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ORIGINAL RESEARCH

Screening of High-Risk Pregnancies by First and Second Trimester Uterine Artery Doppler for Improving Sensitivity in Prediction of Adverse Pregnancy Outcome

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ABSTRACT

Background: To determine the clinical value of first trimester and second-trimester uterine artery Doppler indices in the prediction of adverse pregnancy outcome (preeclampsia, IUGR, unexplained stillbirths).

Materials &Methods:This was a prospective study in which uterine artery Doppler was performed at 22-24 weeks of gestation 100 high-risk women attending antenatal OPD at Dr psims & rf in the first trimester between 11 to 13 weeks6days POG for early pregnancy scan and uterine artery Doppler, followed with second-trimester uterine artery doppler at the time of anomaly scan 18 to 20weeks from June 2019 to June 2020.

Results: Among the high-risk women in the present study the risk factors are chronic hypertension (40%), precious pregnancy (10%), overt DM (12%), previous history of preeclampsia (15%),RPL(10%),SLE (7%), twins (3%), oligohydramnios (3%). Abnormal uterine artery Doppler indices had the highest sensitivity (100.0%) for predicting preeclampsia in the mother and the lowest sensitivity (51.4%) for predicting preterm. For predicting pre-eclampsia, IUGR, neonatal mortality, preterm the sensitivity of RI was 100%,85.7%,83.3%,51.4% respectively, and the specificity was 92.3%,100%,95.8%,100% respectively. Overall, 35 (35.0%) women had a preterm delivery, 16 (36%) had a cesarean delivery, and 19 (61%) had a spontaneous vaginal delivery. Among the preterms, 18(51.4%) died due to prematurity and its associated complications. The positive predictive value of abnormal uterine artery Doppler was highest for preeclampsia (36.84%) among all adverse pregnancy outcomes assessed.

Conclusion: Uterine artery Doppler ultrasonography at 22-24 weeks of gestation is a significant predictor of at least one adverse pregnancy outcome, with the highest prediction for preeclampsia.

Keywords: Uterine artery Doppler, preeclampsia, fetal growth restriction, low birth weight, adverse obstetric outcome.

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INTRODUCTION

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

complications. In these pregnancies, the uteroplacental circulation remains in a state of high resistance, which causes generalized endothelial cell injury, compromises vascular integrity, and an atherosis-like process in small arteries that results in vascular occlusion, local ischemia, and necrosis. Under these conditions, the uteroplacental circulation remains in a state of high resistance and low flow. Doppler ultrasonography is a noninvasive tool for evaluating vascular resistance in these otherwise inaccessible maternal vessels. An increase in uterine artery impedance that predates the onset of clinical findings has been shown in preeclampsia and FGR; both disorders are associated with placental insufficiency.[1]

Uterine artery Doppler is an attractive screening test in mid pregnancy. In theory, 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 preeclampsia. In this study, uterine artery Doppler was done in 20-24 weeks of gestation, contrary to the first trimester and early second trimester in many studies done previously.[1-3] The timing was based on the hypothesis that it is unlikely that the fetal growth and well being are influenced by the transformation of uteroplacental vessels at 11 weeks to 13 weeks 6 days period of gestation because substantial changes in the placental development take place between first and second trimester that have practical importance for the development of the clinical screening program.[4]

Doppler examination of the uterine arteries is a non- invasive tool that can be used to indirectly assess trophoblast development and uteroplacental perfusion. The trophoblast invasion is maximal in the first trimester, and that preeclampsia derives from a relative failure of this event, justifies the evaluation of uterine artery Doppler findings in the first trimester of pregnancy.

This study was performed to assess the role of second trimester uterine artery Doppler in predicting adverse pregnancy outcomes in pregnant women

Aims and Objectives:

To determine the clinical value of first- trimester and second-trimester uterine artery Doppler indices in the prediction of adverse pregnancy outcome (preeclampsia, IUGR, unexplained stillbirths).

MATERIALS & METHODS

Study design: A prospective observational study.

Subjects: 100 high-risk women attending antenatal OPD at Dr psims & rf in the first trimester between 11 to 13 weeks6days POG for early pregnancy scan and uterine artery Doppler, followed with second-trimester uterine artery doppler at the time of anomaly scan 18 to 20weeks from June 2019 to June 2020.

Inclusion and Exclusion Criteria

The study sample includes Antenatal women attending OPD in the first trimester(<14 weeks). Primi with high-risk indicators(teenage pregnancy, elderly primi>35yrs, chronic medical disorders, hypertension, diabetes, renal disorders, SLE), Multigravida with prev h/o preeclampsia, eclampsia, IUGR, unexplained stillbirth. An RI of 0.58 or less and a PI of 1.6 or less was considered normal.

Women with insulin-dependent diabetes mellitus, chronic hypertension, hypertension that developed before 24 weeks of pregnancy, cardiac disorders, renal disorders and antiphospholipid syndrome, and multiple gestations were excluded. A detailed informed consent was obtained from all participants after enrolment in the study. Uterine artery Doppler was performed in all these women at 22-24 weeks of gestation using a Philips HD7 ultrasound machine (number-Ci52100333). Uterine artery Doppler was performed by a single

observer using a 225-Hz transabdominal probe. The proximal uterine arteries were located at their cross-over point with the external iliac arteries using color flow mapping. The angle of insonation was zero to ten degrees. Pulsed-wave Doppler was obtained for 3 similar consecutive waveforms on both sides. The pulsatility index (PI) was calculated [peak systolic flow minus end diastolic flow divided by mean flow: (A-B)/M]. Women with bilateral uterine artery notches or those with the mean PI of both the arteries ≥1.45 (PI greater than 95th percentile) were classified as abnormal second trimester uterine artery Doppler.

Follow-up continued till delivery and the pregnancy outcome was assessed. Pregnancy outcome was assessed in terms of normal outcome, preeclampsia, FGR, low birth weight (weight <2500 gm), spontaneous preterm delivery, oligohydramnios, fetal loss, or at least one adverse outcome.

RESULTS

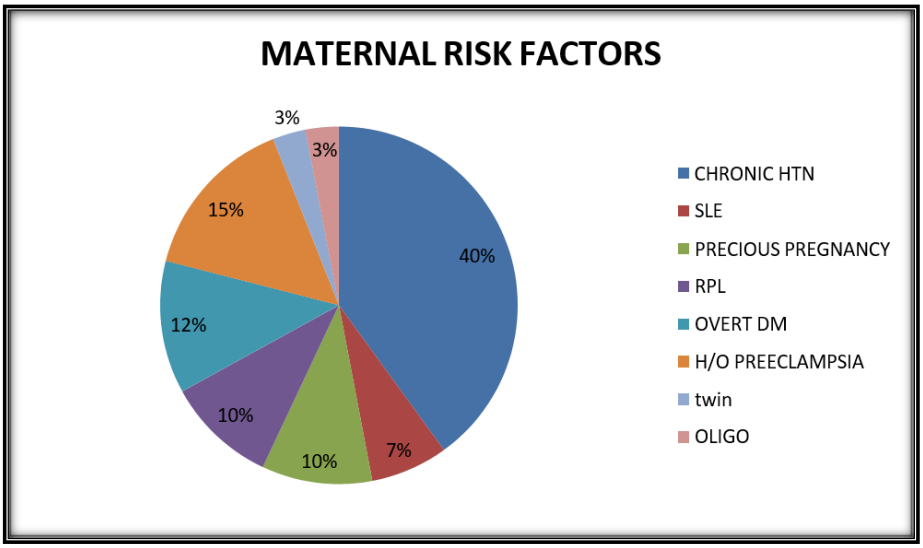

Figure 1: Maternal Risk Factors

Among the high-risk women in the present study the risk factors are chronic hypertension (40%), precious pregnancy (10%),overt DM(12%), previous history of preeclampsia (15%), RPL(10%),SLE (7%), twins (3%),oligohydramnios (3%).

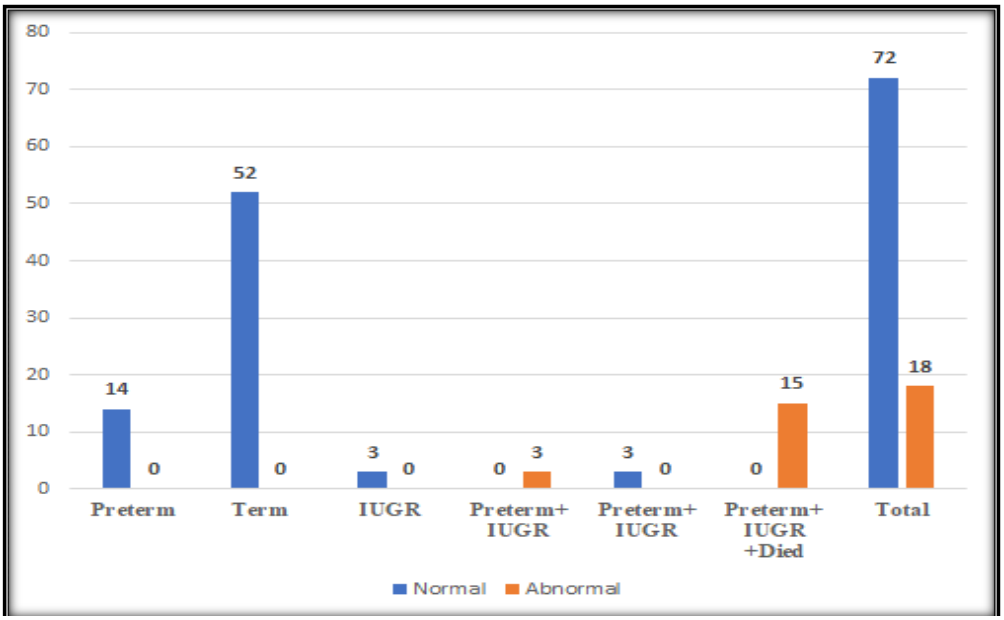

Figure 2: Fetaloutcomes

Table 1: Fetal outcome

Outcomes	Abnormal	Normal
Preterm	100%	23.6%
Iugr	100%	4.1%
Death	83.3%	4.1%

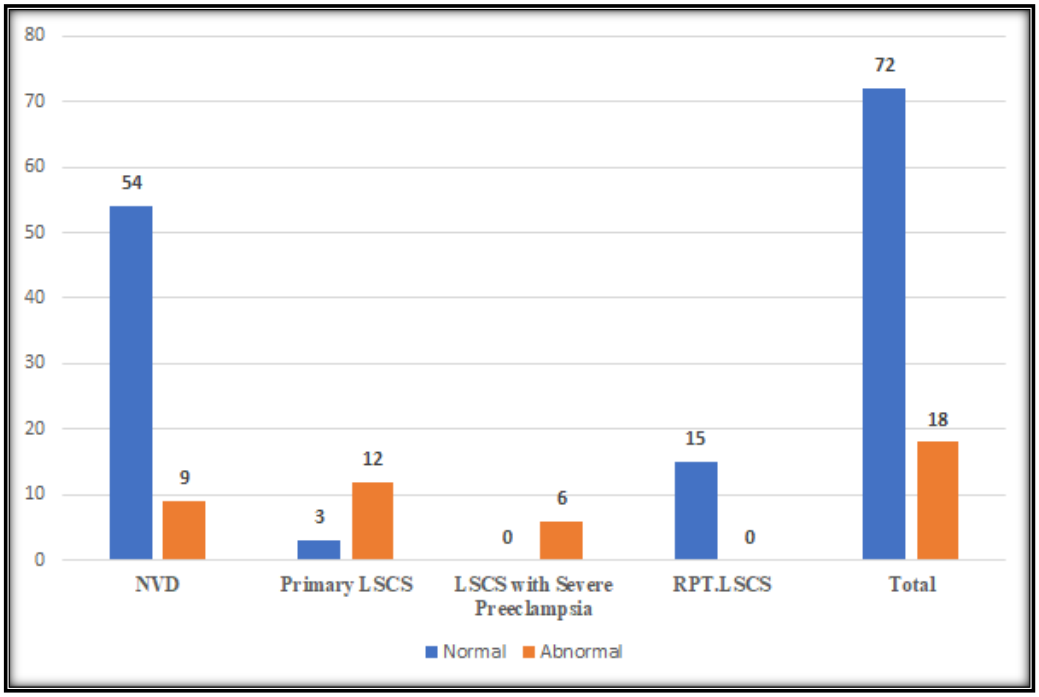

Figure 3:Maternal Outcomes

Table 2: Maternal outcome

Maternal outcomes	Abnormal doppler	Normal doppler
Primary LSCS	66.6%	4.1%
Repeat LSCS	0	20.8%
Primary LSCS ind severe PE	33.3%	0
NVD	50%	75%

This study was conducted among 100 high-risk women who attended antenatal OPD at Dr psims and rf.

Doppler study was done during the first and second trimester. Comparision was done with both the trimester doppler in terms of maternal and fetal outcome. First-trimester dopplers were all normal in this study. Among the second- trimester doppler 18% showed abnormal reports, and 72 % showed the normal report. Outcomes were analyzed with these second-trimester results. All the second-trimester abnormal doppler had both abnormal RI and abnormal PI.

Abnormal uterine artery Doppler indices had the highest sensitivity (100.0%) for predicting preeclampsia in the mother and the lowest sensitivity (51.4%) for predicting preterm. For predicting pre-eclampsia, IUGR, neonatal mortality,preterm the sensitivity of RI was 100%,85.7%,83.3%,51.4% respectively, and the specificity was 92.3%,100%,95.8%,100% respectively. Overall, 35 (35.0%) women had a preterm delivery, 16 (36%) had a cesarean

delivery, and 19 (61%) had a spontaneous vaginal delivery. Among the preterms, 18(51.4%) died due to prematurity and its associated complications.

DISCUSSION

Although no single screening test in the prediction of adverse pregnancy outcomes, especially preeclampsia, has gained widespread adoption into clinical practice, uterine artery Doppler screening is the best performing of the available clinical tests to date, and is certainly the most widely studied. The association between increased uterine artery PI and subsequent development of preeclampsia is thought to be the consequence of impaired trophoblastic invasion of maternal spiral arteries.[7] Preeclampsia, which is genetically and immunologically governed, constitutes a disease of circulatory maladaptation to this defective trophoblastic invasion. In normal pregnancy, the luminal diameter of spiral arteries is greatly increased and vascular smooth muscle is replaced by trophoblast cells. In preeclampsia, the process is deficient with a consequent decrease in the vascular capacitance and increased resistance in the uteroplacental circulation, which is reflected as impedance of blood flow in the uterine artery.[8] FGR is also the result of impaired blood flow to the patient.

Abnormal second-trimester uterine artery Doppler indices have a high detection rate of pregnancies at risk of preeclampsia and FGR. In this study, 40.6% of patients with abnormal uterine artery Doppler developed preeclampsia.[9]

Impaired uteroplacental blood flow as reflected by abnormal uterine artery Doppler flow velocities remains the important cause for severe pregnancy complications, ex preeclampsia, and FGR. This has lead to the idea of uterine artery Doppler as a screening test for adverse pregnancy outcomes.[10]

The ability to correctly predict the risk of adverse pregnancy outcomes is an essential part of obstetric care. The performance of Doppler indices has been considered as a tool for predicting adverse pregnancy outcomes in recent years. The present study evaluated the ability of second-trimester uterine Doppler indices to predict preeclampsia, IUGR, and preterm among high-risk women.

The clinical value of uterine Doppler as a screening tool in low-risk populations is defined by the high negative predictive value of abnormal uterine artery Doppler waveforms. In this study, we examined the predictive value for pregnancy complications of second-trimester uterine artery Doppler in the high-risk population.

In our study, the second trimester Doppler scan's positive predictive value is 100 percent in diagnosing intrauterine growth restriction. A large number of Doppler studies have to be performed to identify a few high-risk women, which may not be cost effective. It is not logistically feasible in regard to availability and expertise of personnel to perform uterine artery Doppler in all pregnant women.

The strength of this study is its prospective nature, albeit with a small sample size and small number of patients with abnormal second-trimester uterine artery Doppler. Larger randomized controlled trials are required for second-trimester uterine artery Doppler for the extrapolation of the results to the whole population.

CONCLUSION

In conclusion, second-trimester Doppler velocimetry among high-risk nulliparous women was found to have limited ability to predict preeclampsia, IUGR, or preterm. Future large studies exploring the clinical utility of these indices in predicting pregnancy outcomes in different cohorts of women and at different time points in pregnancy are encouraged. Future research should focus on further improvement to predict adverse pregnancy outcome, e.g., by

a combination of uterine artery Doppler at 20-24 weeks' gestation and biochemical testing (ex, alpha-fetoprotein, beta-human chorionic gonadotropin).

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