

UTERINE ARTERY DOPPLER STUDY FOR PREDICTION OF ADVERSE OUTCOME IN HIGH RISK PREGNANCYGunjan Goswami¹**HOW TO CITE THIS ARTICLE:**

Gunjan Goswami. "Uterine Artery Doppler Study for Prediction of Adverse Outcome in High Risk Pregnancy". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 56, July 13; Page: 9735-9742, DOI: 10.14260/jemds/2015/1405

ABSTRACT: AIM: To detect abnormal waveforms in uterine artery in pregnancies at risk between 20 to 24 weeks of gestation and to measure Resistance index (RI) and systolic/diastolic ratio(S/D) of these waveforms in study population and to study correlation of Doppler data with adverse pregnancy outcome. **METHODS:** This is a prospective study included Doppler analysis of uterine artery waveforms in 107 normotensive women with singleton pregnancy between 20 to 24 weeks of period of gestation who were considered to be at increased risk of developing pregnancy complications. Women with Multiple gestation, with congenital anomaly of fetus, chronic hypertension, renal disease, cardiac disease, Diabetes Mellitus were excluded from the study. Bilateral uterine artery Doppler was done and Parameters studied were S/D ratio and RI in uterine artery. Early diastolic notch in uterine artery was watched for. The flow velocity waveforms considered abnormal if there was an early diastolic notch in uterine artery in either right or left uterine artery was watched for abnormal pregnancy outcomes considered are Gestational hypertension, Pre-eclampsia IUGR, Abruptio placentae, IUD and preterm deliveries. **RESULTS:** minimum women were aged 21–25 year with minimum of 18 years and maximum of 36 years, 28% were primigravidae while 72% were multigravidae mean gestational age of which scan was done was 22 wks 1 day (20-24) minimum gestational age at time of delivery was 28 wks of gestation 70% women were delivered vaginally and 30% LSCS. 7% women developed Gestational Hypertension, 5% developed Preeclampsia, 8% neonates with IUGR, 3% developed Placental Abruption while 4% had IUD and 8% had Preterm deliveries. **CONCLUSION:** Abnormal uterine artery Doppler studies in second trimester have been associated with subsequent adverse pregnancy outcomes including Preeclampsia IUGR and perinatal mortality. Doppler velocimetry is a primary tool for fetomaternal surveillance in high risk pregnancies as the changes in uterine artery circulation strongly correlate with pregnancy outcome, it helps us to take timely action, to plan the treatment and also counsel the patient in their future pregnancies.

KEYWORDS: Doppler velocimetry, Gestational Hypertension, Fetomaternal surveillance.

INTRODUCTION: Pregnancy is associated with a physiological increase in uterine artery blood flow from 40ml/min in the non-pregnant state to 400ml/min by term.¹This major increase in blood flow is thought to be the consequence of a fall in downstream resistance through trophoblastic invasion of spiral arteries, a process beginning at 8 weeks of gestation and well established by 18 weeks of gestation.²Pregnancies failing to establish a low resistance circulation are at a substantial risk for developing complications such as pre-eclampsia, fetal growth restriction, abruptio placentae and fetal demise.³Pre-eclampsia and Intrauterine Growth Restriction are important causes of perinatal and maternal morbidity and mortality.^{4,5} Deficient placentation is characterized by inadequate trophoblastic invasion into the maternal spiral arteries and failure to develop low resistance utero-

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placental circulation.⁶ Early screening for Pre-eclampsia may allow vigilant antenatal surveillance and appropriate timing of fetal delivery in order to avoid serious sequelae. 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 This study is an attempt to assess the credibility of Doppler ultrasound imaging of uterine arteries as a predictor of adverse pregnancy outcome in high risk population.

METHODS: This is a prospective study which was conducted in the department of Obstetrics and Gynecology in association with department of Radiology of Jawaharlal Nehru Hospital and Research Center, Bhilai, Chhattisgarh over a period of 1½ years. Study population was selected from women attending antenatal clinic of this hospital. The study included Doppler analysis of uterine artery waveforms in 107 normotensive women with singleton pregnancy between 20 to 24 weeks of period of gestation who were considered to be at increased risk of developing pregnancy complications based on one or more of the following Inclusion criteria normotensive patients with one or more following risk factors were selected Nulliparity, singleton pregnancy, family history of - Hypertension, Pre-eclampsia, Eclampsia and past obstetric history of Pre-eclampsia, fetal growth restriction, abruptio- placentae or unexplained pregnancy losses in previous pregnancies and some were the exclusion criteria like Multiple gestation, women with congenital anomaly of fetus, chronic hypertension, renal disease, cardiac disease, Diabetes Mellitus and pregnancies that lost follow up. After taking a verbal consent the selected women were subjected to Doppler study. 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 Doppler indices were obtained directly from the machine. Parameters studied were S/D ratio and RI in uterine artery. Early diastolic notch in uterine artery was watched for. The flow velocity waveforms considered abnormal if there was an early diastolic notch in uterine artery in either right or left uterine artery and when S/D, RI exceeds 95th percentile of the reference range.

These women were followed up till delivery, details of pregnancy events, labour, delivery and neonatal outcome were noted. The abnormal pregnancy outcomes considered are Gestational hypertension, Pre-eclampsia IUGR, Abruptio placentae, IUD and preterm delivery etc.

The Doppler indices were defined as:

$$S/D \text{ Ratio}^8 = \frac{S}{D} \text{ where, } S \text{ is systolic peak velocity } D \text{ is end diastolic flow } RI^9 = \frac{S-D}{S}$$

Cut off values for Doppler Indices.^{10,11,12}

RI >95th percentile (0.55)

S/D >95th percentile (2.61)

The data collected through the interview of patients and Doppler study was entered on predesigned proforma. It was then tabulated in master chart with the help of Microsoft excel spread sheet. The data thus collected was used to establish and draw conclusion.

RESULTS: 107 women entered in this study, most of the women included were from age group 21 to 25 years. Only 4% women were above age 30 years. 28% women were primigravidae while 72% were multigravidae. Mean gestational age at the time of scan was 22.15 weeks (ranges 20 -24 wks) in

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the study 95th percentile of S/D ratio in Left uterine artery is 3.9425 and 95th percentile of S/D ratio in Right uterine artery is 3.8425 and 95th percentile of S/D ratio in Left uterine artery is 0.7875.

PREGNANCY OUTCOME IN THE STUDY: Reveals that 17% women had abnormal outcome. IUGR was most common pregnancy outcome (8%) followed by Gestational hypertension (7%) and pre-eclampsia (5%) the mean gestational age at the time of delivery was 38.51 (28-41wks) and the mean birth weight was 2.79 kg (0.7-4.2) on observation mean duration of stay in NICU 7.38 days (1 -45) out of 100 deliveries 21 new born were admitted in NICU, uterine artery Doppler study in predicting pre-eclampsia reveal that Notch as a single parameter is the best indicator with highest sensitivity and positive predictive value however combination of parameters is the best indicator for negative predictive value (98.86%). In this study in prediction of Gestational Hypertension all parameters have same sensitivity (14.3%) and bilateral notch has highest specificity (96.8%) along with highest positive and negative predictive value of 25% and 93.75% respectively in this study in prediction of IUGR highest specificity (97.8%) and PPV (50%) was obtained with bilateral notch however in prediction of abruption placentae, IUGR and IUD, presence of bilateral notch has highest specificity, PPV and NPV, when there was presence of notch in uterine artery Doppler in this study (obtained in 8 women) 38% developed pre-eclampsia, 13% women developed Gestational hypertension and 38% women developed IUGR while 62% women had IUD.

| Uterine Artery Doppler | Gestational Hypertension | Pre-eclampsia | IUGR | IUD | Placental Abruption |
|-----------------------------|--------------------------|---------------|-------|------|---------------------|
| S/D Ratio (n=9) | 11 | 33.33 | 33 | 33 | 22 |
| RI(n=8) | 12.5 | 25 | 25 | 12.5 | 25 |
| Early diastolic notch (n=8) | 12.5 | 37.5 | 37.5 | 62.5 | 37.5 |
| Combined (12) | 8.3 | 33.33 | 33.33 | 25 | 25 |

Correlation of uterine artery doppler study with pregnancy outcome (%)

DISCUSSION: In this prospective study in a setup of tertiary level care center, whose inflow includes Indian women from rural and urban sectors, the predictive values of various Doppler indices such as Resistance index (RI), Systolic/Diastolic ratio (SD Ratio) and uterine artery velocity waveform with or without a diastolic notch have been evaluated. This is similar to the majority of research that has been centered on an elevation of RI or PI or the persistence of a uterine artery diastolic notch to detect the presence of increase utero-placental vascular resistance although PI is less commonly reported as stated by Anthony C, Scission (2009).¹³ In this study 28% patients were recruited in view of being primi gravida, Dempsey JC, Sorensen TK, (2003)¹⁴ states that Pre-eclampsia has long been believed to be a disease of primigravidae, nulliparous women have high risk of developing adverse pregnancy outcomes. In present study most of the remaining patients had previous pregnancy losses in terms of abortions, 5 patients had history of pre-eclampsia in previous pregnancies, 6 patients had developed gestation hypertension in previous pregnancy, 6 patients had intrauterine death and 6 patients had history of Abruption placentae in previous pregnancy. All these patients were normotensive at the time of inclusion for this study. Anthony C. Sciscione, DO, Edward J. Hayes, MD (2009)¹³ mentioned in his study that restriction of screening to populations at increased risk for

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adverse outcomes can improve the predictive value of the test. Based on this principle it is plausible that uterine artery Doppler studies could prove more useful when performed on at-risk women. In a study of North RA (1994)¹⁵ the gestational age limit of 19-24 weeks of period of gestation was used because of similar reasons. In present study the flow velocity waveforms considered abnormal if there is an early diastolic notch in uterine artery in either right or left uterine arteries or both. S/D ratio and RI values of more than 95th percentile of the reference range were considered abnormal. Anthony C. Sciscione, Edward J. Hayes (2009)¹³ used Similar cut offs of 95th percentile for RI and above along with uterine artery notching in his study of Uterine artery Doppler flow in obstetric practice. Among the 100 patients studied there were 12 patients with abnormal uterine artery Doppler study.

Among which 9 patients had abnormal SD ratio, 8 patients had abnormal RI, 8 patients had early diastolic notch, among them 4 had bilateral notch and 4 had unilateral notch. In present study the adverse pregnancy outcomes in the form of preeclampsia was 5% which was similar to that quoted by Bewley Susan, Cooper Derek, (1991)¹⁶ 4.6%. Prevalence of Intra uterine growth retardation that is the weight less than 10 percentile in present study was 8%, which is similar to that of North RA, Ferrier CL, Long D (1994)¹⁵ 6.6% and Prevalence of Gestational hypertension in present study was 7%. Espinoza J, Kusanovic JP (2010)¹⁷ quoted prevalence of 7.9% for Gestational hypertension. In present study among 5 patients of pre-eclampsia 2 patient had bilateral notch, one had unilateral notch, 3 patient had abnormal S/D ratio and 2 patient had abnormal RI with a sensitivity of 60%, 40%, and 60% for uterine artery S/D ratio, RI and notch respectively while the specificity were 93.7%, 93.7% and 94.7% for S/D, RI and Notch respectively.

In present study 2 cases with Abruptio placenta and IUD had elevated Doppler indices in uterine artery out of which one patient had bilateral notch in uterine artery and had intrauterine death at 35 weeks of gestation with a small for gestation age baby of 1.45kg who also had pre-eclampsia, the other had intrauterine death at 32 weeks with birth weight of 1.4kg, there was no pre-eclampsia but Gestational hypertension in this patient. The third case of abruptio placentae that had bilateral notch in uterine artery delivered alive baby at 34 weeks with birth Weight of 1.7kg. There was one case of pre-eclampsia who had bilateral notch in uterine artery and who delivered following induction, a small for gestational age baby of 700 grams at 28 weeks, which was still born. In present study there were 8 preterm deliveries out of which 4 required preterm deliveries before 34 weeks of gestation. This shows that abnormal Doppler is associated with poor pregnancy outcome of uteroplacental insufficiency.

In present study with presence of bilateral uterine artery notching a significant specificity (placental abruption: 98.97%, preterm deliveries: 100%, IUD: 98.95%) and negative predictive value (placental abruption: 100%, preterm: 95.83%, IUD: 98.95%) is found with highest value for Placental abruption. In context of above discussion, Agrawal Prerna (2006)¹⁸ had also similar view who found in her study that all the patients with bilateral uterine artery notch developed some complication – one (12.5%) had IUD, four (50%) developed IUGR with PIH and three (37.5 %) developed IUGR without PIH.

The search for an ideal predictive test for adverse pregnancy outcomes and its preventive measures remain challenging. It is obvious that uterine artery Doppler studies might help us to divide our patients into low risk (normal outcome) and high risk (abnormal outcome) so that proper vigilance may be done in high risk women.

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CONCLUSION: Abnormal uterine artery Doppler studies in second trimester have been associated with subsequent adverse pregnancy outcomes including preeclampsia, IUGR and perinatal mortality. Women who had normal uterine artery Doppler studies at 20-24 weeks gestation could be considered to be a low risk group suitable to less intensive antenatal care. For pre-eclampsia highest specificity and positive predictive value can be obtained by bilateral notch, while all parameters have good negative predictive value thus they can be used to classify high and low risk groups for developing pre-eclampsia. Uterine artery notching was the most prevalent Doppler parameter associated with adverse outcomes like pre-eclampsia, IUGR and IUD. Persistence of uterine artery notch, especially bilateral one, can be a good predictor of pre-eclampsia, IUGR and IUD. Overall S/D ratio is less significant parameters as compared to Notch and RI in prediction of adverse pregnancy outcome. Overall bilateral notch in the uterine artery as a single parameter is better than the individual Doppler indices for developing obstetric complications related to uteroplacental insufficiency. Thus this study concludes that the Doppler velocimetry is a primary tool for fetomaternal surveillance in high risk pregnancies as the changes in uterine artery circulation strongly correlate with pregnancy outcome. It helps us to take timely action, plan the treatment & also counsel the patients in their future pregnancies.

RECOMMENDATIONS: In developing countries, uterine artery Doppler studies should be introduced and performed among high risk pregnancies to rule out adverse outcomes. Normal test would help in Avoidance of unnecessary in-utero interventions and would reduce vigorous antenatal fetal surveillance among high-risk pregnancy Abnormal test would help in Identifying high risk women who should be specifically evaluated so that frequent antenatal monitoring and necessary timely intervention can be done.

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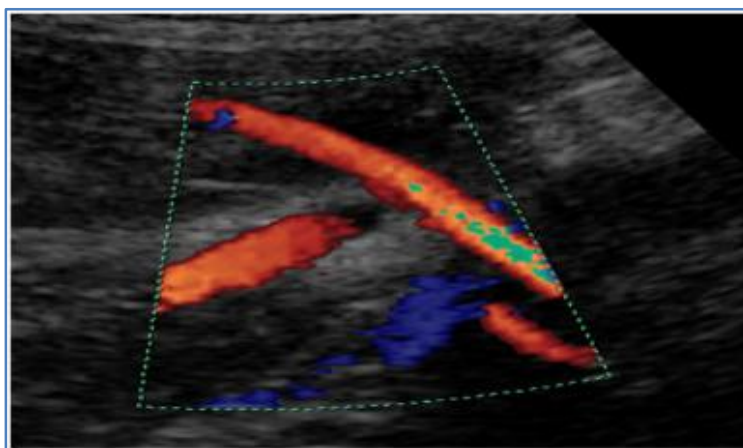


Fig. 1: Insonation of the uterine artery at the crossover with the iliac artery

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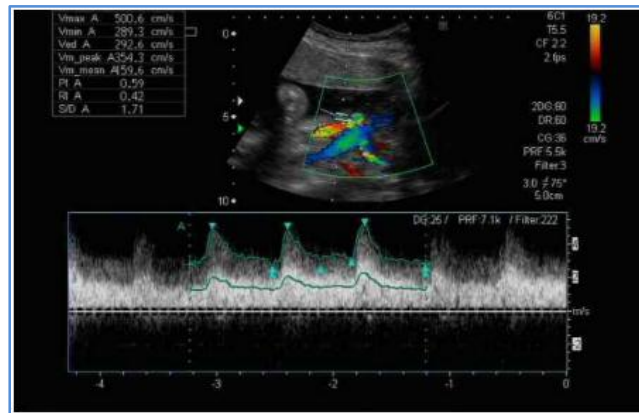


Fig. 2: Normal flow velocity waveform from the uterine artery at 24 weeks of gestation

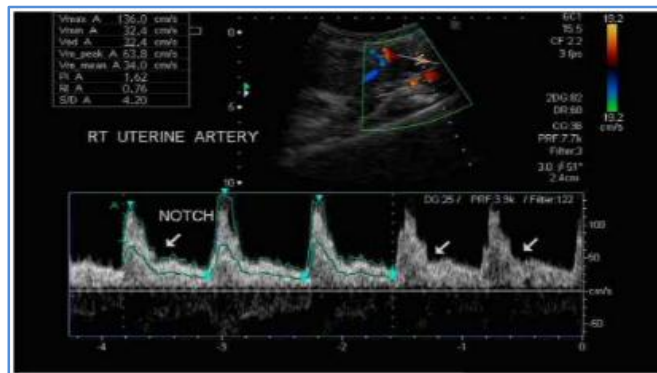


Fig. 3: Flow velocity waveform from the right uterine artery at 24 weeks of gestation in a pregnancy with impaired placentation, in early diastole there is a notch (arrow) with raised RI and S/D ratio

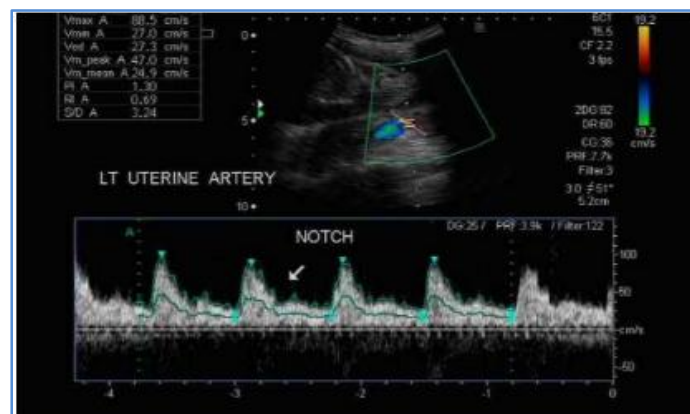


Fig. 4: Flow velocity waveform from the left uterine artery at 24 weeks of gestation in a pregnancy with impaired placentation, in early diastole there is a notch (arrow) with raised RI and S/D ratio

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