

ORIGINAL RESEARCH

A Prospective Study on Sensitivity of Uterine Artery Doppler in the Prediction of PIH and IUGR

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ABSTRACT

Background: Pre-eclampsia and intrauterine growth restriction are characterized by abnormal placenta formation, which results in inadequate uteroplacental blood flow. This has led to the idea of using Doppler ultrasonography to assess the velocity of uterine artery blood flow as part of routine ultrasound screening. To find out the sensitivity of uterine artery in the prediction of pregnancy induced hypertension and intrauterine growth restriction at 20-22 weeks of gestation thereby to follow up the at risk patients and to improve perinatal outcome. **Methods:** Study was conducted at a tertiary care teaching hospital for a period of one year in the department of Obstetrics and Gynecology and in the department of Radiology. Selection of cases about 200 antenatal mothers were selected and they were separated as High risk cases include 100 antenatal mothers (multi) with previous history of hypertension, FGR, IUD at 20-22 weeks of gestation. Low risk cases include 100 antenatal mothers (primi/multi) with no prior history of hypertension, FGR, IUD at 20-22 weeks of gestation. **Result:** In Group I, out of 97 cases, bilateral notch was noted in 33 cases. There is a significant association between bilateral notch and parity. Two cases had HT, 15 cases had FGR. Insignificant association was noted between bilateral notch and HT. out of 33 cases, FGR was noticed in 15 cases. Significant association was noted between notch and FGR. Out of 33 cases, 6 cases had both HT and FGR. Significant association was noted between notch and HT & FGR. Out of 33 cases, 10 babies were delivered prematurely, 14 cases had caesarean delivery, and 19 cases had vaginal delivery. **Conclusion:** It is better to do uterine artery Doppler study, along with Target scan at 20-22 weeks of gestation, thereby both anomalies of fetus and risk of preeclampsia, FGR can be predicted in the same visit. Prediction value of uterine artery Doppler study is increased by doing the test along with serum beta HCG, PAPP, inhibin A. Those cases with bilateral notch require more fetal surveillance and timely intervention compared to unilateral and absent notch.

Key words: Hypertensive disorders, fetal growth restriction, uterine artery Doppler.

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INTRODUCTION

Pregnancy and child birth is a unique experience in women's life. Every woman has her own expectation and emotions for delivering a healthy child. The primary aim of antenatal care is to achieve at the end of pregnancy, a healthy mother and a healthy baby. Recently there have been many modern investigative and treatment modalities to provide a good health care. Despite advances in antenatal care, hypertensive disorder in pregnancy contributes to increased maternal morbidity and mortality and thereby accounts for increased perinatal morbidity and mortality.

Major cause of maternal mortality according to 2001-2003 SRS survey are Hemorrhage (38%), sepsis (11%), hypertension (5%), obstructed labor (5%),

abortion(8%), and other conditions(34%).

Main pathophysiology in preeclampsia and fetal growth restriction is impaired uteroplacental and fetoplacental circulation respectively. Pathophysiology in preeclampsia is absence of secondary wave of trophoblastic invasion into spiral arterioles at deciduo - myometrial invasion. So the muscular tissues in the tunica media layer is not destroyed leading to persistence of high resistant vessels, leading to decreased uteroplacental circulation.

Pre-eclampsia and intrauterine growth restriction remain important causes of maternal and perinatal morbidity and mortality.¹⁻³ Maternal complications of pre-eclampsia include coagulopathy, renal and liver failure, and stroke. Adults who were affected by

intrauterine growth restriction in utero are at increased risk for cardiovascular disease, hypertension and type 2 diabetes.⁴

Pre-eclampsia and intrauterine growth restriction are characterized by abnormal placenta formation,⁵ which results in inadequate uteroplacental blood flow. This has led to the idea of using Doppler ultrasonography to assess the velocity of uterine artery blood flow as part of routine ultrasound screening.⁷ Low end-diastolic velocities and an early diastolic notch characterize the waveforms of uterine artery blood flow in women who are not pregnant or are in their first trimester. Persistence of a diastolic notch (beyond 24 weeks' gestation) or abnormal flow velocity ratios have been associated with inadequate trophoblast invasion.

Accurate prediction of pre-eclampsia and intrauterine growth restriction is crucial to allow judicious allocation of resources for monitoring and preventive treatment to improve maternal and perinatal outcomes.⁶ However, studies investigating the predictive accuracy of uterine artery Doppler indices have revealed considerably varied results. Thus, it is questionable whether uterine artery Doppler ultrasonography should be used as a predictive test.

Colour Doppler ultrasound of uterine artery at 20-22 weeks of gestation showing persistent diastolic notch helps in predicting pregnancy induced hypertension and intrauterine growth restriction. Normally the early diastolic notch persists till 22 weeks after which there will be disappearance of diastolic notch. Persistence of diastolic notch beyond 22 weeks indicates defective placentation. This study is conducted to predict pregnancy induced hypertension and intrauterine growth restriction by using uterine artery Doppler and thereby to follow up the risk patients and to reduce both maternal and perinatal morbidity and mortality. Based on this aim of our study is to find out the sensitivity of uterine artery Doppler in prediction of pregnancy induced hypertension and intrauterine growth restriction at 20-22 weeks of gestation thereby to follow up the at risk patients and to improve perinatal outcome.

MATERIALS AND METHODS

The materials and methods employed in this study This study was conducted to find out the sensitivity of uterine artery Doppler in predicting pregnancy induced hypertension and intrauterine growth restriction at 20-22 weeks of gestation, thereby to follow up the at risk patients and to improve perinatal outcome. This study was conducted at a tertiary care teaching hospital for a period of one year in the department of Obstetrics and Gynecology and in the department of Radiology.

About 200 antenatal mothers were selected and they were separated as high risk (Group I) and Low risk (Group II). High risk cases include 100 antenatal mothers with previous history of hypertension, FGR, IUD at 20-22 weeks of gestation. Low risk cases

include 100 antenatal mothers (primi / multipara) at 20-22 weeks with no prior history of hypertension, FGR, IUD. Whereas patients with Multiple gestations. Antenatal mother with cardiac diseases, DM, SLE, chronic hypertension and epilepsy were excluded All antenatal mothers were registered in Antenatal OP.A detailed history elicited and then examination done. After getting consent, Doppler study done at 20-22 weeks of gestation. The Doppler characters studied for prediction of pre-eclampsia and FGR was bilateral diastolic notch.

Antenatal mother is placed in a supine and slightly left lateral position to prevent supine hypotension. The frequency of doppler used is 3.5-5 MHZ. Doppler measurement is done at a point just distal to the crossover with the iliac artery before uterine artery divides into arcuate arteries.

Comparison of data was done using chi-square test. Both univariate and multivariate analysis of data was done. Validity of the tests was evaluated by calculating sensitivity, specificity, positive and negative predictive values, likelihood ratio for positive and negative test.

RESULT

In this study, 71 cases (71%) in group I and 72 cases (72%) in group II belonged to the age group of 21-30 yrs. 12 cases (12%) in group I and 25 cases (25%) in group II belonged to the age group of 18- 20 yrs and the remaining belonged to the age group of 31- 35 years. In Group I, all the 100 cases (100%) were multigravida. In Group II, 40 cases (40%) were multigravida, 60 cases (60%) were primigravida.

Coming to the Doppler findings In Group I, bilateral notch was present in 33 cases (34.02%) and unilateral notch was present in 5 cases (5.15%). In Group II, bilateral notch was present in 12 cases (12.24%) and unilateral notch was present in 6 cases (6.12%). In Group I, in cases with persistence of bilateral notch 33 (100.0%) cases were multi and no cases (0.00%) in primi. In cases with persistence of unilateral notch, 5 cases (100.0%) were multi and no cases (0.00%) were reported in primi. P value of <0.001 indicates significant (at 5%) relationship between notch & parity. Notch is associated with multigravida. In Group II, persistence of bilateral notch were noted in 8 (66.7%) of cases in primi and in multi 4 cases (33.3%) were noted. Persistence of unilateral notch was noted in 4 cases (66.7%) in primi and 2 cases in multi (33.3%). P-value of 0.022 indicates significant relationship between notch and parity. Notch is associated with parity.

In group I, 2 cases (6.1%) had HTD and 15 cases (45.4%) had FGR in those cases with persistence of bilateral uterine artery notch. 1 case (20.0%) had HTD and 3 cases (60.0%) had FGR in the case with persistence of unilateral uterine artery notch. 4 cases (6.7%) had HTD, and 4 cases (6.7%) had FGR in the absence of notch.

In group II, 1 case (8.3%) had HTD, 2 cases (16.7%) had FGR in the cases of persistence of bilateral uterine artery notch. In group II, no cases were reported to have hypertension in both unilateral and absent notches. 1 case (8.3 %) had FGR in the cases of persistence of unilateral uterine artery notch and no case had FGR in cases of absent notch. As a whole in both groups (195 cases), notch was seen in 56 cases (28.7%). Among them 4 cases had HTD (7.1), 21 cases (37.5%) had FGR, 22 cases had FGR with HTD (39.3%).

In this study, in Group I i.e the cases with persistence of bilateral notch in 2 (6.1%) had gestational HT, 6 (18.2%) had mild preeclampsia and 10(30.3%) had severe preeclampsia. In the cases with persistence of unilateral notch 1(20.2%) had gestational HT, 1 (20.0%) had mild preeclampsia and 1 case (20.0%) had severe preeclampsia. In this study, in Group II i.e the cases of persistence of bilateral notch 1 (8.3%) had gestational HT, 1 (8.3%) had mild preeclampsia and 1(8.3%) had severe preeclampsia. In the cases of unilateral notch 1 case (16.7%) had mild preeclampsia.

In Group I, in the presence of bilateral notch, 19

cases (57.6%) had vaginal delivery and 14 cases (42.4%) had caesarean delivery. In the presence of unilateral notch, 3 cases (60.0%) had vaginal delivery and 2 cases (40.0%) had caesarean delivery. In Group II, 7 cases (58.3%) had vaginal delivery and 5 cases (41.7%) had caesarean delivery in cases of bilateral notch, 5 cases (83.3%) had vaginal and 1 case (16.7%) had caesarean delivery with unilateral notch.

In Group I, in the presence of bilateral notch, 17 cases (51.5%) had abnormal perinatal outcome and in the presence of unilateral notch 4 cases (80.0%) had abnormal perinatal outcome. Abnormal perinatal outcome was noted as apgar <6/10, meconium aspiration syndrome, respiratory distress, small for gestational age, preterm delivery and its complications and NICU admission. in Group II, in the presence of bilateral notch, 5 cases (41.7%) had abnormal perinatal outcome and in the presence of unilateral notch 1case (16.7%) had abnormal perinatal outcome. P-value of < 0.001 indicates significant (at 5%) relationship notch and perinatal outcome. Notch is associated with perinatal abnormality.

Table 1. Persistence of Notch and Perinatal Outcome

Notch	Group 1			Group 2		
	Number of cases	Perinatal outcome		Number of cases	Perinatal outcome	
		Abnormal	Normal		Abnormal	Normal
Bilateral	33	17	16	12	5	7
Unilateral	5	4	1	6	1	5
Total	38	21	17	18	6	12
Absent notch	59	8	51	80	1	79

Coming to mode of delivery P-value of 0.069 indicates insignificant relationship between notch and mode of delivery. Also there was no relationship between notch and gestational age at delivery.

We also calculated and identified the sensitivity and specificity of Doppler findings in predicting hypertensive disorders and IUGR as below.

Table 2. Prediction of HTD /FGR by Uterine Artery Doppler Screening

Diagnostic Test	Sensitivity	Specificity	PPV	NPV	LR for + test	LR for (-)Test	FP	FN
For HTD								
Any notch	42.85%	61.11%	7.89%	93.22%	1.10	0.93	57.14%	92.10%
Bilateral notch	33.33%	65.93%	6.1%	93.75%	0.97	1.01	66.67%	93.94%
For FGR								
Any notch	81.81%	73.33%	47.37%	93.22%	3.04	0.25	18.18%	52.63%
Bilateral notch	78.95%	76.92%	45.45%	93.75%	2.39	0.27	21.05%	54.55%

DISCUSSION

Doppler study application was made feasible first by Fitzgerald and Drumm. It is a noninvasive technique which uses high frequency sound waves for investigation of blood flow.

In our study in group I, 2 cases (6.1%) had HTD, 15 cases (45.4%) had FGR in cases with persistence of

bilateral notch. In Group I, 1 case (20.0%) had HTD, 3cases (60.0%) had FGR in the case with persistence of unilateral notch. In Group I, 4 cases (6.7%) had HTD, and 4cases (6.7%) had FGR in case of absent notch. In Group II, 1 case (8.3%) had HTD, 2cases (16.7%) had FGR in presence of bilateral notch. In Group II, no cases reported to have HT in both

unilateral and absent notches. 1 case (8.3%) had FGR in case of persistence of unilateral notch and no case had FGR in case of absent notch.

Bilateral notch persistence was associated with severe form of HTD and FGR compared to unilateral notch. Kofinas et al⁷ found persistence of diastolic notch in uterine artery with increased risk of HTD, FGR, caesarean delivery, preterm delivery and admission to NICU.

Campbell et al⁸ first demonstrated relationship between HTD, FGR, fetal distress, increased cesarean delivery and low APGAR score with persistent bilateral diastolic notch. Deutinger et al⁹ found that early diastolic notch was associated with increased uteroplacental insufficiency.

Zimmermann et al¹⁰ studied the utility of uterine artery doppler between 21-24 weeks in prediction of preeclampsia and FGR. Doppler was less informative in cases of low risk. In case of bilateral notch, there is increased risk of preeclampsia and FGR. In case of bilateral notch, preeclampsia and FGR was noted in 58.3% compared to 8.3% in absent notch.

Pai¹¹ found that in predicting HTD/FGR, persistent diastolic notch was a better parameter than resistant index. Flesicher et al conducted the study after 26 weeks and found that early diastolic notch was associated with increased cesarean rate, preeclampsia, FGR, fetal distress and admission to NICU.

Thaler et al¹² found diastolic notch as a better outcome than S/D ratio and Resistance index (RI). Lower et al also found correlation between diastolic notch and HTD, FGR, fetal distress, Trudinger et al¹³ studied only high risk patients for prediction of preeclampsia, FGR.

In this study, in Group I, in case of bilateral notch, 6.1% had gestational HT, 18.2% had mild preeclampsia, and 30.3% had severe preeclampsia. In case of unilateral notch, 20.0% had gestational HT, 20.0% had mild pre-eclampsia, and 20.0% had severe preeclampsia. In Group II, in cases of persistence of bilateral notch 8.3% had gestational HT, 8.3% had mild preeclampsia, and 8.3% had severe preeclampsia. In case of unilateral notch 16.7% had mild preeclampsia. Overall, increased risk of cesarean delivery is noted in Group I (High risk) cases and that to in cases with persistent bilateral notches. Aristidou et al¹⁴ and Christopher Lees¹⁵ demonstrated persistent diastolic notches with increased risk of HT, FGR and low APGAR scores.

In this study, preterm delivery was more common in High risk (Group I) cases. In Group I, 30.3% had preterm delivery in case of bilateral notches, and only 20.0% had preterm delivery in case of unilateral notches. The useful part of a test depends on negative predictive value. Negative predictive value of 100% in Group II (low risk) indicates that both HT/FGR will not be present. Validity of tests in Group I&II for any notch and bilateral notch for hypertensive disorder/ fetal growth restriction when compared to other studies like the ones done by Bower et al¹⁶ and

Campbell et al¹⁷. Sensitivity and specificity were comparable to Ashraf Jamal et al¹⁸, Albaiges et al¹⁹.

CONCLUSION

From our study it is concluded that in High risk group, in case of bilateral notches there is increased risk of preeclampsia, FGR, preterm delivery and abnormal perinatal outcome compared to cases with unilateral notches and absent notches. In low risk group also, bilateral notches are associated with increased risk of preeclampsia, FGR, Preterm delivery and abnormal perinatal outcome compared to unilateral and absent notches. In both groups, bilateral diastolic notch was associated with poor prognosis. It is better to do uterine artery Doppler study, along with Target scan at 20-22 weeks of gestation, thereby both anomalies of fetus and risk of preeclampsia, FGR can be predicted in the same visit. Prediction value of uterine artery Doppler study is increased by doing the test along with serum beta HCG, PAPP-A, inhibin A. Those cases with bilateral notch require more fetal surveillance and timely intervention compared to unilateral and absent notch.

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