To Assess Uterine Artery Doppler Findings at 18-22 Weeks in Predicting Adverse Pregnancy Outcome

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Abstract:
Introduction: *Preeclampsia and intrauterine growth restriction are important causes of perinatal and maternal morbidity and mortality. Although much research into the etiology and mechanism of pre-eclampsia has taken place, its exact pathogenesis remains uncertain.*
Objective: *To assess uterine artery Doppler findings at 18-22 weeks in predicting adverse pregnancy outcome.*
Methods: *Special designed performa was used to collect data. The data were expressed in mean, SD, number and percentage.*
Results: *The Present study has been evaluated in 140 patients. Mean age of the women under study is 26.6 years. Mean gestational age at time of scan is 19.5 weeks ,with minimum age at 18 and maximum at 22 weeks .Most of women in the study has S/D ratio of 2-2.2 and RI of 0.35-0.4. Majority of the women delivered vaginally that is approximately (103)73%.In the study total 28 women had abnormal doppler , out of which S/D ratio was elevated in 14 women, RI was elevated in 12 women & diastolic notch was present in 12 women. Out of 28 women 8 developed preeclampsia with sensitivity of 62% for S/D ratio, 50% for RI and for end diastolic notch 62.5%.Out of 140 women 12 developed FGR that is birth weight less than 10 th perpercentile for that gestational age as predicted by the abnormal uterine artery doppler with sensitivity of 41.7% for S/D ratio, 25% for RI & 33.3 % for end diastolic notch. Out of 23 total preterm deliveries 14 women delivered before term had elevated or abnormal doppler studies. Out of 33 babies requiring NICU admission, in 18 babies, their mother had abnormal doppler indices. One neonatal death noted in a woman who developed preeclampsia at 28 weeks delivered preterm with very low birth weight 925 grams died on 2nd postnatal day.*
Conclusion *Second trimester uterine artery S/D ratio, end diastolic notch & ResistanceIndex can be used as a predictor for pre-eclampsia and Intra uterine growth restrictions. Diastolic notch and S/D ratio are better predictors than other Doppler indices.*
Kewwords: *Uterine artery doppelr, Pre-eclampsia, Diastolic notch, FGR,*

I. Introduction

Preeclampsia and intrauterine growth restriction are important causes of perinatal and maternal morbidity and mortality[1]. Prevalence of preeclampsia is approximately 15%[2]. In developed countries 16% maternal deaths are from hypertensive disorders[3]. It was estimated that approximately 10% of infants are growth restricted[4]. Fetal growth restriction is associated with substantiate perinatal morbidity and mortality.

Fetal demise, birth asphyxia, meconium aspiration and neonatal hypoglycemia and hypothermia are all increased, and also the prevalence of abnormal neurological development is increased [5, 6]. This is true for both term and preterm infants [7, 8]. Early screening for Preeclampsia may allow vigilant antenatal surveillance and appropriate timing of fetal delivery in order to avoid serious maternal & fetal complications. Various haemodynamic and biochemical measures have been found to have limited accuracy as screening measures for this condition[8, 9].

Although much research into the etiology and mechanism of pre-eclampsia has taken place, its exact pathogenesis remains uncertain. Some studies support notions of inadequate blood supply to the placenta making it release particular hormones or chemical agents that predisposes mother to a condition which leads to damage of the endothelium (lining of blood vessels), alterations in metabolism, inflammation and other possible reactions[10.] Preeclampsia is characterized by an imbalance between prostacycline and thromboxane production, as well as failure of the second wave trophoblastic invasion of the endometrio-myometrial vasculature. The result is abnormal uteroplacental blood flow [10].

But there is no sufficient data or previous studies available. Hence, further studies are needed to study the clinical utility of uterine artery Doppler velocimetry in predicting PIH and FGR.

Objective: Assessment of uterine artery Doppler findings at 18-22 weeks in predicting adverse pregnancy outcome.

II. Material & Methods

Necessary approval from the Institutional Ethics Committee was obtained before initiating the study.

Study site
The study was carried out in the Department of Obstetrics and Gynecology of Academy of Medical Sciences, Pariyaram Medical College & Hospital, Kerala, India From 15th November 2011 to 15th April 2013.

Study design : Prospective Observational study

Sample size: 140 pregnant women
Inclusion & exclusion criteria
Inclusion criteria: All pregnant women coming to Obstetrics & Gynecology OPD at 18-22weeks with live singleton pregnancy.
Women who give consent to enroll into the study. Women between 19-35 years of age.

Exclusion Criteria:
* Women with multiple gestation,
* Women with congenital anomalies,
* Women with chronic hypertension, kidney diseases, Diabetes with vascular complications, connective tissue disorder.
* Women who are not willing to enroll into the study.

Study Procedure: After getting informed consent, the women's details as regard to age, parity, registration no., education, socio-economic status were recorded. Pregnancy dating was done from the last menstrual period and confirmed by ultrasonography. General examination findings and Blood pressure recorded in sitting position right upper arm were noted.

After getting the ethical clearance from the ethical committee of the institution and the informed written consent, women were subjected to Doppler ultrasound examination using real time pulsed wave colour flow Doppler along with anomaly scan by the sonologist of the hospital , for all the subjects between 18 -22 weeks.Data collected by color Doppler machine with convex probe 3.5 MHz. Fetal biometry and morphology scan was done with ultrasonography and then Doppler mode was switched on. Patient is put in recumbent position with transducer in the longitudinal plane. The external iliac artery is visualized at pelvic side wall with color Doppler. The transducer is then angled medially towards the uterine artery, where they cross the external iliac artery. The flow velocity waveforms on the right and left uterine arteries were taken, when 3 or 4 waves of equal height were seen, the image was frozen and measurements were taken either by trace method/ manually/automatic trace . Then Doppler indices were obtained directly from the machine.

Parameters studied are S/D ratio and RI in uterine artery. Early diastolic notch in uterine artery was watched for. The flow velocity waveforms were considered abnormal if there was an early diastolic notch in uterine artery in either right or left uterine arteries , S/D ratio more than 2.6(124) , RI more than 0.57 (125) as per the reference range for that population.

The abnormal pregnancy outcomes considered are preeclampsia, PIH & IUGR. Prenatal outcomes are considered are IUD, birth weight, Apgar at 1 min, Apgar at 5 min NICU admission, stay in NICU, neonatal death.

Statistical Analysis
Resistance index n S/D RATIO formulae.

S/D RATIO: maximum systolic flow / end diastolic flow.

Resistance index: S-D/S
These data collected from the study was analyzed using Sensitivities,
Specificity using following formula.

$$\text{Sensitivity}: \frac{\text{True positive}}{(\text{True positive} + \text{False negative})} \times 100$$

$$\text{Specificity}: \frac{\text{True negative}}{(\text{True negative} + \text{False positive})} \times 100$$

Positive predictive value
$$\frac{\text{True positive}}{(\text{False positive} + \text{True positive})} \times 100$$

Negative predictive value
$$\frac{\text{True negative}}{(\text{True negative} + \text{False negative})} \times 100$$

Likelihood ratio positive:
$$\frac{\text{sensitivity}}{1\text{-specificity}}$$

Likelihood ratio negative:
$$\frac{1 - \text{sensitivity}}{\text{Specificity}}$$

Diagnostic odds ratio :
$$\frac{\text{sensitivity} * \text{specificity}}{(1 - \text{sensitivity}) * (1\text{-specificity})}$$

III. Results
Table No.1: Agewise distribution in the study

SN	Age (yrs)	No. of females
1	≤ 20	6
2	21-25	56
3	26-30	49
4	>30	29
	Total	140

Most of the women studied were in the age group between 21-30 years.

Table no. 2: Descriptive Statistics for age and gestational age at the time of scan

Study variable	No. of Subjects	Minimum	Maximum	Mean	Std. Deviation	Std. Error
Age (yrs)	140	19	35	26.64	3.97	0.34
Gestational age at the time of scan (Week)	140	18	22	19.57	1.20	0.10

Mean age of the women under study is 26.6 years. Mean gestational age at time of scan is 19.5 weeks ,with minimum age at 18 and   maximum at 22 weeks .

Table no. 3: Descriptive Statistics for the uterine artery doppler indices

Study variable	No. of subjects	Minimum	Maximum	Mean	Std. Deviation	Std. Error
Systolic / Diastolic ratio (Left)	140	1.1	6.9	2.07	0.91	0.08
Systolic / Diastolic ratio (Right)	140	1.18	7.65	2.18	1.12	0.09
Resistance Index Ratio (left)	140	0.11	0.83	0.35	0.14	0.01
Resistance Index ratio (Right)	140	0.12	0.78	0.35	0.14	0.01

Most of women in the study has S/D ratio of 2-2.2 and RI of 0.35-0.4
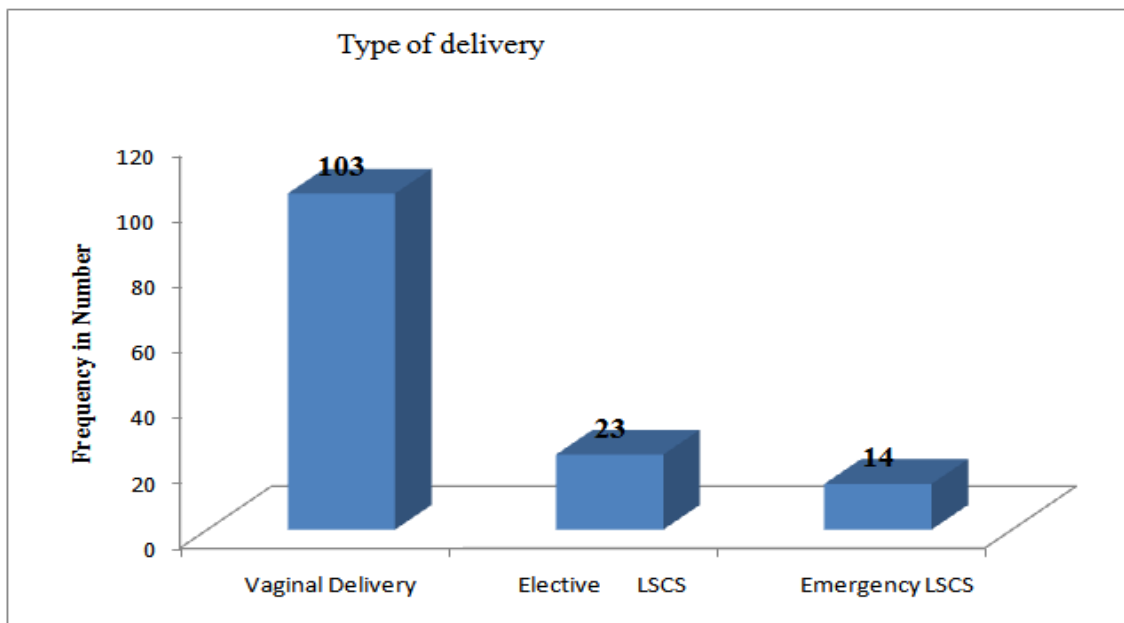
Fig 1 Shows: Type of Delivary

Majority of the women delivered vaginally that is approximately (103)73%

Table No 4 : Uterine artery Doppler in predicting pre-eclampsia

Doppler Test	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Likelihood Ratio Positive	Likelihood Ratio Negative	Diagnostic Odds Ratio
S/D	62.50%	93.20%	35.7%	97.60%	9.2	0.4	22.8
RI	50%	93.9%	33.30%	96.90%	8.30	0.50	15.5
Notch	62.50%	94.70%	41.70%	97.7%	11.8	0.4	29.8

S/D ratio and diastolic notch having better sensitivity, good specificity & good negative predictive value.

Table No 5: Uterine artery Doppler in predicting Gestational hypertension

Doppler Test	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Likelihood Ratio Positive	Likelihood Ratio Negative	Diagnostic Odds Ratio
S/D	20.0%	90.8%	14.3%	93.7%	2.2	0.9	2.5
RI	10.0%	91.5%	8.3%	93.0%	1.2	1.0	1.2
Notch	30.0%	93.10%	25%	94.5%	4.3	0.8	5.8

Negative predictive value for gestational hypertension is high.

Table 6:Uterine artery Doppler in predicting FGR

Doppler Test	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Likelihood Ratio Positive	Likelihood Ratio Negative	Diagnostic Odds Ratio
S/D	41.70%	93.00%	35.7%	94.40%	5.9	0.60	9.4
RI	25.00%	93.0%	25%	93.00%	3.6	0.80	4.4
Notch	33.33%	93.8%	33.33%	94.53%	5.3	0.70	13.06

IV. Discussion

The Present study carried out in a tertiary care centre , the study included 150 pregnant women who were visiting the tertiary care center for regular ANC check up . Out of these 10 cases were failed to follow up because of not willing to participate in study. Hence, total 140 pregnant women were studied. The period of 18-22 weeks was chosen. Most of the women were between age group of 21-30 years with mean age of 26.6 years. In our study most of the women had S/D ratio 2.07 (mean) & RI of 0.35 (mean) which is considered as normal for that population.

The prevalence of preeclampsia was found to be 5.7% which was almost similar to that quoted by Bewley et al, 1991 (4.6%) [11], & Irion et al 1998 (4 %)[12]. Prevalence of FGR was 8.6% which is similar to Valensise [13] et al, 1993 7%, North [14] et al 1994 6.6%, When birth weight less than 10th percentile was taken as cut off.

In the study total 28 women had abnormal doppler , out of which S/D ratio was elevated in 14 women, RI was elevated in 12 women & diastolic notch was present in 12 women.

Out of 28 women 8 developed preeclampsia with sensitivity of 62% for S/D ratio, 50% for RI and for end diastolic notch 62.5% which was similar to those of Campbell 1986 (67%) [129] & Kurdi 1998 (62%) [15] with specificity of 93%, 93.9%, 94.7% respectively for S/D ratio, RI & notch. similar to Bewley et al [11] (95%) 1991, Valensise [13] et al (93%),1993 ,North [14] et al 1994 (90%). Pappargorghiu [16] et al 2001 sensitivity of developing preeclampsia was 24%.

With diagnostic odds ratio of 22.8, 15.5, and 29.8 for S/D ratio, RI & diastolic notch indicates notch has better performance to predict preeclampsia than others.

In the study 10 women developed gestational hypertension (non protienuric) with sensitivity of 20%, 10%, 30% for S/D ratio, RI & for diastolic notch. And specificity ranging from 90 to 93% with poor positive predictive value.

Out of 140 women 12 developed FGR that is birth weight less than 10 th perpercentile for that gestational age as predicted by the abnormal uterine artery doppler with sensitivity of 41.7% for S/D ratio, 25% for RI & 33.3 % for end diastolic notch. These results were similar to earlier studies done by North [14] et al 1994 (47%), Irion [12] et al 1998 (29%). Specificity was almost 93% similar to that of North [14] et al 1994 (91%),with Positive Predictive value of 35.7%,25%,33.3% for S/D ratio, RI & Diastolic notch respectively, similar to studied by North et al 1994.(27%). and Negative predictive value of 94.4% for S/D ratio,93% for RI,93.8% for notch, comparable to quoted by North [14] et al 1994 (96%), Valensise [13] et al,1993 (97%).

This indicates that S/D ratio is a better predictor for developing FGR than diastolic notch & RI which differs from previous studies.

All these test parameters indicates elevated S/D ratio is a good indicator that the women is at risk of developing FGR.Two women with abnormal doppler developed oligohydramnios along with FGR requiring NICU admission. Two women delivered at term had low birth weight babies, defined as less than 2.5 kg they also had abnormal doppler indices.

Out of 23 total preterm deliveries 14 women delivered before term had elevated or abnormal doppler studies. Approximately 50% women had preterm deliveries. Pappargorghiu [135] et al 2004 sensitivity of preterm delivery before 36 weeks was 70%.

Out of 33 babies requiring NICU admission, in 18 babies, their mother had abnormal doppler indices. One neonatal death noted in a woman who developed preeclampsia at 28 weeks delivered preterm with very low birth weight 925 grams died on 2nd postnatal day. Uterine artery doppler Study was abnormal in this woman. Out of 140 total deliveries 103 were vaginal deliveries,23 emergency LSCS,14 elective. LSCS with different indication. 2 women had abruption, 1 PPROM, 4 GDM cases were noted in the study but doppler studies were normal in these women. No IUD was noted in the study.

V. Conclusion

Second trimester uterine artery S/D ratio, end diastolic notch & ResistanceIndex can be used as a predictor for pre-eclampsia and Intra uterine growth restrictions. Diastolic notch and S/D ratio are better predictors than other doppler indices. Uterine artery doppler indices are better predictors for preeclampsia & FGR than non proteinuric gestational hypertension. Uterine artery Doppler can incorporated in hospitals where facilities are Available to identify women at risk of developing Preeclampsia & fetal growth restriction.

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