Original Article

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Study on Uterine Artery Doppler: Screening Tests in Hypertesive Disorders Of Pregnancy

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ABSTRACT

Objectives: To Study and analyse uterine artery Doppler Resistance index as predictor of Hypertensive disorders in pregnancy at 18 to 22 weeks

Materials and Methods: A Longitudinal Prospective observational Study was done on 274 antenatal mothers attending the outpatient department of Obstetrics & Gynaecology, Rangaraya Medical College, Kakinada from January 2015 to October 2016 in 18 -35 yrs.Uterine artery Doppler resistance index (0.58 taken as cut-off) was recorded at 18 -22weeks of gestation. Appropriate statistical tests were performed using SPSS software version 17. Sensitivity, specificity, positive and negative predictive value of the tests was calculated were followed up till term for development of pre-eclampsia

Results: The incidence of hypertensive disorders detected in positive Doppler screening was16.2% (n= 44) where as 83.8 % (n = 230) of the study subjects were not hypertensive. Majority of the cases (67%) were found to have Mild preeclampsia (n =29) followed by severe preeclampsia in 17 % of cases (n = 7) and 8% of cases developed eclampsia and also 8% developed gestational hypertension (n = 4). 217 (79.2%) of the study participants were found to be having RI ≤ 0.58. Uterine artery Resistance Index as a predictor of hypertension has a sensitivity of 88.64% specificity of 92.17% positive predictive value of 68.42%, negative predictive value of 97.7% and diagnostic accuracy was 91.6%, this association is also found to be significant [p = 0.000 (< 0.05)].

Conclusion: The present study concluded uterine artery resistance index as a better test in prediction of hypertension in pregnancy to prevent or reduce maternal as well as perinatal morbidity and mortality.

Keywords: *Pregnancy Induced Hypertension; Blood Pressure; Preeclampsia; Uterine Doppler*

Introduction

Hypertension in pregnancy remains an important cause of maternal and foetal morbidity and mortality[1],with increased risk of adverse foetal, neonatal and maternal outcomes, including preterm birth, intrauterine growth restriction (IUGR), perinatal death, acute renal ,hepatic failure, antepartum haemorrhage, postpartum haemorrhage and maternal death[2].

Worldwide about 76,000 pregnant women die each year from preeclampsia and related hypertensive disorders. And, the number of babies who die from these disorders is thought to be on the order of 500,000 per annum[3].

India is estimated to account for over one third of all maternal deaths worldwide in 2015, with an approximate 58 000 maternal deaths (19%) and 45 000 maternal deaths (15%), respectively[4].

Preeclampsia is diagnosed when SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg on two occasions at least 6 hours apart, associated with proteinuria greater than 300mg per 24 hours or greater than 1 gm/lit in a random sample or protein (mg/dL) / Creatinine ratio (mg/dL) ≥ 0.3, dipstick reading of 1+ after 20 weeks of gestation[7]. (ACOG 2013)

Early screening for preeclampsia may allow vigilant antenatal surveillance and appropriate timing of foetal delivery in order to avoid serious sequelae. Various haemodynamic and biochemical measures have been found to have limited accuracy as a screening measures for this condition[5,6].

Preeclampsia is characterised by an imbalance between prostacycline and thrombaxane A2 production[7], as well as failure of the second wave trophoblastic invasion of the endometrio-myometrial vasculature. The result is abnormal uteroplacental blood flow and this lead an idea of using Doppler assessment of uterine artery velocimetry waveforms as the method of screening for this antenatal complication[8].

Doppler is a non-invasive method for evaluation of feto-placental circulation without any disturbance to human pregnancy[9]. A high Resistance Index, Pulsatility Index and persistent uterine artery notching in uterine artery Doppler wave form has shown as the best screening test[10].

Severe Notching with an Abnormal Resistance Index: When the Resistance Index is abnormal (low-diastolic

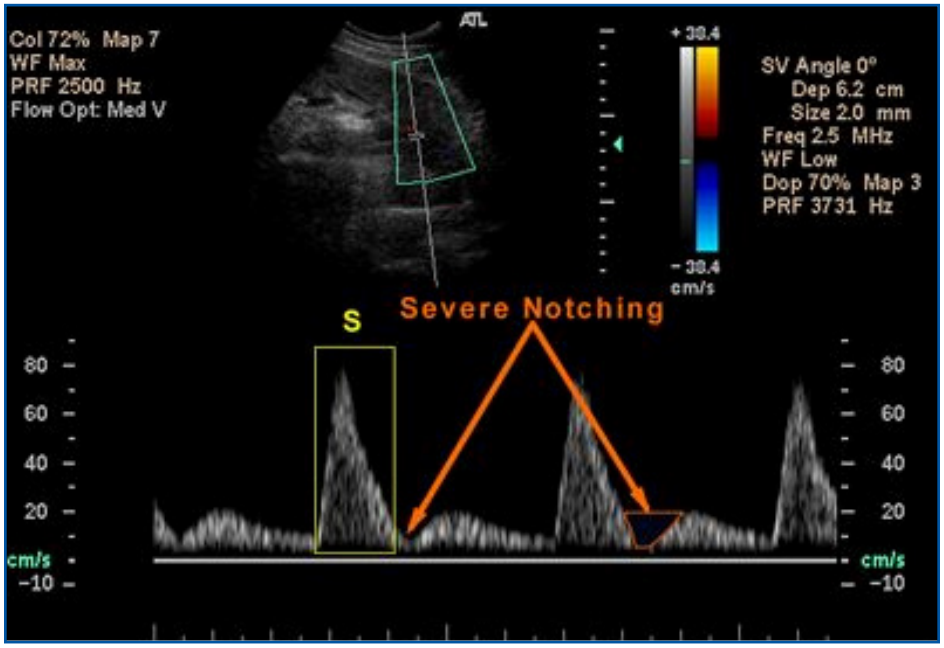

Fig. 1

flow) and a notch is present, this places the patient at the highest risk for adverse pregnancy outcome[11].

Uterine artery doppler was considered abnormal between 18 and 23 weeks of gestation if

- Resistance index > 95th centile.
- Early diastolic notch in either of the two uterine arteries.
- When the mean PI of both uterine arteries was > (1.45-.58).

Doppler is a non-invasive method for evaluation of feto-placental circulation without any disturbance to human pregnancy. A high Resistance Index, Pulsatility Index and persistent uterine artery notching in uterine artery Doppler wave form has shown as the best screening test..

Materials and Methods

A Longitudinal Prospective observational Study was done on 274 antenatal mothers attending the outpatient department of Obstetrics & Gynaecology, Rangaraya Medical College, Kakinada from January 2015 to October 2016 on 18 -35 yrs with singleton pregnancy who met inclusion criteria and non hypertensive.Uterine artery Doppler resistance index (0.58 taken as cut-off) was recorded at 18 -22weeks of gestation. The subjects were followed up till term for development of pre-eclampsia

All women who meet the inclusion and exclusion criteria were taken into the study after signing an informed written consent. Detailed history was taken and thorough general physical examination was done and a Trans-abdominal Doppler ultrasonography for the measurement of Resistance Index at 18 to 22 weeks of gestation.

The results were documented. Subsequently they were followed up at 2 weekly intervals until term . At each visit blood pressure were recorded. The primary outcome is the development of pre-eclampsia or gestational hypertension.

Statistical Analysis: Appropriate statistical tests were performed using SPSS software version 17. Sensitivity, specificity, positive and negative predictive value of the tests was calculated.

Result

The incidence of hypertensive disorders was 16.2 % (n = 44) where as 83.8 % (n = 230) of the study subjects were not hypertensive(**Fig 2)**

Distribution of Cases in to Various Groups

Table1: Distribution of Cases in to various categories.

Categories of HTN Disorders	No of cases	Percentage
Gestational hypertension	4	8%
Mild Pre Eclampsia	29	67%
Severe Pre Eclampsia	7	17%
Eclampsia	4	8%
HELLP Syndrome	0	0%
Total	**44**	**100%**

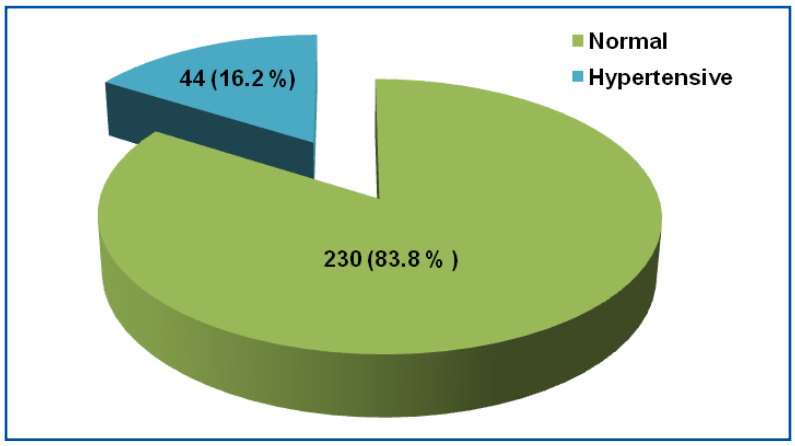

Fig. 2

Majority of the cases (67%) were found to have Mild preeclampsia (n =29) followed by severe preeclampsia in 17 % of cases (n = 7) and 8% of cases developed eclampsia and also 8% developed gestational hypertension (n = 4). No cases were diagnosed with HELLP syndrome(Table 1).

Age Distribution: The incidence of hypertension in pregnancy was found to be more among 21 – 25 years of age group (50%) and normotensive subjects were more among 18 – 20 years. There was a statistically significant difference in the incidence of hypertension ($p<0.05$) (table 4) which was more among younger women compared to elderly.

Parity: When compared with parity between normotensive & hypertensive patients, majority of them were primigravida in both the groups (67.7% & 75%) but there is no significant difference statistically between the two groups ($p > 0.05$)

Body Mass Index: Majority of the study subjects were within the normal BMI range ,most of the hypertensive patients were also found to be having normal BMI (66.7%) table 2, however when mean BMI of the two groups when compared has shown that hypertensive subjects had higher mean BMI and the difference was found to be statistically highly significant ($p < 0.01$) (student t test). The mean BMI has a highly significant difference between the two groups .

Socioeconomic Status: Majority of patients belong to lower middle class in both the normotensive & hypertensive group patients (38.6% & 48.3%). There is no significant difference between the two groups ($p> 0.05$) based on socioeconomic scale.

Onset of Hypertension: Onset of hypertension was higher among 28 – 34 weeks of gestation**.** No cases of hypertension were seen among women with 20 -24 weeks of gestation in this study.

Uterine Artery Resistance Index: Out of 274 women, 57 cases were positive for Uterine Artery Resistance Index (21%) 239 women were negative (87.1%)**.**The resistance index (RI) was positive (> 0.58) among 57 (20.8%) as shown in table no.2, and 217 (79.2%) of the study participants were found to be having RI ≤ 0.58.

This table**3** shows a highly significant difference ($p < 0.01$) in the incidence of hypertension among women, who were tested for Resistance Index. Similarly sensitivity; specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy were also calculated.

As shown in the table 4 Resistance Index has a sensitivity of 88.64% (true positives) higher and lower specificity of 92.17% (true negatives).

Discussion

The incidence of hypertension in pregnancy was found to be 16.2 % (n = 44) according to this study, which closely

Table2: Comparison of Resistance Index at 18 – 20 weeks.

Resistance Index	Developed HTN	%	Not developed HTN	%	No of cases	%
≤ 0.58	5	2.3	212	97.7	217	100
> 0.58	39	68.4	18	31.6	57	100
Total	**44**	**16.1**	**230**	**83.9**	**274**	**100**

Resistance index compared with normal and hypertensive women $\chi 2$ value – 75.615 p value – 0.000 Efficacy of Resistance Index:

Table3: Cross tabulation of RI with hypertension

Resistance Index	Hypertension		Total
	Yes	No	
Positive	a = 39 (TP)	b = 18 (FP)	57 (a + b)
Negative	c = 5 (FN)	d = 212 (TN)	217 (c + d)
Total	**44 (a + c)**	**230 (b + d)**	**274**

χ2 value – 146.396 p value – 0.000

Table4: Evaluation of Resistance Index.

Factor	%
Sensitivity { a/(a+c)*100}	88.64 %
Specificity { d/(b+d)*100}	92.17 %
PPV { a/(a+b)*100}	68.42%
NPV { d/(c+d)*100}	97.7%
Diagnostic accuracy {(a+d)/(a+b+c+d)*100}	91.6%

correlates with different studies done elsewhere. Uterine artery Resistance Index as a predictor of hypertension has a sensitivity of 88.64% specificity of 92.17% positive predictive value of 68.42%, negative predictive value of 97.7% and diagnostic accuracy was 91.6%, this association is also found to be significant [p = 0.000 (< 0.05)] in our study.

The present study concluded uterine artery resistance index as a better test in prediction of hypertension in pregnancy According to national eclampsia registry the incidence of hypertensive disorders in India is found to be 10.8%. (FOGSI Jan – feb 2014)[12] In a study done by Salako et al[13] the incidence of hypertension was 15.1%, However the overall prevalence of hypertensive disorders in pregnancy was 7.8% in a study done by Manjusha Sajith et al.On further distribution of cases into various categories, Mild preeclampsia was found to be the leading presentation occurring among 67% (n = 29) of the cases followed by severe preeclampsia in 17% (n = 7) and Eclampsia in 8% (n = 4) of the cases. 8% developed gestational hypertension (n = 4) and no cases were diagnosed with HELLP syndrome. In a study done by Manjusha Sajith et al[14]Similar findings were noted with Preeclampsia as the most common cause of hypertension during pregnancy (71.2%).Out of 44 cases who developed hypertension in this study, the time of onset of hypertension was most frequently found among 28 – 34 weeks of gestation, i.e. 66.7% (n = 29) followed by 25% (n = 11) during 24 – 28 weeks and remaining 8.3% (n = 11) developed hypertension more than 34 weeks of gestation.

The resistance index (RI) was positive (> 0.58) among 57 cases (20.8%)(table no.2), out of which 44 cases (77.2%) developed hypertension and the remaining 13 cases (22.8%) were normotensive. There is a highly significant difference (p < 0.01) in the incidence of hypertension among women, who were tested positive for uterine artery Resistance Index. North RA et al in their study on uterine artery Doppler flow velocity wave forms in the 2nd trimester for the prediction of preeclampsia and fetal growth retardation identified 51% of women with abnormal uterine artery resistance index associated with increased risk of preeclampsia and FGR[15]. In a large prospective study done by Katie M Groom et al, the rate of adverse pregnancy outcome and preeclampsia was higher among the group with abnormal resistance index, Which differed among groups 1 (85 [4.6%]), 2 (9 [7.6%], 3 (7 [5.5%]), and 4 (15 [18.3%]) with group 4 having the highest[16].

Uterine artery Resistance Index as a predictor of hypertension has a sensitivity of 88.64% specificity of 92.17% positive predictive value of 68.42%, negative predictive value of 97.7% and diagnostic accuracy was 91.6%. Bhattacharyya S. K. et al in their study on the role of uterine artery doppler flow velocimetry in predication of preeclampsia observed a sensitivity of 73.3% and specificity of 86.48% in high risk group[17]. Coleman et al observed a sensitivity of 91%, specificity of 42%, positive predictive value of 37% and negative predictive value of 92%[18]. Padmalatha V.V et al[19] observed 60% sensitivity,92% specificity,16% positive predictive value, 99% negative predictive value.

Study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Present study	88.64	92.17	68.42	97.7
Bhattacharyya S. K. et al[17]	73.33	86.48	68.74	88.88
Coleman et al[18]	91	42	37	92
Padmalatha vv et al[19]	60	92	16	99

The study showed a relatively higher specificity for Uterine artery resistance index with 92.17 % respectively sensitivity of 83.64 % for Uterine artery resistance index. CA Meads et al[20] (2008) conducted systematic reviews of accuracy and effectiveness in methods of prediction and prevention of preeclampsia, for the 27 tests they reviewed some tests appeared to have high specificity, but at the expense of compromised sensitivity, the only Doppler test with a sensitivity of over 60% was resistance index. Kanwal Gujral et al[21] (2016) in their review on prediction of preeclampsia concluded that Doppler is the primary screening modality for prediction of PE and individually, no biomarker has shown to have sufficient clinical value in prediction of PE. Various studies showed different diagnostic indices with a sensitivity of 63% (RI>0.58) Steele (1990), 27% (RI > 90th percentile) North (1994) as reported in the study. The authors recommended a combination of uterine artery Doppler and maternal characteristics which offer a best predictive power. Bower *et al*. examined the uterine arteries in 2058 pregnancies at 18–22 weeks. An abnormal result, defined by a resistance index above the 95th centile or the presence of an early diastolic notch in either of the two uterine arteries, was found in 16% of the pregnancies. The sensitivity of the test was 75% for preeclampsia and 46% for intrauterine growth restriction, and the specificity was 86% for both. This study highlighted the fact that abnormal Doppler results provide a better prediction of the more severe types of pregnancy complications[22]

Conclusion

Uterine artery Resistance Index as a predictor of hypertension has a sensitivity of 88.64% specificity of 92.17% positive predictive value of 68.42%, negative predictive value of 97.7% and diagnostic accuracy was 91.6%, this association is also found to be significant [p = 0.000 (< 0.05)].The present study concluded uterine artery resistance index as a better test in prediction of hypertension in pregnancy to prevent or reduce maternal as well as perinatal morbidity and mortality.

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