Original Article

Role of doppler studies in predicting intra – Uterine growth retardation

Balaji P Nalwad[1*], Rajesh V Darade[2], Chate Preshit[3]

[1,3]Assistant Professor, Department of Obstetrics and Gynaecology, MIMSR Medical College, Vishwanathpuram, Latur, Maharashtra, INDIA.
[2]Professor, Department of Obstetrics and Gynaecology, Government Medical College, Latur, Maharashtra, INDIA.
Email: drbpnalwad@gmail.com

Abstract

Introduction: The association between abnormal umbilical artery Doppler velocimetry and adverse pregnancy outcome has been investigated widely. **Aims and Objectives:** To Study Role of Doppler studies in predicting Intra-Uterine Growth. Retardation **Materials and Methods:** This was a prospective study done over a period of one and half years in tertiary hospital from August 2012 to February 2014. 100 women with singleton pregnancy attending hospital for OPD were scanned for Doppler velocimetry. Pregnant Patients within 26-30 years were included into study. Data was collected by HP image point colour Doppler machine with convex probe 3.5 MHz with ultrasonography. Fetal biometry and morphology scan was done. The Doppler mode was switched on. These data collected from the study was analyzed using Sensitivity, Specificity, Positive predictive value, Negative predictive value. **Result:** The majority of the Patients were in the age group of 21-25 Yrs. of age i.e. 51%, followed by 26-30 Yrs. - 32%, ≤20 Yrs. – 13%, and 4% were seen in >31 Yrs. We have found that Out of the 100 women IUGR was found among 8 patients i.e. 8% Notch as a single parameter is best indicator with predictive value i.e. Sensitivity- 42.9%, Specificity- 93.5% however combination of parameter has best sensitivity i.e. Sensitivity 50% Specificity-89.3%. In uterine artery Doppler, when there was notch 38 % patients developed IUGR. This indicates umbilical artery Doppler is associated with abnormal pregnancy outcome, one patient has absent diastolic flow which is associated with IUGR. For the detection of IUGR it was observed that Normal uterine and umbilical artery found in 3.85% individuals; Normal uterine and abnormal umbilical artery found in 12.5% individuals; Abnormal uterine and normal umbilical artery found in 16.67%and Abnormal uterine and umbilical artery found in 100% individuals. **Conclusion:** Combination of uterine and umbilical artery Doppler is the best indicator for prediction of fetal growth restriction. diastolic notch in the uterine artery as a single parameter is better than the individual Doppler indices in uterine artery. Absent diastolic flow in umbilical artery is better predictor of fetal growth restriction and poor prenatal outcome. Uterine and umbilical artery Doppler may be included in hospital with facilities and infra structure to identify a group of patients at risk of developing fetal growth restriction. As the power of the study is low further studies have to be done to know Doppler predictive value in general population.

Keywords: Intra-Uterine Growth Retardation, Early diastolic notch in uterine artery, Intra -Uterine deaths.

[*]**Address for Correspondence:**
Dr. Balaji P Nalwad, Assistant Professor, Department of Obstetrics and Gynaecology, MIMSR Medical College, Vishwanathpuram, Latur, Maharashtra, INDIA.
Email: drbpnalwad@gmail.com

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INTRODUCTION

The association between abnormal umbilical artery Doppler velocimetry and adverse pregnancy outcome has been investigated widely.[1,2] many reports have shown a statistically significant relation between increased fetoplacental resistance, as estimated by either the resistance index or systolic-diastolic ratio (S/D), and the later development of either preeclampsia or fetal growth restriction (FGR)[3,4] despite these statistically significant correlations, the clinical utility of umbilical artery Doppler studies has been questioned because of its low predictive values for either preeclampsia of FGR and other adverse outcome in low risk population.[5,6] The first

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obstetric application of Doppler ultrasonography was detection of fetal heart movements.[7] originally developed for fetal heart detection, the technique was further developed for non-invasive continuous electronic monitoring of the fetal heart rate. Currently, they constitute the most common use of Doppler sonography in obstetrics. The system is based on utilizing relatively simple continuous wave Doppler ultrasound to determine the fetal heart rate from the fetal cardiac wall or valvular motion. The first application of Doppler velocimetry in obstetric was reported by Fitzgerald and drumm and McCallum *et al*.[8] the former are recognized as the first group to publish a peer-reviewed article in this field. These publications were followed by an era of impressive research productivity during which investigators extended the use of Doppler velocimetry for assessing various component of fetal and maternal circulation. These studies utilized continuous wave and duplex-pulsed wave Doppler technology. Use of two-dimensional color Doppler flow mapping techniques in obstetrics was reported by dovore and associates[9] and maulik and associates.[10] in both studies Doppler flow mapping was used to characterize fetal cardiac flow dynamics. Taylor and colleagues were the first to characterize the Doppler waves from the ovarian and uterine arterial circulations utilizing pulse duplex Doppler instrumentation.[11] According to brosen *et al* [12] a lack of endovascular infiltration by trophoblast into the myometrial portion of the placental bed spiral arteries is a consistent finding in the presence of preeclampsia. Classically it is held that second wave of endovascular trophoblastic invasion that proceeds in myometrial segment of the spiral arteries from about 15 weeks, does not occur in patients who will develop fetal growth restriction or preeclampsia. Lack of physiological conversion is not only apparent in the myometrial segment of spiral arteries, but also in the decidual parts of some of the vessels, so that a proportion of spiral arterial completely fail to undergo trophoblastic invasion and physiological changes. Intrauterine Growth Restriction: The association between the IUGR and increased perinatal mortality and morbidity has received considerable attention in recent years.[13] the accurate and timely identification of growth- restricted fetus is an important goals that may optimize pregnancy outcome. There are several methods available to the obstetricians in the identification of growth restricted fetus. Clinically, these methods have involved measurement of uterine size using symphysiofundal height and clinical estimation of fetal weight. These methods may be inaccurate in the presence of maternal obesity, leiomyomata and polyhydramnios. The advent of real time ultrasound has allowed for sonographic estimation of fetal weight using a variety of computer generated formulas.[14-15] in the setting of accurate pregnancy dating, the sonographic estimation of fetal weight may prove to be of greater value in the identification of growth retarded fetus.[12]

MATERIALS AND METHODS

This was a prospective study done over a period of one and a half year in tertiary hospital from august 2012 to February 2013. 103 women with singleton pregnancy attending hospital OPD scan. After fulfilling the inclusion and exclusion criteria. Pregnant Patients within 26-30 years were included into study while Patient with congenital anomaly of fetus, multiple gestation, chronic hypertension, renal disease, cardiac disease, those who are not getting booked for delivery at study hospital, with unreliable LMP details and not confirmed by first trimester scan were excluded from the study. When above criteria were met study group was subjected to Doppler study after biometry and morphology scan. Data was collected by HP image point color Doppler machine with convex probe 3.5 MHz with ultrasonography fetal biometry and morphology scan was done the Doppler mode was switched on. Absent and reverse diastolic flow in umbilical artery. 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, RI exceeded 95th centile of the reference range for that population. In, umbilical artery if S/D ratio and RI exceeded 95th centile and if there was absent and reverse and diastolic flow velocity in umbilical artery. These patients were followed up till delivery and details of pregnancy events. Labour and delivery and neonatal outcome were noted. These data collected from the study will be analyzed using sensitivity, specificity, Positive predictive value and Negative predictive value.

RESULT

Table 1: Age wise distribution in the study (years)

Age	Frequency	Percentage
≤20	13	13
21-25	51	51
26-30	32	32
>31	4	4
Total	**100**	**100**

The majority of the Patients were in the age group of 21-25 Yrs. age group i.e. 51% followed by 26-30 Yrs. - 32%, ≤20 Yrs. – 13%, and 4% were seen in >31 Yrs.

Table 2: Prevalence of IUGR

Conditions	No. of subjects (n=100)	Percentage
IUGR	8	8

Out of the 100 women IUGR was found among 8 patients i.e. 8%

Table 3: Uterine artery Doppler in predicting IUGR.

Doppler Test	True positive	False negative	False positive	True Negative	Sensitivity	Specificity	Positive Predictive value	Negative Predictive value
S/D	3	5	6	86	42.9	93.5	33.3	95.6
RI	2	6	6	86	28.6	93.5	25	94.6
Notch	3	5	4	88	37.5	95.7	42.9	94.6
Combined	4	4	10	82	50	89.3	28.6	95.3

Notch as a single parameter is best indicator with predictive value i.e. Sensitivity-42.9%, Specificity-93.5% however combination of parameter has best sensitivity i.e. Sensitivity 50% Specificity-89.3%

Table 4: Correlation of uterine artery Doppler with IUGR

Uterine artery Doppler	IUGR
S/D ratio (N=9)	33
RI(n=7)	29
Early diastolic notch (n=8)	38
Combined=14	29

In uterine artery Doppler when there was notch 38 % patients developed IUGR.

Table 5: Correlation of umbilical artery Doppler with pregnancy out comes

Uterine artery Doppler	IUGR
SD ratio (n=5)	40
RI(n=5)	25
Absent diastolic flow (n=1)	100
Combined=10	30

40% of patients developed IUGR. This indicates umbilical artery Doppler is associated with abnormal pregnancy outcome, one patient has absent diastolic flow which is associated with IUGR.

Table 6: Showing combination of uterine and umbilical Doppler indices for IUGR

Study variables	No. of Subjects	Normal uterine and umbilical artery (N=78)	Normal uterine and abnormal umbilical artery (N=8)	Abnormal uterine and normal umbilical artery (N=12)	Abnormal uterine and umbilical artery (N=2)
IUGR	8	3.85%	12.5%	16.67%	100%

For the detection of IUGR it was observed that Normal uterine and umbilical artery found in 3.85% individuals ; Normal uterine and abnormal umbilical artery found in 12.5% individuals ; Abnormal uterine and normal umbilical artery found in 16.67% and Abnormal uterine and umbilical artery found in 100% individuals.

DISCUSSION

Doppler analysis of uteroplacental and fetal circulation is a technique that may be particularly well suited to the identification of growth-retarded fetus. IUGR is a condition that may results from broad variety of pathophysiologic mechanisms of which placental insufficiency is one such condition. In our study, we have found that Out of the 100 women IUGR was found among 8 patients i.e. 8% Notch as a single parameter is best indicator with predictive value i.e. Sensitivity-42.9%, Specificity-93.5% however combination of parameter has best sensitivity i.e. Sensitivity 50% Specificity-89.3%. In uterine artery *Doppler when there was notch 38 % patients developed IUGR. 40% of patients developed IUGR*. This indicates umbilical artery Doppler is associated with abnormal pregnancy outcome, one patient has absent diastolic flow which is associated with IUGR. For the detection of IUGR it was observed that Normal uterine and umbilical artery found in 3.85% individuals; Normal uterine and abnormal umbilical artery found in 12.5% individuals; Abnormal uterine and normal umbilical artery found in 16.67% and Abnormal uterine and umbilical artery found in 100% individuals. These studies are similar toCreasy *et al*[16] demonstrated that when the placental circulation of fetal lambs was embolized using microspheres, a 30% decrease in birth weight occurred microsphere embolization is thought to decrease the placental surface available for nutrient and gas exchange, and may be associated with an increase in impedance to blood flow. During the progress of normal pregnancy an increase in placental size and blood flow has been demonstrated. Deficient placental growth and function may clearly result in the development of URGR. These placental abnormalities may be detected using Doppler velocimetry. This, in fact, is the theoretical basis on which the use of Doppler velocimetry to diagnose IUGR has been proposed. Campbell *et al* (1983)[13] was first to report uterine artery Doppler velocimetry. They showed that compared to pregnancies with normal uterine artery waveforms. Pregnancies with abnormal uterine artery Doppler waveforms were asbirtd with more proteinuric hypertension, required more anti-hypertensive therapy, and resulted in lower birth weight in younger gestational ages at births the capability of this potentially safe non-invasive prospective means of analyzing uterine artery blood flow during pregnancy was realized and set-off a wave of interest and research over the ensuing years. Gerard Albaiges[17] *et al* (2000) conducted a study on one-

stage screening for pregnancy complication with Doppler assessment of uterine arteries. Women who had higher risk are those with bilateral notches and high mean pulsatile index. They have 40% changes of developing pre-eclampsia, 45% of developing infant birth weight less than 10% percentile. Harrington *et al*[18] (1991) reported on two mid pregnancies screening studies on 925 patients in predicting subsequent developmend of PIH and IUGR. There was a significant association between abnormal flow (RL higher than the 95th percentage) and subsequent development of hypertension and IUGR. There was no significant association with non proteinuric hypertension. To improve the sensitivity, color flow imaging and use of the distribution notch as well as elevated RI was introduced. In this study 3437 patients were studied at 20 weeks gestation. 16% had abnormal waveforms. 5.4% persisted at 24th weeks and 4.6% persisted at 26 weeks of gestation. Therefore the high sensitivity of 76% at 20 weeks was maintained at 24 and 26 weeks while the specificity improved from 86% to 97%. The utility of umbilical artery Doppler velocimetry in the screening of low risk population for IUGR. Beattie and doman[19] (1989) studied 2097 pregnancies of confirmed gestation age were studied at 28, 34, 38 weeks of gestation. The sensitivity of Doppler velocimetry in detecting IUGR ranged from 31-40%. Bruinse *et al*[20] (1889) performed a similar screening study on 405 unselected patients they noted a sensitivity of 17% for an examination performed at 28 weeks gestation and sensitivity of 22% for examination performed at 34 weeks gestation. Fleischer-*et al* [21] (1985) studied a series of 189 high-risk pregnancies with umbilical artery velocimetry and showed that as the S/D ratio increases, the birth weight percentile decreases. The sensitivity and specificity of S/D ratio of more than 3 identifying IUGR fetus was 78% and 85% respectively, based on these data, and S/D ratio of more than 3 was proposed as abnormal beyond 30 weeks' gestation.

CONCLUSION

Combination of uterine and umbilical artery Doppler is the best indicator for prediction of fetal growth restriction. diastolic notch in the uterine artery as a single parameter is better than the individuals Doppler indices in uterine artery. Absent diastolic flow in umbilical artery is better predictor of fetal growth restriction and poor prenatal outcome. Uterine and umbilical artery Doppler may be included in hospital with facilities and infra structure to identify a group of patients at risk of developing fetal growth restriction. As the power of the study is low further studies have to done to know Doppler predictive value in general population.

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