



PREDICTION OF ADVERSE PREGNANCY OUTCOMES USING UTERINE ARTERY DOPPLER IMAGING AT 20-24 WEEKS OF PREGNANCY

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ABSTRACT

Aim And Objective: To evaluate the second trimester (20-24 week) uterine artery Doppler in the prediction of the development of adverse pregnancy outcome such development of preeclampsia and FGR. **Material And Method:** The present study was prospective and observational study carried out in 100 patients (low risk population) in obstetrics unit of department of obstetrics and gynaecology in govt medical college and associated group of hospitals, Kota. Uterine artery doppler performed at 20-24 weeks of gestation in 100 pregnant women with singleton pregnancies. And data analysed by using statistical test. **Results:** In this prospective study was done on 20-24 week of gestation of 100 singleton pregnancy. The 20% was developed HDP in which 13% was developed preeclampsia. The majority of women which developed PE was in 19-23 age group. And 35% of patient delivered preterm and mean age group is (35.15) and FGR develop in 18%, APH in 2% cases and IUFD in 1% cases and oligohydramnios was present in 6%. our study 84% delivered vaginally and 16% had LSCS. **Conclusion:** uterine artery doppler parameters RI, PI, and S/D were significantly higher in cases that developed PE and FGR. The importance of uterine artery doppler as a screening tool lies in its NPV and specificity for adverse pregnancy outcome. So uterine artery doppler can be use as a screening tool in second trimester for diagnosis of adverse pregnancy outcomes.

KEYWORDS

Uterine artery doppler, FGR, IUFD, Pre-eclampsia, Parameters

INTRODUCTION

Defective trophoblastic invasion of the spiral arteries is associated with subsequent development of preeclampsia, fetal growth restriction (FGR), and other associated complications¹.

An increase in uterine artery impedance that predates the onset of clinical findings has been shown in preeclampsia, FGR, IUFD; These disorders are associated with placental insufficiency¹.

Uterine artery Doppler is an attractive screening test in mid pregnancy. In theory², the test is capable of identifying pregnancies that are at premature delivery from a range of clinical complications that are attributable to chronic placental disease, namely intrauterine growth retardation, abruption and preeclampsia².

Uterine artery blood reflects hemodynamic changes that occur on the maternal side of the placenta

Indices of Uterine Artery Waveform Analysis:

1. S/D Ratio or A/B Ratio: Peak systole divided by end diastole.
2. Pulsatility Index (PI): which is the most complex of the three. It is calculated by peak systole minus end-diastole divided by mean value of the area under the curve over one cardiac cycle (S-D/mean velocity).
3. Resistance index (RI) or Pourcelot Ratio: Peak systole minus end diastole divided by peak systole (S-D/S).

Impedance to blood flow in the uterine arteries may increase in pregnancies complicated by hypertension increased uterine resistance in hypertensive pregnant women should indicate that the fetus is significantly compromised abnormal uterine artery Doppler velocimetry in the second trimester is associated with a higher risk to develop preeclampsia at or before 34 weeks than after 34 weeks.^{3,4}

Pregnancies are complicating by hypertensive disorders of about 5-10% and along with haemorrhage, sepsis and fetal growth restriction constitute a tried contributing to maternal Morbidity and mortality⁵

In India, Incidence of hypertensive disorders in pregnancy is 5.38%, while preeclampsia and eclampsia accounted for 44% and 40% complications respectively⁶.

The impairment or complete absence of the physiological process is

associated with increased vascular resistance and increased impedance to blood flow and ultimately affect blood flow into the placenta^{7,8}

Doppler flow studies of the uterine artery therefore provides an accurate means of assessing uteroplacental resistance to blood flow and a good method of assessing impairment or absence of uteroplacental blood flow.

MATERIALS & METHODS-

The present study was prospective and observational study carried out in 100 patients (low risk population) who attended antenatal clinic in obstetrics unit of department of obstetrics and gynaecology in govt medical college and associated group of hospitals, Kota. Uterine artery doppler performed at 20-24 weeks of gestation in 100 pregnant women with singleton pregnancies.

Method Of Selection -

Inclusion criteria was Singleton pregnancy and second trimester pregnancy.

Exclusion criteria were Multiple pregnancy, Congenital fetal anomalies, Mother who are already hypertensive, If the patient could not followed till delivery for any reason, Cardiac disorder, Renal disorder and Antiphospholipid syndrome.

Patients were followed up till delivery and pregnancy outcome was assessed in term of fetomaternal outcome:

1. NORMAL OUTCOME
2. PREECLAMPSIA
3. FETAL GROWTH RESTRICTION
4. LOW BIRTH WEIGHT
5. SPONTANEOUS PRETERM DELIVERY
6. OLIGOHYDRAMNIOS
7. FETAL LOSS
8. PLACENTAL ABRUPTION

Table no : 1 Distribution according to age group

Age group	Frequency	Mean age (year)	S/D
19-23	53	21.9	0.92
24-28	40	24.87	1.11
29-33	7	30.85	1.57

Table 2 : Distribution of patients according to parity

PARITY	FREQUENCY	PERCENTAGE
NULLIPARA	84%	84%
PRIMIPARA	15%	15%
MULTIPARA	1%	1%

Table No: 3 Distribution Of The Variable Of The Study Population

VARIABLE		FREQUENCY	PERCENTAGE
PARITY	NULLIPARA	84	84%
	MULTIPARA	16	16%
ALBUMINURIA	PRESENT	15	15%
	ABSENT	85	85%
PRE-ECLAMPSIA	YES	13	13%
	NO	87	87%
FGR	YES	18	18%
	NO	82	82%
	YES	20	20%
HDP	NO	80	80%

Table no – 4 Adverse pregnancy outcome

Outcome	Frequency
HDP	20%
PE	13%
FGR	18%
APH	2%
IUFD	1%

Table no – 5 Neonatal outcome

Outcome	Frequency	Mean	SD	Std Error
PTVD	35	36.31 weeks	1.1	0.11
LBW	23	2.1Kg	0.33	0.033

Table 6 Distribution of patients according to uterine artery doppler indices

STUDY VARIABLE	NO. OF PATIENTS	MEAN	Std Error	Std deviation	MIN	MAX	95% PERCENTILE
UT RT S/D	100	2.01	0.098	0.98	1.23	6.8	4.5
UT LT S/D	100	1.84	0.07	0.7	1.03	5.34	3.3
UT RT PI	100	0.95	0.032	0.32	0.53	1.92	1.83
UT LT PI	100	1	0.034	0.34	0.53	1.95	1.88
UT RT RI	100	0.41	0.013	0.13	0.18	0.8	0.66
UT LT RI	100	0.38	0.013	0.13	0.1	0.85	0.65

Table 7 Mode Of Delivery

TYPE OF DELIVERY	NO.OF SUBJECTS	PERCENTAGE
NVD	84	84%
LSCS	16	16%

Table 8: Distribution Of Validity Parameter Of Doppler Test For Preeclampsia

Parameter	Sensitivity	Specificity
UT RT S/D	88.88%	95.60%
UT LT S/D	77.77%	96.70%
UT RT PI	77.77%	96.70%
UT LT PI	66.66%	96.70%
UT RT RI	88.88%	91.20%
UT LT RI	88.88%	97.80%
Notch	33.33%	97.80%

Table 9 – Distribution of validity parameters of doppler test for FGR

Parameter	Sensitivity	Specificity
Ut Rt S/D	90%	96.60%
Ut Lt S/D	70%	96.66%
Ut Rt PI	60%	95.50%
Ut Lt PI	60%	96.66%
Ut Rt RI	70%	90%
Ut Lt RI	80%	97.70%
Notch	30%	97.70%

Table No 10 - Distribution Of Validity Parameters Of Doppler Test For Pe.

PARAMETER	UTERINE ARTERY						UTERINE ARTERY NOTCHING
	S/D		RI		PI		
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	
SENSITIVITY(%)	88.88	77.77	88.88	88.88	77.77	66.6	33.33
SPECIFICITY(%)	95.6	96.7	91.2	97.8	96.7	96.7	97.8
PPV(%)	66.6	70	50	80	70	66.66	60
NPV(%)	98.8	97.7	98.8	98.8	97.7	96.71	93.68
% of false +ve	11.12	22.23	11.12	11.12	22.23	33.4	66.67
% of false -ve	4.4	3.3	8.8	2.2	3.3	3.3	2.2

Table 11 - Distribution Of Validity Parameter Of Doppler Test For Fgr.

PARAMETER	UTERINE ARTERY						UTERINE ARTERY NOTCHING
	S/D		RI		PI		
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	
SENSITIVITY (%)	90	70	70	80	60	60	30
SPECIFICITY (%)	96.6	96.66	90	97.7	95.5	96.66	97.7
PPV(%)	75	70	43.75	80	60	66.66	60
NPV(%)	98.8	96.66	96.42	97.77	95.5	95.6	92.63
% of false +ve	10	30	30	20	40	40	70
% of false -ve	3.4	3.4	10	2.3	4.5	3.34	2.3

Case Study

Table no 1 shows that in our study for age group 19-23 mean age is 21.90 and frequency is 53%. In age group of 24-28 the mean age is 24.87 and frequency is 40%. And in the age group of 29-33 mean age is 30.85 and frequency is 7%.

Table no 2 shows that in our study max patients were nulliparous (84%) and multipara was 16%. 88.88% patients who developed preeclampsia were primigravida.

Table no 3 shows that albuminuria present in 15% of cases. In a study by Jim et al 2014 shows that pre-eclampsia is associated with albuminuria.

Table no 4 shows that Preeclampsia developed in 13% cases, FGR developed in 18% cases.

GHTN in 20% cases. APH in 2% cases and IUFD in 1% cases and oligohydramnios was present in 6%.

Table no 5 shows that in our study preterm delivery frequency was 35% mean age group (35.15) and LBW frequency is 23%. Which is similar to results obtained by Bilano et al 58(2014). The study conducted a secondary analysis of the WHO Global survey on maternal and perinatal health. data from 24 low- and middle-income countries showed that the rates of preterm birth in PE patients were 12.28 – 76.09% while the rates of LBW were ranged from 13.65 to 39.71%.

Table no 6 shows that Mean S/D ratio in right and left uterine artery was 2.01 and 1.84 respectively, with a range of 1.23-6.8 and 1.03 -5.34 respectively.

The mean PI in right and left uterine artery was 0.95 and 1.00 respectively with a range of 0.53-1.92 and 0.53 -1.95 respectively.

The mean RI in right and left uterine artery was 0.41 and 0.38 respectively with a range of 0.18-0.80 and 0.1 -0.85 respectively

Table no 7 shows that in our study 84% delivered virginally and 16% had LSCS. Dr Nabnitapatnayak⁶³ studied delivery outcome among 57 non pre-eclamptic and pre-eclamptic woman and caesarean section in 21(30.3%) in no PE group, 16(21.5%) in mild PE group and 31(25.4%) in severe PE group and term delivery in 28(60.4%) in non PE ,

6(14.7%) in mild PE 1(21.9%) in severe PE.

Table no 8 and 10 shows Sensitivity for right and left uterine artery S/D ratio is 88.88% and 77.77% and specificity is 95.6% and 96.7% respectively. PPV is 66.6% for right Ut artery and 70% for left Ut artery and NPV is 98.8% and 97.7% for right and left Ut artery respectively.

For RI sensitivity for right and left uterine artery is 88.88% for both and specificity is 91.2% and 97.8% respectively. PPV is 50% for right Ut artery and 80% for left Ut artery and NPV is 98.8% and 98.8% for right and left Ut artery respectively.

For PI sensitivity for right and left uterine artery is 77.77% and 66.6% and specificity is 96.7% for both. PPV is 70% for right Ut artery and 66.66% for left Ut artery and NPV is 97.7% and 96.7% for right and left Ut artery respectively.

Percentage of false positive for S/D, PI, RI are 11.12%(right), 22.23%(left), 11.12% (right and left), 22.23%(right and left) respectively.

For uterine notching sensitivity is 33.33% and specificity is 97.8%. Table no 9 and 11 shows Sensitivity for right and left uterine artery S/D ratio is 90% and 70% and specificity is 96.6% and 96.66% respectively. PPV is 75% for right Ut artery and 70% for left Ut artery and NPV is 98.8% and 96.66% for right and left Ut artery respectively.

For RI sensitivity for right and left uterine artery is 70% and 80% respectively and specificity is 90% and 97.7% respectively. PPV is 43.75% for right Ut artery and 80% for left Ut artery and NPV is 96.42% and 97.77% for right and left Ut artery respectively.

For PI sensitivity for right and left uterine artery is 60% and 60% and specificity is 95.5% and 96.66% respectively. PPV is 60% for right Ut artery and 66.66% for left Ut artery and NPV is 95.5% and 95.6% for right and left Ut artery respectively.

Percentage of false positive for S/D, PI, RI are 10%(right), 30%(left), 30%(right), 20%(left), 40%(right and left) respectively.

For uterine notching sensitivity is 30% and specificity is 97.7%. Comparison of present study with previous studies on uterine artery doppler for preeclampsia:

Author	Outcome measure	Indicator	Sensitivity	specificity	PPV	NPV
Bewley et al9., 1991	Pre-eclampsia	RI >95TH CENTILE	24%	95%	20%	96%
Bower et al10., 1993	Pre-eclampsia	RI>95 th centile +/- notch	7.50%	86%	12%	99%
North et al11., 1994	Pre-eclampsia	RI>90th Centile	27%	89%	8%	97%
Chan et al., 1995	Pre-eclampsia	RI>95th Centile	22%	97%	36%	94%
Irion et., al12 1998	Pre-eclampsia	SD>90 th centile +notch	26%	88%	7%	
Kurdi et al13., 1988	Pre-eclampsia	RI>95th > Centile	62%	89%	11%	99%
Present Study	Pre-eclampsia	RI>95TH centile	88.88%	91.20%	50%	98.80 %

Comparison of present study with previous studies on uterine artery doppler for IUGR:

Author	Outcome measure	Indicator	Sensitivity	specificity	PPV	NPV
Bewley et al9., 1991	IUGR<10th centile	RI>95 th Centile	15%	96%	35%	88%
Bower et al10., 1993	IUGR<10th centile	RI>95 th Centile	37.50 %	86.60 %	25.50 %	91.80 %
North et al11., 1994	IUGR<10th centile	RI>95th Centile	47%	91%	27%	96%
Irion et al12 1998	IUGR<10th centile	RI>90 th Centile	29%	89%	25%	-

Irion et al12 1998	IUGR<10th centile	notch	30%	88%	24%	-
Wu et al14 (2021)	IUGR<10th centile	Rt RI	63.20 %	91.30 %		
		Lt RI	71.90 %	84.20 %		
		Rt PI	66.70 %	87.30 %		
		Lt PI	73.70 %	84.20 %		
Present study	IUGR<10th centile	RI>95 th Centile	70%	90%	43.75 %	96.42 %

CONCLUSIONS

The validity of doppler as predictor was tested using sensitivity, specificity, positive and negative predictive values and percentages of false positive and false negative for the outcome measures.

The RI, PI, and S/D were significantly higher in cases that developed PE and FGR.

The importance of uterine artery doppler as a screening tool lies in its NPV and specificity for adverse pregnancy outcome.

Pre-eclampsia is significantly associated with IUGR in the risk population

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