UTERINE ARTERY DOPPLER IN PREDICTION OF FOETAL INTRAUTERINE GROWTH RESTRICTION DURING PREGNANCY

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ABSTRACT

BACKGROUND
During pregnancy, the uterine artery represents the major portion of the anterior division of the internal iliac artery. The diastolic component of the uterine artery Doppler wave form is thus transformed during normal pregnancy from one of low peak flow velocity and an early diastolic notch by 18-22 weeks (wks.). Where there is impaired placentation, the average resistance index in the left and right uterine artery is increases and is associated with an early diastolic notch. If this notch persists beyond 24 wks. of gestation, this indicate a severe adverse outcome defined by intra uterine growth restriction (IUGR) and foetal asphyxia that may be followed by pre-eclampsia and foetal death. We investigated the prognostic value of uterine artery Doppler examination in prediction of foetal intrauterine growth.

Aims and Objectives- The objectives of this study were to recognise IUGR by screening of placental insufficiency by uterine artery Doppler, and to confirm the clinical diagnosis of IUGR for the better management of pregnant mothers.

MATERIALS AND METHODS
Pregnant mothers, both normotensive and hypertensive were taken from antenatal OPD of R. G. Kar. Medical College & Hospital. Pregnancies with multiple gestations, congenital anomalies and preterm deliveries were excluded from the study. This is a two-stage screening test of uterine arteries by pulsed wave Doppler one at 14-18 wks. and further at 26-28 wks. of gestation. An early diastolic notch was also carefully observed in the wave of both uterine arteries. Mothers were followed up to delivery for observing foetal intrauterine growth restriction and measuring the birth weight of all babies. Sensitivity, specificity, positive predictive value (PPV) & negative predictive value (NPV) of IUGR were calculated according to the resistance index.

RESULTS
In our study there were 40% primigravida's and 60% multigravidas. The sensitivity, specificity, PPV and NPV of IUGR are 45.5%, 94.8%, 71.4% and 88.3% respectively.

CONCLUSION
Women with an early diastolic notch after 24 wks. of pregnancy have considerably a higher risk of developing IUGR. Increased impedance to flow in the uterine arteries is associated with increased risk for subsequent development of IUGR.

KEYWORDS
Uterine artery Doppler, early diastolic notch, resistance index, foetal intrauterine growth restriction, pregnancy.

BACKGROUND
During pregnancy, the uterine artery represents the major portion of the anterior division of the internal iliac artery. These vessels run up each side of the uterus and anastomose with branches of the opposite side, such that utero-placental blood flow is a summation of each arterial supply. The uterine arteries branch into arcuate arteries, leading into radial, basal and spiral arteries, within the myometrium. During the latter part of the first trimester,

cells termed the extravillious trophoblast (EVT) migrate from the anchoring villi into the uterine decidua. The cells invade and surround the spiral arteries, converting these vessels from innervated and muscularized narrow vessels of high resistance, to denervated, passively dilated vessels of low resistance. In addition to their invasive properties, the EVT cells promote maternal blood flow to the implantation site by the production of vasodilatory peptides acting locally in the decidua and myometrium. The diastolic component of the uterine artery doppler wave form is, thus, transformed during normal pregnancy from one of low peak flow velocity and an early diastolic notch by 18-22 wks.

Where there is impaired placentation, the average resistance index in the left and right uterine artery is increased and associated with an early diastolic notch. If this notch persists beyond 24 wks. of gestation this indicate a severe adverse outcome defined by IUGR and foetal

asphyxia that may be followed by pre-eclampsia and foetal death.

Intra uterine growth restriction is said to be present in those babies whose birth weight is below the 10th percentile of the average for the gestational age. But not all babies above 10th percentile are completely normal. Clinical methods often fail to detect about one third of cases and gestational age cannot be accurately determined up to 40% of cases. The meticulous colour Doppler evaluation of clinically assessed small for gestational age foetuses may attain an accuracy of diagnosis rate to about 60%-70% whereas only clinical assessment alone can detect IUGR in only 30%-40% of cases.

As early as 1952 when McKeown and others were the first investigators who estimated foetal weight by gestational age.[1] Donald and Brown (1961) studied the tissue and organ of human body including the gravid uterus and appreciation of boundaries and surface edges of foetal structure. They detected the echoes from the foetuses to be detected by ultrasonography as early as 9th week of gestational age. They also measured the bi-parietal diameter for the first time even.[2] In 1966, Gruenwald expanded the concept of growth curve of foetal body weight for gestational age.[3] Most commonly used standard weight for dates reference are the curves, of those Lubchenco et al. 1963, usher and Mclean (1969), and Brenner et al. 1976 which is the reference standard.[4,5,6] In 1982, Koops et al revaluated the neonatal risk in relation to foetal weight and gestational age and found that small for date foetuses exhibit higher neonatal morbidity and mortality rate than foetuses of average gestational ages.[7]

Separate studies of Campbell (1974) and Wittmann et al (1979) shows abdominal palpation is not an efficient method of recognising small for date foetuses (detection rate: 30-40%).[8,9] Neilson JP, Whitfield CR and Aitchison TC (1980) recommended two stage ultrasonic screening for "small for date" as an effective method, where the first measurement taken at first trimester using crown-rump length (CRL) or biparietal diameter (BPD) and second stage measurement taken at 34-36 wks. using several foetal variables.[10] The results of which is assessed singly and in combination. They have shown that the foetal head measurement to be least sensitive indicator of IUGR (accuracy 50-59%) whereas the measurement of trunk area and circumference correctly identified in 81% and 83% respectively product of CRL and trunk area displayed most sensitivity.[10]

In this era of modern science doppler ultrasound monitoring of foetal growth provides adequate information in the antenatal period, so that all the complications associated with IUGR can easily be superseded by better and easy isolation and management of pregnant mothers. The prior detection and proper management of IUGR in antenatal period is a must. For these reasons our study of doppler evaluation of IUGR, along with clinical correlation will perhaps be a useful procedure for the antenatal assessment of growth restricted foetuses without any harmful effect. In this study we investigated the prognostic value of uterine artery doppler examination in prediction of foetal intrauterine growth.

Aims and Objectives
The aim and objective of this study is to recognise IUGR by screening of placental insufficiency by uterine artery doppler, and to confirm the clinical diagnosis of IUGR for the better management of pregnant mothers.

MATERIALS AND METHODS
The present study was conducted between June 2016 to May 2017 in the department of Radiodiagnosis, in collaboration with the department of Gynaecology & Obstetrics of R.G. KAR. Medical College & Hospital, Kolkata. Pregnant mothers, both normotensive and hypertensive were included in study. Pregnancies with multiple gestations, congenital anomalies and preterm deliveries were excluded from the study. The selected mothers were subjected for history, clinical examination and routine laboratory investigations.

Study was conducted by using B-mode commercially available ultrasound machine of Philips scanner 200 having grey scale display and real-time facilities with 3.5 MHZ convex sector and 5 & 7.5 MHZ linear transducer and Agilent image point-HX colour doppler machine of Hewlett Packard (HP) having colour doppler, power doppler, continuous wave and pulse wave facilities with 1.8, 2.5, 3.5, 7.5 & 10 MHZ curvilinear probes with attachment of computer 9 Pentium) and colour printer (HP-Deskjet 640 C).

This is a two-stage screening test of uterine arteries of 50 unselected pregnant mothers by pulsed wave Doppler one at 14-18 wks. and further at 26-28 wks. of gestation.

An early diastolic notch and low impedance flow (resistive index less than 0.58) was found in normal pregnancy before 24 wks. of gestation. Cases showing early diastolic notch beyond 24 wks. and/or RI value more than 0.58 are associated with development of intrauterine growth restriction.

Gestational age was calculated from the patient's statement of LMP and by grey-scale measurement of foetal parameters (BPD, HC, AC, FL). Pulsed wave doppler was then used to obtain flow velocity wave form of both uterine arteries in the lower lateral border of the uterus. The site of examination was where it crosses the external iliac artery. This gave the ideal doppler wave pattern and accurate value of resistance index.

The resistance index of both uterine arteries was recorded, and the mean was calculated. An early diastolic notch was also carefully observed in the wave of both uterine arteries. Sensitivity, specificity, positive predictive value & negative predictive value of IUGR were calculated according to the resistance index.

Mothers were followed upto the delivery to observe whether there was foetal IUGR during pregnancy.

RESULTS

Maternal Characteristics	No. of Cases	Percentage of Cases
Primigravida	30	60%
Multigravida	20	40%

Table 1. Distribution of Maternal Characteristics

Gestational Age	Presence of Early Diastolic Notch with Increased RI (>0.58) in Total No. of Cases	Percentage of Cases
14- 18 wks.	16	32%
26-28 wks.	07	14%

Table 2. Doppler Characteristics at 14-28 Weeks of Gestation

Neonatal Outcome	Number of Cases	Percentage of Cases
IUGR	5	10%

Table 3. Neonatal Outcome in Respect of Doppler Characteristics

Neonatal Outcome	Number of Cases	Percentage of Cases
IUGR	11	22%

Table 4. Actual Neonatal Outcome Found After Delivery

Screening Test (26-28 wks.)	Diagnosis		Total
	IUGR Present	IUGR Absent	
Positive	5	2	7
Negative	6	37	43
Total	11	39	50

Table 5. Results of Uterine Artery Doppler in Predicting IUGR

Adverse pregnancy outcome	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
IUGR	45.4%	94.8%	71.4%	88.3%

Table 6. Diagnostic Accuracy of Uterine Artery Doppler in Predicting IUGR

DISCUSSION

It was a two-stage screening test of uterine artery in unselected pregnant women from 14 wks. to 28 wks. of gestational age to detect placental insufficiency and prediction of subsequent development of IUGR. Fifty unselected pregnant women were taken in our study. Duplex colour doppler study of uterine artery was done between 14-18 wks. and further at 26-28 wks. of gestation. Mothers were followed up to the delivery and birth weight of all babies were taken. Pregnancies with multiple gestation, congenital anomalies and preterm deliveries were excluded from the study.

In our study we found that an early diastolic notch in uterine artery waveform at 14-18 wks. were normally present. But if this notch persists beyond 24 wks. with increased resistive index, it suggests IUGR.

Increased impedance to flow in the uterine arteries at 26-28 wks. of gestation was 14% of pregnancies. The prevalence of high impedance and presence of early diastolic notch in uterine arteries wave form at 14-18 wks. of pregnancy was more than 2 times higher than at 26-28 wks. of gestation.

In the group with increased impedance at 14-18 wks. of pregnancy but normal result at 26-28 wks., the prevalence of pregnancy complications was not increased compared to those with normal impedance at 14-18 wks.

In the analysis of IUGR, results of Valensise et al 1993 can be compared with our results.[11] The values of uterine arteries sensitivity and specificity in predicting IUGR in our study (45.4% and 94.8%) is comparable to that of Valensise et al (67% and 95%).

Study	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Valensise	67%	95%	54%	97%
Our study	45.4%	94.8%	71.4%	88.3%

Table 7. Comparison of Study Results

Probably, the difference is due to the smaller size of our sample.

CONCLUSION

Women with an early diastolic notch after 24 wks. of pregnancy have considerably a higher risk of developing IUGR. On the other hand, women with normal uterine artery waveform at this period are unlikely to develop IUGR infants. Increased impedance to flow in the uterine arteries is associated with increased risk for subsequent development of IUGR. The test may be useful to minimize unnecessary interventions.

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