Third Trimester Uterine Artery Doppler in High Risk Pregnancies for Prediction of Adverse Perinatal Outcome

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ABSTRACT

Introduction: Uterine artery Doppler study, in addition to the conventional Doppler of umbilical artery can be used as a screening tool to predict fetal and maternal outcome in high risk pregnancies. Aims and objectives: To evaluate the value of Third Trimester Uterine Artery Doppler (Ut A), in addition to Umblical artery doppler, to predict adverse perinatal outcomes in high risk pregnancies. Settings and design: Prospective study done in 100 high risk pregnant patients, during two years.

Material and methods: High risk pregnancies between 28–40 weeks were recruited. Doppler study of uterine artery was done and compared with adverse fetal outcome. Statistical analysis used: Parameters and outcome, both maternal and foetal were tabulated and statistically analysed using Chi square test. If during statistical analysis expected cell frequency was less than 5, fisher exact test was used. P value of less than 0.05 was considered as significant.

Results: Almost half of the cases, with abnormal UtA Doppler had low birth weight (<2.5 kgs). 29.4% of these delivered at <37 weeks of gestation and low APGAR at 1 minute was seen in 41.1%. 29.4% required admission to NICU and perinatal death was reported in 17.6% of the cases (p<0.007). Perinatal outcome was found worse in cases in which both umblical artery and uterine artery Doppler was abnormal.

Conclusion: Adverse outcomes reported with a normal UtA Doppler were lower, than with an abnormal Uterine Artery Doppler. Thus, both the maternal and the fetal side of the placental perfusion is important during Doppler evaluation.

Keywords: Doppler, High Risk Pregnancy, Surveillance, Uterine Artery Doppler, Umblical Artery Doppler, Third Trimester

Key messages: Uterine artery Doppler can be used as a screening tool in addition to umblical artery Doppler in third trimester for predicting adverse perinatal outcome.

INTRODUCTION

In non-pregnant state, uterine artery flow shows rise and fall during systole and a "notch" in early diastole.[1] The compliance increases till 26 weeks of gestation with loss of diastolic notch, representing appropriate invasion by trophoblasts.

This evaluation is done at 20-26 weeks gestation.[2,3] Negative predictive value is high during this period. However, second trimester test reports high false-positives, and abnormal findings are followed by an uneventful pregnancy! The detection rate of late onset pre-eclampsia and IUGR was also low. This is due to the delayed establishment of a low-resistance placental circulation, until the end of mid-trimester.[4]

Study aimed to evaluate the value of Third Trimester Uterine Artery Doppler in addition to Umblical artery Doppler, in predicting the adverse perinatal outcome in high risk pregnancies.

MATERIAL AND METHODS

After informed consent, 100 pregnant women with high risk pregnancies in a tertiary care centre, were recruited for the study, over two years.

Inclusion Criteria: 1. Singleton pregnancies 2. Gestational age 28-40 weeks 3. Patients with Hypertensive Disorders of Pregnancy 4. IUGR 5. Chronic Hypertension 6. Oligohydroamnios 7. Diabetes Mellitus and Gestational Diabetes Mellitus

Exclusion Criteria: 1. Multiple pregnancies 2. Pregnancies with fetal anomalies 3. Gestational age less than 28 weeks 4. Prolonged pregnancies (>40 completed weeks of gestation)

Ultrasound to confirm gestational age, estimate fetal birth weight, amniotic fluid index and to rule out congenital anomalies was done. Doppler evaluation of the bilateral uterine arteries was performed abdominally (using color and pulsed Doppler imaging), in addition to the conventional Doppler study of umblical arteries. Uterine artery Doppler measurements were obtained at a point distal to the crossover of the uterine artery with the external iliac artery. Pulse waved Doppler sonography, was used to obtain at least 3 consecutive good-quality waveforms. The presence of a diastolic notch was noted, and the uterine artery PI was calculated as the mean for both sides. The uterine artery Doppler waveform was considered abnormal when a bilateral notch or PI above (PI>1.2) was found.

These parameters were then converted into Uterine artery score (UAS) as described

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by Hernandez et al[5]:-

- 0 = normal blood velocity waveforms in both the arteries
- 1 = one abnormal parameter present (high PI or notch)
- 2 = two abnormal parameters present
- 3 = three abnormal parameters present
- 4 = four abnormal parameters present (high PI and notching in both the arteries)

The Doppler study of uterine artery was compared with umblical artery doppler to predict adverse perinatal outcome.

STATISTICAL ANALYSIS

Parameters and outcome, both maternal and foetal were tabulated and statistically analysed using Chi square test. If during statistical analysis expected cell frequency was less than 5, fisher exact test was used. P value of less than 0.05 was considered as significant.

RESULT

Maximum subjects belonged to the age group 20-24 years (47%) and mean age was 26.1 years. 61% were multigravida and 39% were primigravida. Majority of the cases were at term gestational age. 61% of the patients delivered at term. 53% of the patients delivered vaginally and 67% of the patients underwent caesarean section for various indications. Out of which, 39% of patients had preterm delivery. 55% babies were LBW, 30% of the neonates had APGAR less than 7 at 1 minute, 13% of the neonates had APGAR less than 7 at 5 minute. 37% of the neonates required admission to NICU.

The study showed that only 4% of the cases had abnormal Doppler findings in 'both' umblical and uterine artery, and in 65% cases, both vessels showed normal study. In 17% of patients, uterine artery abnormality was seen, in which umbilical artery Doppler (UA Doppler) was normal. Abnormal UA Doppler was detected in 14% with Normal UtA Doppler.

We found abnormal uterine artery Doppler in 12.9%, 41.7%, 37.5%, 26.3%, 14.3% and 11.1% cases of pre-eclampsia, IUGR, GDM & DM, Gestational HTN, Oligohydroamnios and Chronic HTN respectively.

Perinatal outcome was poor when Doppler in both vessels was abnormal. When isolated UtA Doppler was abnormal, almost half of the cases, had low birth weight (<2.5 kgs) (P value-1.000). 29.4% of these delivered at <37 weeks of gestation, 41.1% had low APGAR at 1 minute (P value-0.122). 29.4% required admission to NICU (P value-0.510) and perinatal death was reported in 17.6% of the cases (P value-0.007). Negative predictive value of uterine artery doppler for predicting adverse outcomes was found to be better than its positive predictive value.

Abnormal UAS was noted in 9.6% of pre-eclampsia and in 33.3% of IUGR cases. Normal UAS was observed in the other high risk categories. With increasing UAS, there was a substantial increase in NICU admission, operative delivery for fetal distress, preterm delivery and SGA baby.

DISCUSSION

Uterine artery Doppler study predicts and screens for adverse outcomes in high risk pregnancies. Doppler study was conducted at 28-40 weeks. Other studies conducted in the third trimester are by Lavanya Rai and Lekshmi S[6] (28-37 weeks) and Polina Shwarzman et al (27-41 weeks).[7]

53% of the patients delivered vaginally, higher than the study conducted by Lavanya Rai and S Lekshmi[6] in which 23% of the patients delivered vaginally. In their study, 40% of the patients delivered before 34 weeks of gestation and caesarean was the preferred mode of delivery, amounting to a higher rate of caesarean section (77%). On the other hand, only 18% of the deliveries took place at <34 weeks in our study.

According to the study by M. Segata et al[8], vaginal delivery occurred in 68.3% of the cases (study constituted only of subjects with fetal growth restriction). Caesarean rate of 47% was reported in our study, as this was a high-risk group and the relative threshold for caesarean was low. The most common indication for caesarean section was fetal distress (63.8%). In the study by Lavanya Rai and S Lekshmi[6], Caesarean section for fetal indication was similarly done in 68% of the cases.

Neonatal morbidity was noteworthy as 37% of the neonates required admission to NICU as this was a high risk group, but it is lower than the rate observed in the study by L. Rai and S. Lekshmi[6] (50%). The reason behind the higher NICU admission can be that 40% of the patients delivered at <34 weeks of gestation in their study. M. Segata et al[8] observed a lower admission rate to NICU (9.7%) with perinatal death occurring in none but also, they included IUGR cases at >34 weeks of gestation only. The most common reason for admission to NICU in our study was LBW, followed by neonatal jaundice and positive pressure ventilation. Our study reported perinatal deaths as 10 out of 100 live births.

In our study, IUGR cases showed uterine artery abnormality in 41.7%. In the literature, studies report variable incidence-M. Segata et al[8] (63.4%), R Cruz-Martinez et al[9] (20.5%) and GS Ghosh and S Gudmundsson[10] observed abnormal Ut A Doppler in 34% of the IUGR fetuses.

We found abnormal uterine artery Doppler in 18% of the Hypertensive patients excluding chronic HTN. H Li et al[11] reported 33.33% abnormality in pre-eclampsia cases. Alexander Kofinas et al[12] reported 63% abnormality in the cases with pre-eclampsia, though the sample size was smaller than ours. Also in our study, most of the uterine artery dopplers were done at term while the study by Alexander Kofinas et al was an opportunistic study done on patients referred to them.

Patients with GDM and DM, showed abnormality in 37.5% of the cases. M Pietryga et al[13] found abnormal UtA Doppler in 16% of GDM cases and 29% of pregestational DM cases. The patient with GDM had abnormal RI only. More abnormalities like abnormal S/D ratio and presence of diastolic notch was noted in cases with pre-gestational DM, leading to more adverse outcomes, as this reflects

the involvement of the uterine artery in the pregestational vasculopathy, as stated by A. Ghidini and A. Locatelli[14] and M Pietryga et al.[13] But, as the number of patients in this group in our study are small, the findings cannot represent for this particular condition.

UtA Doppler was abnormal in 11.1% of the cases with chronic HTN. Alexander Kofinas et al[12] reported a higher incidence of 30% abnormality in their study.

Nearly 50% of the patients having abnormal UtA Doppler with normal UA doppler had LBW, also seen by Gabrielle et al (53%) with a positive predictive value (PPV) of 53%.[15] The PPV in our study was 47.1%.

29.4% of the cases with abnormal UtA doppler delivered at <37 weeks of gestation and 41.1% had low APGAR at 1 minute. 29.4% required admission to NICU (P value-0.510) and perinatal death was reported in 17.6% (P < 0.007) of the cases. GS Ghosh and S Gudmundsson[10] reported a higher rate of adverse outcome in 120 women with abnormal uterine artery in their study of IUGR cases - 60% delivered prematurely, 77.5% newborns were LBW, and 73.3% were admitted to NICU. M. Segata et al[8] observed admission in NICU in 3.3% of the cases which is much lower than the NICU admissions in our study as the gestational age at delivery in their study was > 34 weeks.

Although our study did not show significant correlation with abnormal uterine artery doppler and adverse perinatal outcome, the study by P. Shwarzman et al, reported abnormal UtA Doppler as statistically significant in predicting LBW, preterm delivery and low APGAR score.[7] Abnormal UtA Doppler has been found to be statistically significant in predicting perinatal death in our study.

In the present study, no perinatal deaths occurred when both uterine and umbilical artery Doppler were normal as stated by Lavanya Rai and S Lekshmi[6] also. Uterine artery Doppler was found more specific and sensitive for indicating preterm delivery and NICU stay in their study which was found insignificant in our study.

With increasing UAS, a substantial increase in risk of NICU admission, operative delivery for fetal distress, preterm delivery and SGA baby was seen, in accordance with Hernandez-Andarde et al.[5] This scoring system can make the interpretation simpler for clinical practice.

Also, one case of reversal in uterine artery flow was documented in our study in a case of IUGR at 38 weeks, and the baby was admitted in NICU for Phototherapy. This entity has been reported by W.L. Lau et al[16] and E. Ekici et al[17] in the third trimester which may reflect the end stage of placental insufficiency in a patient with high risk pregnancy. Limitations of our study include lesser number of cases. Inclusion of only SGA and pre-eclampsia will give a homogenous population for predicting adverse perinatal outcome. Also, high risk cases underwent caesareans for other absolute/relative indications, which has increased the overall rate of caesarean delivery in this study.

CONCLUSION

In high risk pregnancies, Doppler evaluation of both the maternal and fetal perfusion is important. Adverse outcomes after normal UtA Doppler were lower, than abnormal UtA Doppler study. This fact is reassuring for the patient and the gynaecologist, requiring less need for surveillance and lesser antenatal visits. Additionally, UtA Doppler identifies a group of high risk patients, not detected by umbilical artery Doppler alone. Also, adverse perinatal outcomes are directly proportional to the severity of abnormality in UtA Doppler as depicted by Uterine Artery Score (UAS). UtA Doppler must be used as a screening tool in third trimester for high risk cases.

REFERENCES

1. Schulman H, Fleischer A, Farmakides G, Bracero L, Grunfeld L. Development of uterine artery compliance in pregnancy as detected by Doppler ultrasound. Am J Obstet Gynecol. 1986;155:1031–6.
2. Costa FS. Which is the best period to perform uterine artery Doppler in the prediction of pregnancy complications? Radiol Bras 2006; 39:97–102.
3. Chan FY. Pregnancy screening by uterine artery Doppler velocimetry: which criterion performs best? Obstet Gynecol 1995; 85:596–602.
4. Ghi T, Contro E, Youseff A, Giorgetta F, A. Farina A, Pilu G et al. Persistence of increased uterine artery resistance in the third trimester and pregnancy outcome. Ultrasound in Obstetrics and Gynaecology. 2010;36:577-581.
5. Hernandez-Andarde E, Brodszki J, Lingman G, Gudmundsson S, Molin J, Marsal K. Uterine artery score and perinatal outcome. Ultrasound in Obstetrics and Gynaecology 2002;19:438-442.
6. Rai l, Lekshmi S. Value of third trimester uterine artery Doppler in high risk pregnancies for prediction of adverse perinatal outcome. South Asian Federation of Obstetrics and Gynaecology. 2010;2:31-35.
7. Shwarzman P, Waintraub A, Frieger M, Bashiri A, Mazor M, Hershkovitz R. Third Trimester Abnormal Uterine Artery Doppler Findings Are Associated With Adverse Pregnancy Outcomes. Journal of Ultrasound in Medicine 2013;32: 2107-2113.
8. Segata M, Ghi T, Piva M, D'Emidio L, Arcangeli T, Pelusi G et al. Uterine Doppler findings and perinatal outcome in small for gestational age fetuses delivered near term. Ultrasound in Obstetrics and Gynaecology 2007; 30:458.
9. Cruz-Martinez R, Savchev S, Cruz-Lemini M, Mendez A, Gratacos E, Figueras, F. Clinical utility of third-trimester uterine artery Doppler in the prediction of brain hemodynamic deterioration and adverse perinatal outcome in small-for-gestational-age fetuses. Ultrasound Obstet Gynecol. 2015;45:273–278.
10. GS Ghosh, Gudmundsson. Uterine and umbilical artery Doppler are comparable in predicting perinatal outcome of growth-restricted foetuses. BJOG. 2009 ;116:424-30.
11. Li H, Gudnason H, Olofsson P, Dubiel M, Gudmundsson S. Increased uterine artery vascular impedance is related to adverse outcome in pregnancy but is present in only one-third of late third-trimester pre-eclamptic women. Ultrasound in Obstetrics and Gynecology 2005;25: 459–463.

12. Kofinas AD, Penry M, Swain M. Uteroplacental Doppler flow velocity waveform analysis correlatespoorly with glycemic control in diabetic pregnant women. Am J Perinatol 1991;8: 273–7.

13. Pietryga M. Abnormal Uterine Doppler Is Related to Vasculopathy in Pregestational Diabetes Mellitus. Circulation. 2005;112:2496–500.

14. Ghidini A, Locatelli A. Monitoring of Fetal Well-Being: Role of Uterine Artery Doppler. Semin Perinatol;32: 258-262.

15. Gabrielle S, Farina A, Marconi R, Segata M, Piva M, Rizzo N. A two-tier approach to the diagnosis of small-for-gestational age foetuses in a low risk population. Ultrasound in Obstetrics & Gynaecology 2007; 30: 459.

16. Lau WL, Lam HSW, Leung WC. Reversed diastolic flow in the uterine artery – a new Doppler finding related to placental insufficiency? Ultrasound in Obstetrics and Gynaecology 2007;29: 232-235.

17. Ekici E, Vicdan K, Dayan H, Dani man N, Go ̈kmen O. Reversed enddiastolic uterine artery velocity in a pregnant woman complicated by mild preeclampsia and severe growth retardation. Eur J Gynecol Reprod Biol 1996;66:79–82

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