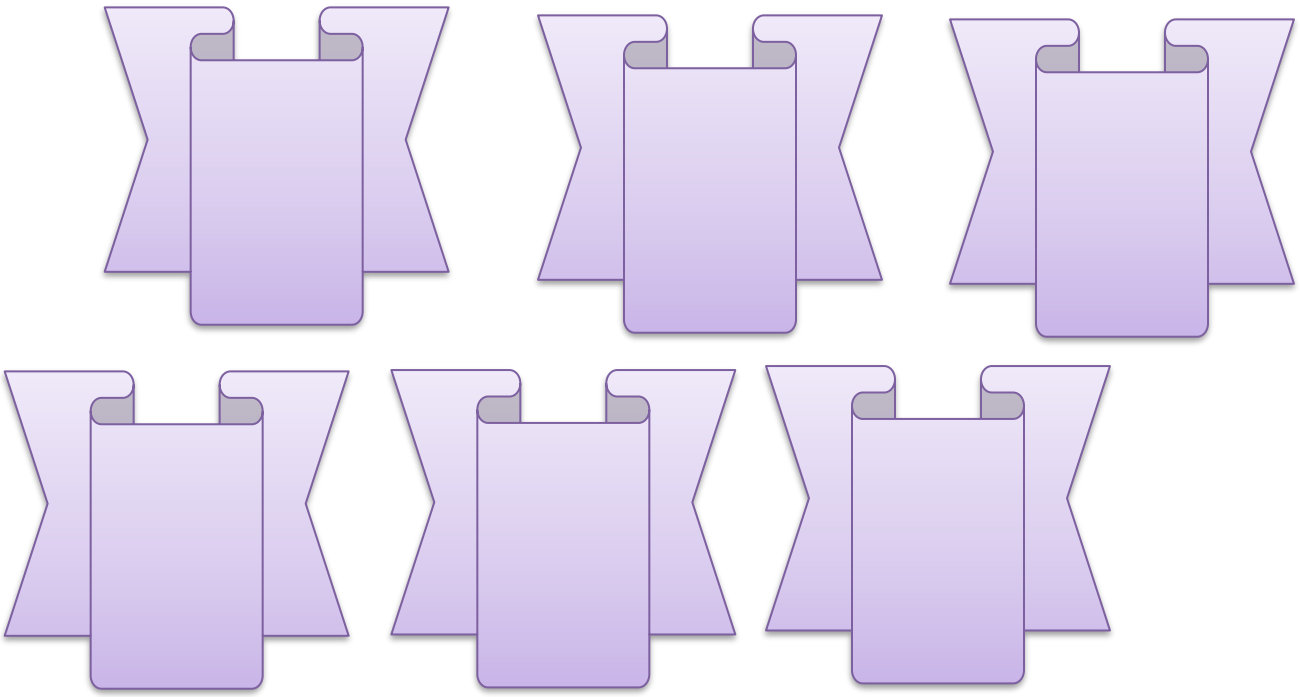

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Original Article

Measurement of Third-Trimester Uterine Artery Doppler for Evaluation of Maternal Postpartum Outcome among Patients with Severe Pre-Eclampsia

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ABSTRACT

Background: Preeclampsia is a frequent pregnancy disease that accounts for a significant portion of maternal and foetal morbidity and mortality. Eclampsia, pulmonary edema, HELLP syndrome, cerebral hemorrhage, severe renal failure, placental abruption, and disseminated intravascular coagulation are among the maternal consequences of pre-eclampsia [DIC].

Aim of the work: To analyze the relationship between maternal problems and uterine artery Doppler measures in women with severe pre-eclampsia.

Patients and Methods: 200 pregnant patients from Sayed Galal and Shebin El-Kom teaching hospitals participated in a case-control study. Two groups of pregnant women were used in this study. Group I [Case group] consisted of 100 pregnant women with viable singleton pregnancies and no other obstetric complications or morbidities aside from preeclampsia. There were 100 expectant women in Group II [the Control group] who did not have pre-eclampsia. At admission, uterine artery Doppler was performed, and the postpartum result was assessed.

Results: Uterine artery When compared to the control group, the case group's Doppler had a much higher resistance, which was linked to an increase in eclampsia, oliguria, renal failure, HELLP, and blood transfusions.

Conclusion: Third trimester High-resistance uterine artery Doppler can be used to predict adverse postpartum outcome.

Keywords: Preeclampsia; Postpartum Outcome; Third trimester; Uterine Artery Doppler

INTRODUCTION

Preeclampsia is a frequent pregnancy disease that accounts for a significant portion of maternal and foetal morbidity and mortality. Preeclampsia has a reported incidence of 5-8% [1].

Proteinuria and hypertension appear in the mother, and systemic involvement may or may not be present. The foetus side experiences stunted growth, decreased amniotic fluid, and compromised oxygen and nutrient delivery [2].

Diabetes, chronic kidney disease, systemic lupus erythematosus, antiphospholipid syndrome, chronic hypertension, first pregnancy, age 40 or older, pregnancy interval of more than ten years, body mass index of 35kg/m2 or more at first visit, and family history of pre-eclampsia are risk factors to identify women at an increased risk of the condition [3, 4].

Eclampsia, pulmonary edema, HELLP syndrome, amaurosis, cerebral hemorrhage, severe renal failure, placental abruption, and disseminated intravascular coagulation are among the maternal consequences of pre-eclampsia [DIC] [5].

Preeclampsia's pathogenesis is not entirely understood, although the placenta has always played a significant role in its etiology because it must be removed for symptoms to improve [6].

The most widely recognized idea is that reduced uteroplacental perfusion results from faulty trophoblastic invasion. A two-stage model was created as a result, with stage 1 being incomplete spiral artery remodeling in the uterus, which contributes to placental ischemia, and stage 2 being the release of antiangiogenic substances into the maternal circulation by an ischemic placenta, which causes endothelial damage [7].

Preeclampsia is a critical health problem since it causes a substantial amount of preterm and has a high risk of maternal and neonatal morbidity and mortality. Eclampsia, acute pulmonary edema, cerebral vascular accident, renal failure, liver failure, and ultimately maternal mortality are possible in women with more severe illness [8, 9].

The main causes of perinatal as well as maternal morbidity and mortality are the side effects of placental insufficiency, pre-eclampsia, and foetal growth restriction [FGR]. Histo-pathological studies imply that the spiral arteries' invasion by trophoblasts and subsequent transformation into low-resistance vessels cause the uterine arteries' flow impedance to decrease with gestation in healthy pregnancy. Complications of uteroplacental insufficiency are linked to failure of trophoblastic invasion. Pre-eclampsia, FGR, and infant death have all been linked to higher resistance to flow in the uterine arteries, according to several Doppler screening studies conducted in the second and more recently in the first trimester of pregnancy [10].

Pre-eclampsia in particular is correlated with increased flow impedance in the uterine arteries as measured by the Doppler measurement. We looked into how well uterine artery Dopplers may predict negative pregnancy outcomes like "pre-eclampsia" and "small foetus for gestational age" [SGA] [11].

The objective of this study is to assess the relationship between maternal problems and uterine artery Doppler measures in women with severe pre-eclampsia.

PATIENTS AND METHODS

At Sayed Galal hospital and Shebin El-Kom teaching hospital, 200 pregnant patients participated in this case-control study. As part of routine antenatal care [ANC] from February 2016 to October 2022, 100 patients with preeclampsia were selected from the obstetric outpatient clinic and department as a case group, and 100 patients without preeclampsia were also recruited as a control group.

All The study's pregnant participants were split into two groups: 100 pregnant women in Group I [the Case group] had viable singleton pregnancies and were free of any other morbidities besides preeclampsia. There were 100 expectant women in Group II [the Control group] who did not have pre-eclampsia. Women between the ages of 20 and 35 who were expecting a single, viable foetus at a gestational age between 28 and 36 weeks were included.

Ethical considerations

The institutional committee's ethical criteria were followed during all proceedings. The Al-Azhar University Hospital Local Medical Ethics Committee gave its clearance for the project.

After explaining the nature and scope of the study to all participants, the goal and steps of the study were laid out for them, and their written informed consent was then obtained.

Inclusion criteria

Mother's age should be between 20 and 35 years old, and the pregnancy should be between 28 and 36 weeks [assessed by the date of the last menstrual period with ultrasound confirmation before 20 weeks].

Exclusion criteria

Women who had several pregnancies, foetal abnormalities that were recognized or recorded, Rh incompatibility, premature membrane rupturing, polyhydramnios, type 2 diabetes, individuals having an antepartum hemorrhage and an unreliable or uncertain date.

Oral informed consent, a thorough history review, a laboratory examination, including a complete blood count, liver and kidney function tests, and two "clean-catch-midstream" or catheter specimens of urine collected about four hours apart, were all required of all pregnant women participating in this study. ultrasound examination to determine foetal weight, amniotic fluid index at the placental location, and gestational age.

The uterine arteries were also examined using Doppler technology. The uterine and iliac vessels' apparent crossover was discovered using color Doppler technology. Just cranial to the vascular "crossing," uterine artery velocity measurements were taken. To compute PI and analyze the presence or absence of an early diastolic notch, three even consecutive blood flow velocity waveforms were used [12].

According to the International Society for the Study of Hypertension in Pregnancy's criteria, preeclampsia was diagnosed in a previously normotensive woman after the 20th week with diastolic blood pressure readings of 90 mm Hg taken twice or more consecutively, at least four hours apart, or 110 mmHg on any one occasion of pregnancy. Together with two 'clean-catch-midstream' or catheter urine specimens collected 4 hours apart showing 2+ on reagent strip, or proteinuria of 300 mg/L in 24-hour urine.

In order to confirm the foetal number, viability, presentation, estimated foetal weight, position and grade of the placenta, amount of alcohol, detailed anomaly scan, biophysical profile, and gestational age, a transabdominal obstetric ultrasound examination was carried out using a Medison X6 machine [Medison Co, Seoul, South Korea] outfitted with a 4-7 MHz transabdominal probe [3D4-7EK].

At the intersection of the uterine and external iliac arteries, uterine artery Doppler velocimetry was carried out using a Medison X6 ultrasound scanner with an insonation angle less than 30°, a velocity of more than 60 cm/s, and a sample volume of 2.0 mm [13].

Statistical analysis

Statistical Package for the Social Sciences [SPSS] version 23 was used on an IBM compatible personal computer to gather, tabulate, and statistically analyze the data [Armnok, NY: IBM Corp.] There were two sections of statistics: Descriptive statistics: the presentation of quantitative data as median and range, Analytical statistics: Chi-square test [2], Student t test [t], Mann-Whitney Spearman correlation, and other tests of significance were used. ROC curves [receiver operating characteristic] Cutoff values, sensitivity, and specificity are respectively P values of ≤0.05 considered significant level.

RESULTS

Our investigation demonstrated that the age difference between the control group [28.053.58 years] and the cases group [26.594.04 years] was statistically significant. Contrarily, there were no appreciable variations in gestational age or parity across the study group [p>0.05]. Also, there was a significantly significant difference [p<0.001] between the analyzed group in terms of surgical history [table 1].

In our study, SBP, DBP, BMI, pulse, uterine artery RI and PI in the right and left sides, and umbilical artery RI and PI were significantly higher in the cases group [189.52163.39 mmHg, 105.504.74 mmHg, 31.322.64 kg/m2, 96.395.39, 0.770.11, 1.720.75, 0.780.10, 1.970.66, Lower limb edema and the early diastolic notch of the uterine artery in the right and left sides were extremely significant differences between the study group [p<0.001] [table 2].

Fetal weight and AFI were substantially higher in the control group [2596.3553.1,

13.115.40] than in the cases group [2245.01337.73, 9.162.42], according to the results of the current study. When it came to the placenta and placenta grade, there were more significant differences between the study group [p<0.001] [table 3].

According to our research, the control group had considerably higher hemoglobin, platelet, and serum albumin levels than the cases group had [9.771.01 g/dl, 156.6948.77 mcL, 3.140.34 g/dl, respectively]. Serum creatinine, urea, ALT, and AST levels were all significantly higher in the cases group [1.170.22 mg/dL, 44.887.73 mg/dL, 50.5917.83 IU/L, and 44.3619.23 IU/L, respectively] than in the control group [0.870.14 mg/dL, 11.124.68 mg/dL, 28.077.81 IU/L, The difference between the study group and regard to albumin in urine was greater significant [p<0.001] [table 4].

According to our study, the studied group and unstudied group had greater levels of significance for eclampsia, oliguria, renal failure, HELLP, blood transfusion, preterm birth, and IUGR [p<0.001] [table 5].

According to the results of the current study, the average resistive and perfusion indices of the umbilical artery for patients who did not deliver prematurely were 0.720.03 and 1.050.09, respectively. The average resistive index in the right and left uterine arteries for patients who did not deliver prematurely was 0.770.11 and 0.780.10, respectively. Also, the average perfusion index in the right and left uterine arteries for individuals who did not deliver prematurely was [1.710.75 and 1.960.66, respectively] [table 6].

According to our research, the perfusion index of the umbilical artery, the resistive index on the right and left, and the perfusion index on the right and left of the uterine artery were all significantly higher in the renal failure group than in the non-renal failure group. While the resistive and perfusion indices of the left and right uterine arteries as well as oliguria and non-oliguria did not differ significantly from each other [p>0.05], eclampsia and non-eclampsia did [table 7].

According to the current study, the resistive index and perfusion index of the uterine artery were both substantially higher in the HELLP group compared to the non-HELLP group [p<0.001]. In contrast, there were no appreciable variations in the umbilical artery's resistive and perfusion indices between the HELLP and non-HELLP groups [p>0.05]. Also, blood transfusion group members' perfusion indices of the umbilical artery, resistive indexes on the right and left, and perfusion indices on the right and left of the uterine artery were all considerably higher than those of the non-transfusion group [p<0.001]. The resistive index of the umbilical artery, however, did not significantly differ between the blood transfusion and non-blood transfusion groups [p>0.05] [table 8].

Our study found that the RI umbilical artery has a sensitivity of 87%, a specificity of 70%, a PPV and NPV of 100%, and a p-value of 0.001 for predicting pre-eclampsia. While PI umbilical artery had 100% sensitivity to predict pre-eclampsia, it only had 67% specificity at cutoff values of >0.95, 100% PPV, and 100% NPV with a p-value of 0.001. Moreover, the RI right of uterine artery had a sensitivity of 79.80%, specificity of 80% at a threshold value of >0.695, [100%] PPV, and [100%] NPV with a p-value of 0.001 to predict pre-eclampsia. Pre-eclampsia was predicted by RI left uterine artery with a sensitivity of 79.80%, specificity of 68%, cutoff value of >0.695, 100% PPV, 100% NPV, and p-value of <0.001. Also, right uterine artery sensitivity to predict pre-eclampsia was 79.80%, specificity was 80% at a cutoff value of >0.695, and p-value was less than 0.001. While the RI left of uterine artery was 79.80% sensitive to predicting pre-eclampsia, it was only 68% specific at a cutoff value of >0.695, with a p-value of 0.001. Moreover, PI right of uterine artery had a sensitivity of 71%, specificity of 66%, and p-value of 0.001 for predicting pre-eclampsia. Pre-eclampsia was predicted by PI left of uterine artery with 86% sensitivity, 64% specificity, and a p-value of 0.001 [table 9].

Table [1]: Demographic data and presenting symptoms among the studied groups

Variables		Studied groups [N=200]				Test	P value
		Cases [N=100]		Control [N=100]			
Age [years]	Mean ±SD Range	26.59±4.04 22.00-36.00		28.05±3.58 22.00-39.00		t = 2.706	**0.007***
Gestational age [weeks]	Mean ±SD Range	34.88±2.44 30.00-38.00		34.78±2.21 31.00-39.00		t = 0.304	0.761
Parity [No., %]	Primigravida Multipara	30 70	30.0 70.0	34 66	34.0 66.0	X^2 = 0.368	0.544
Medical history [No., %]	Negative Positive	100 0	100.0 0.0	100 0	100.0 0.0	NA	---
Presenting symptoms **Negative**		43	43.0	0	0.0	X^2 = 157.143	**<0.001***
Positive		**N=57**		**N=100**		X^2 = 157.143	**<0.001***
Blurring of vision		9	15.79	0	0.0		
Epigastric pain		13	22.81	0	0.0		
Abdominal pain		16	28.07	0	0.0		
Antenatal care		12	21.05	100	100.0		
Headache		6	10.53	0	0.0		
Lower limb edema		1	1.75	0	0.0		

t: student t test, X^2: Chi square test * significant

Table [2]: Clinical examination and Doppler findings among the studied groups

Variables		Studied groups [N=200]				U	P value	95% CI	
		Cases [N=100]		Control [N=100]				lower	Upper
SBP [mmHg]	Mean ±SD Range	189.52±163.39 160.00-230.00		118.35±11.12 100.0-140.0		35.925	**<0.001***	-75.08	-67.26
DBP [mmHg]	Mean ±SD Range	105.50±4.74 100.00-110.00		71.55±7.90 60.00-85.00		36.835	**<0.001***	-35.77	-32.13
BMI [kg/m^2]	Mean ±SD Range	31.32±2.64 27.00-37.00		28.56±3.13 24.00-37.00		6.748	**<0.001***	-3.57	-1.95
Pulse	Mean ±SD Range	96.39±5.39 83.00-103.00		92.13±7.12 80.00-110.00		4.770	**<0.001***	-6.02	-2.50
Umbilical artery RI	Mean ±SD Range	0.72±0.03 0.67-0.78		0.62±0.08 0.50-0.75		11.512	**<0.001***	-0.12	-0.08
PI	Mean ±SD Range	1.05±0.09 0.96-1.20		0.90±0.19 0.53-1.20		7.089	**<0.001***	-0.19	-0.11
Uterine artery Right RI	Mean ±SD Range	0.77±0.11 0.60-0.90		0.58±0.11 0.44-0.76		12.830	**<0.001***	-0.23	-0.17
Left RI	Mean ±SD Range	0.78±0.10 0.59-0.90		0.62±0.13 0.42-0.85		9.362	**<0.001***	-0.19	-0.13
Uterine artery Right PI	Mean ±SD Range	1.72±0.75 0.80-2.71		1.0±0.27 0.61-1.45		8.920	**<0.001***	-0.87	-0.56
Left PI	Mean ±SD Range	1.97±0.66 1.10-2.96		1.17±0.37 0.62-1.73		10.500	**<0.001***	-0.94	-0.65
Uterine artery Rt early d. notch		**No.**	**%**	**No.**	**%**	**X^2**	**<0.001***	---	---
Negative Positive		19 81	19.0 81.0	92 8	92.0 8.0	107.885			
Lt early d. notch								---	----
Negative Positive		5 95	5.0 95.0	71 29	71.0 29.0	92.455	**<0.001***		
Lower limb edema		10	10.0	89	89.0			----	-----
Negative positive		90	90.0	11	11.0	124.832	**<0.001***		

SBP: Systolic blood pressure DBP: Diastolic blood pressure BMI: Body mass index U: Mann-Whitney test; X^2: Chi square test * significant

Table [3]: Ultrasound examination among the studied groups

Variables	Studied groups [N=200]				t	P value	95% CI	
	Cases [N=100]		Control [N=100]				lower	Upper
Fetal weight								
Mean ±SD	2245.01±337.73		2596.3±553.1		5.421	**<0.001***	223.49	479.09
Range	1800.00-2840.0		1450.0-3555.0					
AFI								
Mean ±SD	9.16±2.42		13.11±5.40		6.675	**<0.001***	2.78	5.12
Range	4.00-12.00		7.00-25.00					
Placenta	**No.**	**%**	**No.**	**%**	**X^2**			
Fundal	31	31.0	69	69.0				
Anterior	29	29.0	11	11.0	29.207	**<0.001***	---	----
Posterior	40	40.0	20	20.0				
Placenta grade								
Negative	0	0.0	100	100.0				
Positive	**N=100**		**N=0**		200.000	**<0.001***	---	----
Second	18	18.0	0	0.0				
Third	82	82.0	0	0.0				

AFI: Amniotic fluid index; t: student t test; X^2: Chi-square test; * Significant

Table [4]: Laboratory investigations among the studied groups

Variables	Studied groups [N=200]				t	P value	95% CI	
	Cases [N=100]		Control [N=100]				lower	Upper
Hemoglobin [g/dl]								
Mean ±SD	9.77±1.01		10.58±0.97		5.794	**<0.001***	0.53	1.09
Range	7.50-11.00		8.70-12.90					
Platelet [mcL]								
Mean ±SD	156.69±48.77		201.19±34.50		7.449	**<0.001***	32.72	56.28
Range	86.00-250.00		120.00-240.00					
Serum creatinine [mg/dL]								
Mean ±SD	1.17±0.22		0.87±0.14		11.284	**<0.001***	-0.35	-.24
Range	0.90-1.50		0.60-1.10					
Serum urea [mg/dL]								
Mean ±SD	44.88±7.73		11.12±4.68		37.376	**<0.001***	-35.54	-31.98
Range	31.00-56.00		5.00-20.00					
ALT [IU/L]								
Mean ±SD	50.59±17.83		28.07±7.81		11.567	**<0.001***	-26.36	-18.68
Range	30.00-75.00		17.00-55.00					
AST [IU/L]								
Mean ±SD	44.36±19.23		27.70±7.62		8.055	**<0.001***	-20.74	-12.58
Range	22.00-85.00		18.00-40.00					
Serum albumin [g/dL]								
Mean ±SD	3.14±0.34		4.27±0.69		14.743	**<0.001***	0.98	1.28
Range	2.50-3.50		3.40-5.40					
Urine Albumin [mg/dL]	**No.**	**%**	**No.**	**%**	**X^2**			
Negative	0	0.0	100	100.0	200.000	**<0.001***	----	---
Positive	100	100.0	0	0.0				

ALT: Alanine transaminase; AST: Aspartate aminotransferase; t: student t test; X^2: Chi square test; * significant

Table [5]: Postpartum maternal outcome and neonatal complication among the studied groups

Variables	Studied groups [N=200]				X^2	P value
	Case [N=100]		Control [N=100]			
	No.	%	No.	%		
Eclampsia						
No	91	91.0	100	100.0	9.424	**0.002***
Yes	9	9.0	0	0.0		
Oliguria						
No	74	74.0	95	95.0	16.835	**<0.001***
Yes	26	26.0	5	5.0		
Renal failure						
No	70	70.0	99	99.0	32.105	**<0.001***
Yes	30	30.0	1	1.0		
Pulmonary edema						
No	93	93.0	100	100.0	NA	**----**
Yes	7	7.0	0	0.0		
HELLP						
No	71	71.0	100	100.0	33.918	**<0.001***
Yes	29	29.0	0	0.0		
Blood transfusion						
No	69	69.0	94	94.0	20.726	**<0.001***
Yes	31	31.0	6	6.0		
Preterm delivery						
No	72	72.0	94	94.0	32.558	**<0.001***
Yes	28	28.0	6	6.0		
IUGR						
No	79	79.0	97	97.0	15.341	**<0.001***
Yes	21	21.0	3	3.0		

IUGR: Intrauterine growth restriction, **X^2:** Chi square test ***** significant

Table [6]: Relation between RI and PI of umbilical and uterine arteries with Preterm delivery of the studied cases patients

Variable	Preterm delivery No [N=100]
Umbilical artery	
Resistive index	
Mean ±SD	0.72±0.03
Range	0.67-0.78
Median [IQR]	0.72[0.06]
Perfusion Index	
Mean ±SD	1.05±0.09
Range	96.00-1.20
Median [IQR]	1.00[0.15]
Uterine artery	
Resistive index. right	
Mean ±SD	0.77±0.11
Range	00.60-00.90
Median [IQR]	0.71 [0.18]
Resistive index. left	
Mean ±SD	0.78±0.10
Range	00.59-00.90
Median [IQR]	0.75 [0.15]
Perfusion Index. right	
Mean ±SD	1.71±0.75
Range	0.80-2.71
Median [IQR]	1.52 [1.65]
Perfusion Index. Left	
Mean ±SD	1.96±0.66
Range	1.10-2.96
Median [IQR]	1.61 [1.21]

Table [7]: Relation between RI and PI of umbilical and uterine arteries with eclampsia, oliguria and renal failure of the studied cases patients

	Variable		No [n= 91]	Yes [n= 9]	U	P value
Eclampsia	**Umbilical artery**					
	Resistive index	Mean ±SD Range Median [IQR]	0.72±0.03 0.67-0.78 0.72[0.06]	0.72±0.03 0.67-0.75 0.70[0.06]	0.557	0.579
	Perfusion Index	Mean ±SD Range Median [IQR]	1.04±0.09 96.00-1.20 1.00[0.15]	1.08±0.11 96.00-1.20 1.12 [0.23]	-1.089	0.279
	Uterine artery					
	Resistive index. right	Mean ±SD Range Median [IQR]	0.77 ±0.11 00.60-00.90 0.79 [0.18]	0.78±0.10 00.65-00.90 0.71 [0.18]	-0.172	0.864
	Resistive index. left	Mean ±SD Range Median [IQR]	0.78±0.10 00.59-00.90 0.80 [0.15]	0.79±0.11 00.59-00.90 0.75 [0.17]	-0.194	0.847
	Perfusion Index. right	Mean ±SD Range Median [IQR]	1.71±0.76 0.80-2.71 1.52 [1.65]	1.71±0.72 0.90-2.71 1.52 [1.50]	0.035	0.972
	Perfusion Index. left	Mean ±SD Range Median [IQR]	1.97±0.66 1.10-2.96 1.61 [1.21]	1.90±0.72 1.10-2.96 1.55 [1.38]	0.335	0.739
			No [n= 74]	**Yes [n= 26]**		
Oliguria	**Umbilical artery**					
	Resistive index	Mean ±SD Range Median [IQR]	0.72±0.03 0.67-0.78 0.72[0.06]	0.72±0.03 0.67-0.78 0.72[0.06]	0.278	0.782
	Perfusion Index	Mean ±SD Range Median [IQR]	1.04±0.09 00.96-1.20 1.00[0.15]	1.07±0.10 00.97-1.20 1.00 [0.22]	-1.255	0.212
	Uterine artery					
	Resistive index. right	Mean ±SD Range Median [IQR]	0.76 ±0.11 00.60-00.90 0.71 [0.21]	0.81±0.09 00.65-00.90 0.88 [0.17]	-1.698	0.093
	Resistive index. left	Mean ±SD Range Median [IQR]	0.77± 0.11 00.59-0.90 0.75 [0.22]	0.81±0.09 00.59-00.90 0.87 [0.17]	-1.531	0.129
	Perfusion Index. right	Mean ±SD Range Median [IQR]	1.64±0.76 0.80-2.71 1.30 [1.66]	1.90±0.71 0.90-2.71 1.52 [1.14]	-1.690	0.094
	Perfusion Index. left	Mean ±SD Range Median [IQR]	1.91± 0.66 1.10-2.96 1.60 [1.21]	2.10±0.67 1.10-2.96 1.61 [1.23]	-1.359	0.177
			No [n= 70]	**Yes [n= 30]**		
Renal failure	**Umbilical artery**					
	Resistive index	Mean ±SD Range Median [IQR]	0.72±0.03 0.67-0.78 0.72[0.06]	0.71±0.04 0.67-0.78 0.70[0.06]	1.144	0.256
	Perfusion Index	Mean ±SD Range Median [IQR]	1.03±0.09 00.96-1.20 1.00[0.03]	1.10±0.08 00.97-1.20 1.12 [0.02]	-4.023	**<0.001***
	Uterine artery					
	Resistive index. right	Mean ±SD Range Median [IQR]	0.73 ±0.10 00.60-00.88 0.71 [0.21]	0.88±0.02 00.86-0.90 0.88 [0.04]	-8.326	**<0.001***
	Resistive index. left	Mean ±SD Range Median [IQR]	0.74± 0.10 00.59-0.87 0.73 [0.22]	0.88±0.02 00.85-0.90 0.89 [0.05]	-7.724	**<0.001***
	Perfusion Index. right	Mean ±SD Range Median [IQR]	1.53±0.66 0.80-2.59 1.30 [1.65]	2.14±0.78 0.90-2.71 2.55 [1.75]	-4.130	**<0.001***
	Perfusion Index. left	Mean ±SD Range Median [IQR]	1.67± 0.49 1.10-2.61 1.55[0.21]	2.66±0 .46 1.40- 2.96 2.78 [0.35]	-9.465	**<0.001***

Mann-Whitney U test; * significant

Table [8]: Relation between RI and PI of umbilical and uterine arteries with HELLP and blood transfusion of the studied cases patients.

Variable			No [n= 71]	Yes [n= 29]	U	P value
HELLP	**Umbilical artery**					
	Resistive index	Mean ±SD Range Median [IQR]	0.72±0.03 0.67-0.78 0.72[0.06]	0.72±0.04 0.67-0.78 0.71[0.06]	0.558	0.578
	Perfusion Index	Mean ±SD Range Median [IQR]	1.04±0.09 0.96-1.20 1.00[0.13]	1.07±0.09 0.97-1.20 1.12 [0.14]	-1.696	0.093
	Uterine artery					
	Resistive index. right	Mean ±SD Range Median [IQR]	0.73 ±0.09 0.60-00.88 0.71 [0.21]	0.89±0.01 0.88-0.90 0.88 [0.02]	-9.214	**<0.001***
	Resistive index. left	Mean ±SD Range Median [IQR]	0.74± 0.09 0.59-0.87 0.73 [0.20]	0.89±0.01 0.87-0.90 0.89 [0.03]	-8.550	**<0.001***
	Perfusion Index. right	Mean ±SD Range Median [IQR]	1.48±0.65 0.80-2.59 1.30 [0.62]	2.25±0.70 0.90-2.71 2.55 [0.08]	-5.032	**<0.001***
	Perfusion Index. Left	Mean ±SD Range Median [IQR]	1.66± 0.50 1.10-2.61 1.55[0.21]	2.68±0 .39 1.40- 2.96 2.78 [0.44]	-9.591	**<0.001***
			No [n= 69]	**Yes [n= 31]**		
Blood transfusion	**Umbilical artery**					
	Resistive index	Mean ±SD Range Median [IQR]	0.72±0.03 0.67-0.78 0.72[0.06]	0.72±0.04 0.67-0.78 0.71[0.05]	1.015	0.313
	Perfusion Index	Mean ±SD Range Median [IQR]	1.02±0.08 00.96-1.20 1.00[0.03]	1.12±0.09 0.97-1.20 1.12 [0.10]	-5.928	**<0.001***
	Uterine artery					
	Resistive index. right	Mean ±SD Range Median [IQR]	0.73 ±0.10 00.60-0.88 0.71 [0.21]	0.88±0.02 00.86-0.90 0.88 [0.04]	-8.305	**<0.001***
	Resistive index. left	Mean ±SD Range Median [IQR]	0.74± 0.10 00.59-0.90 0.73 [0.21]	0.88±0.02 00.85-00.90 0.89 [0.03]	-7.769	**<0.001***
	Perfusion Index. right	Mean ±SD Range Median [IQR]	1.47±0.64 0.80-2.71 1.30 [0.62]	2.26±0.69 0.90-2.71 2.59 [0.04]	-5.675	**<0.001***
	Perfusion Index. left	Mean ±SD Range Median [IQR]	1.68± 0.51 1.10-2.78 1.55[0.21]	2.61±0 .50 1.40- 2.96 2.78 [0.35]	-8.453	**<0.001***

Mann-Whitney U test; * significant

Table [9]: Cut-off level of RI and PI of umbilical artery for predicted pre-eclampsia.

Umbilical	Area	Std. Error	Asymptotic Sig.	Asymptotic 95% CI		PPV	NPV	Cutoff	Sens.	Spec.
				Lower	Upper					
RI	0.854	0.026	**<0.001***	0.803	0.905	100	100	>0.685	87%	70%
PI	0.763	0.037	**<0.001***	0.690	0.836	100	100	>0.95	100%	67%
RI. Right	0.875	0.024	**<0.001***	0.828	0.922	100	100	>0.695	79.80%	80.00%
RI. Left	0.826	0.028	**<0.001***	0.771	0.882	100	100	>0.695	79.80%	68.00%
PI. Right	0.772	0.033	**<0.001***	0.706	0.837	100	100	>1.15	71.00%	66.00%
PI. Left	0.821	0.029	**<0.001***	0.765	0.877	100	100	>1.35	86.00%	64.00%

RI: Resistive index; PI: Perfusion Index

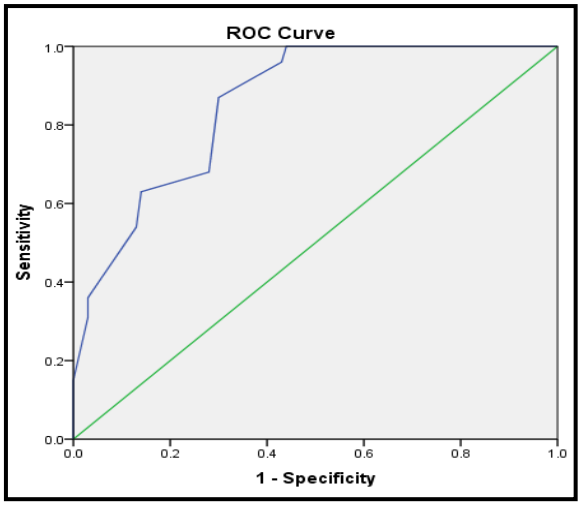

Figure [1]: Cut-off level of RI of umbilical artery for predicted pre-eclampsia

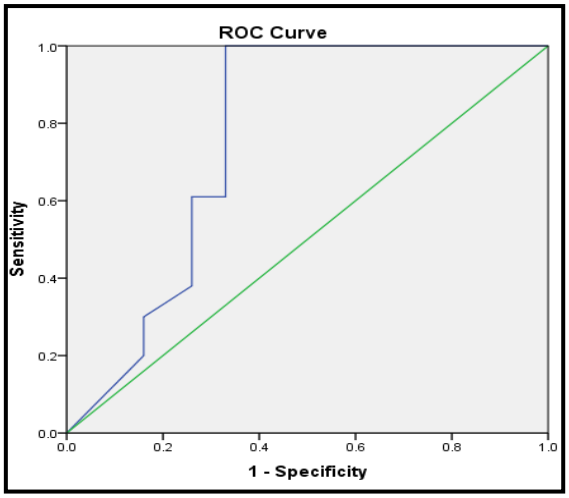

Figure [2]: Cut-off level of PI of umbilical artery for predicted pre-eclampsia

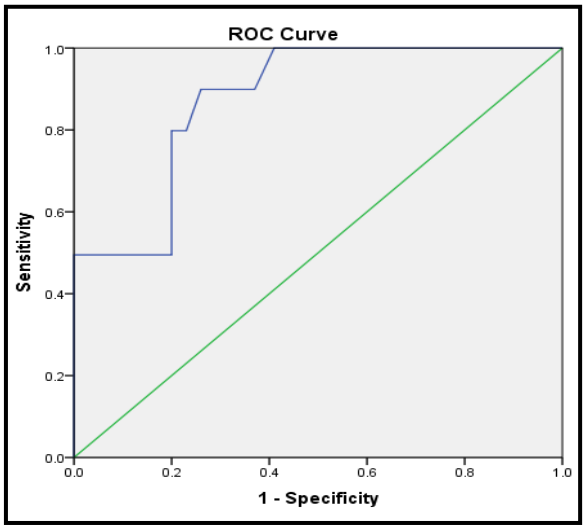

Figure [3]: Cut-off level of RI right of uterine artery for predicted pre-eclampsia

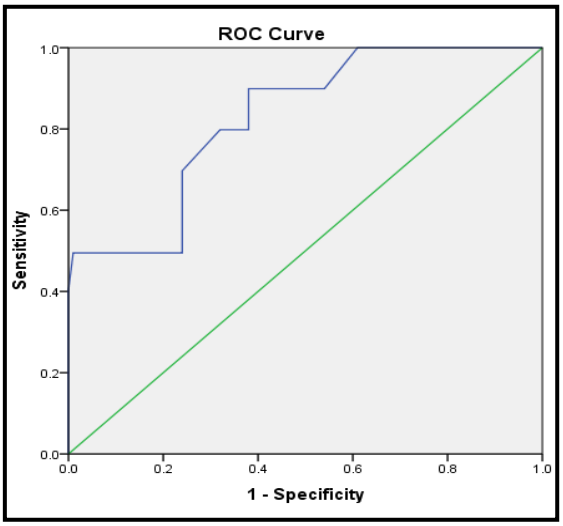

Figure [4]: Cut-off level of RI left of uterine artery for predicted pre-eclampsia

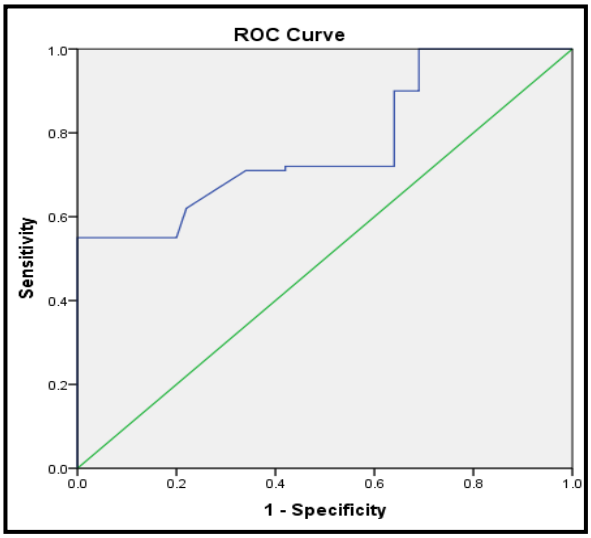

Figure [5]: Cut-off level of PI right of uterine artery for predicted pre-eclampsia

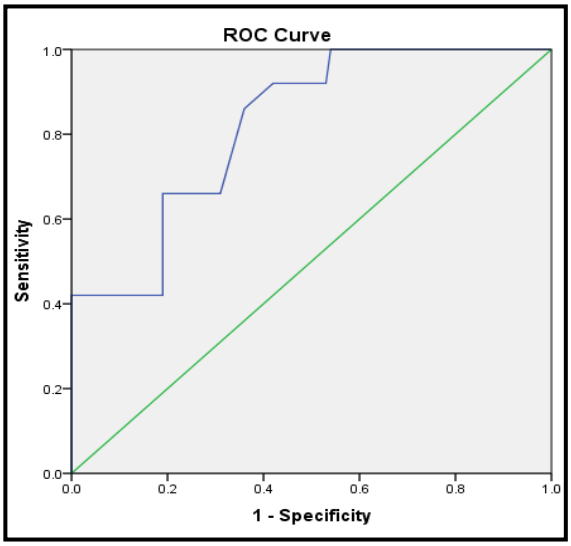

Figure [6]: Cut-off level of PI left of uterine artery for predicted pre-eclampsia

DISCUSSION

Pre-eclampsia is a syndrome unique to pregnancy that has an impact on many organ systems. The emergence of proteinuria continues to be a crucial and objective diagnostic criterion, despite the fact that it is more complicated than just gestational hypertension with proteinuria [14]. Young and nulliparous women are more susceptible to preeclampsia than older women, who are more likely to have persistent hypertension in addition to preeclampsia. Also, racial and cultural background, as well as social, environmental and even seasonal factors, all have a significant impact on the disorder's incidence. The prevalence is lower in multiparas and affects between 3% and 10% of nulliparous women [15].

The results of the current investigation demonstrated that cases groups had considerably higher uterine artery RI and PI in the right and left sides than did controls, as well as umbilical artery RI and PI in the right and left sides. The study by **Chyad *et al.*** [16] found that there was a statistically significant difference between the preeclampsia group and the control group based on the level of uterine artery RI and PI in the right and left sides as well as the mean of uterine artery right and left. Our findings are consistent with their findings. A significant difference between the normotensive and severe PIH groups was also found in the study by **El Makawy *et al.*** [17] with relation to uterine artery Doppler parameters. This is in accordance with **Borna *et al.*** [18] who found preeclampsia incidence and the results of uterine Doppler artery ultrasonography are tightly related. **Pedroso *et al.*** [19] results showing uterine artery Doppler alone is a poor predictor of PE development are in conflict with this.

Maternal mortality in the current research was 0%. To determine the overall morbidity and mortality of pre-eclampsia in the UK, **Douglas and Redman** [20] examined each case in 1994. With a 1.8% mortality rate, the authors detected 383 confirmed cases of pre-eclampsia. In comparison, patients with severe pre-eclampsia had a maternal death rate of 6.7%, according to **Akinola *et al.*** [21]. The availability of top-notch ICU care and doctors' experience in treating these individuals can be blamed for the reduced fatality rate seen in the current study.

In this study, the analyzed group's disparities in postpartum maternal outcomes including eclampsia, oliguria, renal failure, and HELLP and newborn complications such preterm delivery and IUGR were more significant. Preterm birth and IUGR occurred in 21% and 28% of the women in the study, respectively. In a similar vein, **de Melo *et al.*** [22] revealed no statistically significant difference in the rate of maternal problems during puerperium between the study groups of patients with normal and resistive uterine artery Doppler. In addition, no statistically significant difference was discovered when the frequency of each consequence was evaluated separately.

This is consistent with what **Garcia *et al.*** [23] observed when they used UA indicators to reduce maternal and neonatal problems. Neonatal mortality was 0.6%; IUGR was 2.8%; small-for-gestational-age births were 6.4%; stillbirths were 0.6%; and NICU days were 12.4. Another opinion was held by **Parry *et al.*** [24] who discovered that UA Doppler measurements were unlikely to pick up SGA newborns, mild to severe hypertension, or spontaneous preterm birth. The study by **Schwarze *et al.*** [25] examined 346 pregnant women, of which 17 [4.9%] had been given a pre-eclampsia diagnosis. Moreover, 7 [2.0%] of the women experienced maternal difficulties, 5 [1.4%] had placental abruptions, and 2 [0.6%] also lost a foetus intrauterinally [26]. On the other hand, **de Melo *et al.*** [22] indicated that 44.8% of the 154 puerperal patients with severe preeclampsia had maternal problems. No statistically significant difference was discovered between the study groups of women with normal or resistive uterine artery Doppler [41.9% versus 47.3%; $p = 0.51$] when the occurrence of any of the problems under assessment was examined.

It has been demonstrated in the past that the link between uterine artery resistance during the third trimester of pregnancy and postnatal difficulties results from extrapolating the disease's physiopathology. An increase in urine volume during diuresis is suggested as a sign of clinical improvement in some studies that explore the clinical manifestations of pre-eclampsia [27]. This is due to the resolution of vasospasms and improvement in renal perfusion. Because systemic vasospasms allow the bilateral early diastolic notching of the uterine artery to remain, problems may occur more frequently in women in whom Doppler velocimetry has revealed a problem with the maternal section [27].

In this study, RI right of uterine artery had a sensitivity of 79.80% and a specificity of 80% at a cutoff value of >0.695 for pre-eclampsia. At a cutoff value of >0.695, the RI left of the uterine

artery had a sensitivity of 79.80% but a specificity of 68%. Also, with a cutoff value of >1.15, the sensitivity of the PI right of the uterine artery was 71% and the specificity was 66%. At a cutoff value of >1.35, the PI left of the uterine artery had a sensitivity of 86% and a specificity of 64%. In the same line, the study by **Chyad *et al.*** [28] found that, the right uterine artery's "resistive index >0.7" has a diagnostic accuracy of 89.7% and a sensitivity of 77.8%, specificity of 95%. Right uterine artery "Pulsatility index >1.4" sensitivity of 44.4%, specificity of 95%. Left uterine artery "Resistive index >0.7" sensitivity of 33.3%, specificity of 91.3%. Moreover, sensitivity of 33.3% and specificity of 91.3% of right uterine artery "Pulsatility index >1.4", when RI index was utilized, revealed that RI index can be dependably used for preeclampsia screening and prediction.

When the PI index was utilized, the sensitivity and specificity were 60.0% and 87.0%, respectively. This noteworthy result confirmed that the PI index can be dependably used for preeclampsia prediction. This demonstrated the usefulness of uterine Doppler sonography in the third trimester for diagnosing difficult pregnancies [16]. Also, the research by **Parretti *et al.*** [28] showed that the final sensitivity and specificity results were 77.8% and 67.6%, respectively. The findings of our investigation are in line with those of **Nagar *et al.*** [29] found that RI > 0.69 had a sensitivity of 40% and a specificity of 94.77%.

This study has some limitation that should be mentioned: A small sample size, as opposed to other studies with a large scale of population [many] in multiple centers, will result in increased surveillance and delivery in a well-equipped setting in high risk detected patients, which is necessary to reduce the maternal and foetal complications, as well as a small number of patients with abnormal third-trimester uterine artery Doppler. Moreover, there was no patient follow-up until the puerperium was over.

Conclusion: Based on the findings of our study, we concluded that uterine artery Doppler during the third trimester of pregnancy is a quick, easy, and reliable procedure that can be used as a screening test for preeclampsia. Additionally, uterine artery Doppler is a noninvasive tool that can be used to indirectly assess trophoblast development and uteroplacental perfusion. Doppler ultrasound is helpful in diagnosing pre-eclampsia in pregnant women, and high-resistance uterine artery Doppler in the third trimester of pregnancy can predict unfavorable postpartum outcomes. The use of this technique makes early intervention feasible, improving prognosis, and lowering morbidity and mortality of pregnant women and their newborns.

Conflict of Interest and Financial Disclosure: None.

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