

UTERINE ARTERY DOPPLER IN PREDICTION OF PRE-ECLAMPSIA DURING PREGNANCYSukharanjan Howlader¹, Santanu Das²¹Associate Professor, Department of Radiology, North Bengal Medical College and Hospital, West Bengal.²Associate Professor, Department of Radiology, R. G. Kar Medical College and Hospital, Kolkata, West Bengal.**ABSTRACT****BACKGROUND**

Uterine artery represents the major portion of the anterior division of the internal iliac artery during pregnancy.¹ In second trimester of pregnancy, uterine blood flow increases from 50 ml/min in the non-pregnant woman to over 700 mL/min. During normal pregnancy, the diastolic component of the uterine artery doppler wave form is thus transformed from one of low peak flow velocity and an early diastolic notch by 18-22 weeks.² The average increase in resistance index in the left and right uterine artery and its association with an early diastolic notch is found in patients, when there is impaired placentation. If early diastolic notch persists beyond 24 wks. of pregnancy, then this indicates a severe adverse outcome in both mother and foetus defined by intra uterine growth restriction and foetal asphyxia that may be followed by pre-eclampsia and foetal death.³

Aims and Objectives- The aim of this study was to identify pre-eclampsia during present and subsequent pregnancies by screening of placental insufficiency by uterine artery Doppler.

MATERIALS AND METHODS

Pregnant mothers were recruited from antenatal outpatient department of R. G. Kar. Medical College & Hospital. Both normotensive and hypertensive pregnant mothers were included in study. Pregnant mothers with multiple gestations, congenital anomalies and preterm deliveries were excluded from the study. In this study, two-stage screening test of uterine arteries was done by pulsed wave doppler, one at 14-18 wks. and the other at 26-28 wks. of gestation. In the wave of both uterine arteries, an early diastolic notch was also carefully observed. Mothers were followed up to the delivery to observe pre-eclampsia. Sensitivity, specificity, positive predictive value & negative predictive value of pre-eclampsia were calculated according to the resistance index.

RESULTS

In our study, 40% of pregnant mothers were primigravidas and 60% were multigravidas. The sensitivity, specificity, PPV and NPU of pre-eclampsia are 66.6%, 89.3%, 28.5%, and 97.5% respectively.

CONCLUSION

A higher risk of developing pre-eclampsia is seen in pregnant women with an early diastolic notch after 24 wks. of pregnancy. There is association between increased impedance to flow in the uterine arteries with increased risk for subsequent development of pre-eclampsia.

KEYWORDS

Uterine artery doppler, pre-eclampsia, early diastolic notch, resistance index, pregnancy.

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BACKGROUND

Uterine artery represents the major portion of the anterior division of the internal iliac artery during pregnancy.¹ Uterine arteries run up from all 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. Within the myometrium the uterine arteries branch

into arcuate arteries, leading into radial, basal and spiral arteries. During the latter part of the first trimester, the extravillous trophoblast (EVT) migrate from the anchoring villi into the uterine decidua. Spinal arteries are invaded and surrounded by these cells, converting the uterine arteries from innervated and muscularized narrow vessels of high resistance, to denervated, passively dilated vessels of low resistance.^{2,3,4} By the production of vasodilatory peptides acting locally in the decidua and myometrium, the EVT cells promote maternal blood flow to the implantation site in addition to their invasive properties. During normal pregnancy the diastolic component of the uterine artery doppler wave form is, thus transformed from one of low peak flow velocity and an early diastolic notch by 18-22 weeks (wks.).⁵ In second trimester of pregnancy, uterine

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blood flow increases from 50 ml/min in the non-pregnant woman to over 700 mL/min.

The average increase in resistance index in the left and right uterine artery and its association with an early diastolic notch is found in patients, when there is impaired placentation. If this notch persists beyond 24 wks. of gestation this indicate a severe adverse outcome defined by intra uterine growth restriction and foetal asphyxia that may be followed by pre- eclampsia and foetal death.⁶

Pre-eclampsia is a syndrome complex characterised by development of hypertension to the extent of 140/90 mmHg or more with oedema or proteinuria or both induced by pregnancy after the 20th week or earlier in case of H. Mole, Multiple pregnancy or acute hydramnios. The incidence of pre-eclamptic toxemia varies widely from 5-15%. A rise in systolic blood pressure of at least 30 mmHg or a rise in diastolic pressure of at least 15 mmHg over the previously known blood pressure or an absolute rise of pressure of at least 140/90 mm of Hg, if the previous blood pressure is not known, is called toxemic hypertension. Intense vasospasm affecting almost all the vessels particularly those of the uterus and the kidneys is a basic underlying factor related with pathologic state of this syndrome. There is increased evidence of premature ageing of the placenta. Areas of acute red infarction and white infarction are occasionally visible on the maternal surface of the placenta. The normal cytotrophoblastic invasion into the spiral arteries fails to occur beyond decidual myometrial junction in pre-eclampsia. As a result, the musculoelastic media in the myometrial segment remains responsive to vasoconstrictor stimuli resulting in decreased blood flow. Demonstration of pitting oedema over the ankles after 12 hours bed rest or rapid gain in weight of more than 1 lb a week or more than 5 lb a month in the later months of pregnancy may be the earliest evidence of toxemia. The term is preferable to albuminuria, as, apart from albumin, the other fractions of protein leak out in the urine. Presence of protein in 24 hours urine of more than 3 gm per litre or more than 1 gm. per litre in 2 or more specimens obtained 6 hours apart, of midstream urine in the absence of urinary tract infection is considered significant.

Aims and Objectives

The aim and objective of this study is to identify pre-eclampsia during present and subsequent pregnancies by screening of placental insufficiency by uterine artery doppler.

MATERIALS AND METHODS

Pregnant mothers were recruited from antenatal outpatient Department of R.G. KAR Medical College & Hospital, Kolkata. The study was conducted between June 2016 to May 2017 in the department of Radiodiagnosis in collaboration with the department of Gynaecology & Obstetrics. Both normotensive and hypertensive pregnant mothers were included in study. Pregnant mothers 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.

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) was used in this study.

In this study two-stage screening test of uterine arteries was done by pulsed wave doppler, one at 14-18 wks. and the other at 26-28 wks. of gestation in fifty unselected pregnant mothers. In normal pregnancy before 24 wks. of gestation an early diastolic notch and low impedance flow (resistive index less than 0.58) was found. Cases showing early diastolic notch beyond 24 wks. and/or RI value more than 0.58 are associated with maternal complication.^{7,8,9}

For examination purpose a 3.5 MHZ curvilinear probe was used. Mothers were placed in recumbent position on the examination table. Patient's statement of LMP and grey-scale measurement of foetal parameters (biparietal diameter, head circumference, abdominal circumference, femur length) was used for calculating the gestational age. 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.

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

Mothers were followed upto the delivery to observe whether there was pre-eclampsia during pregnancy.

RESULTS

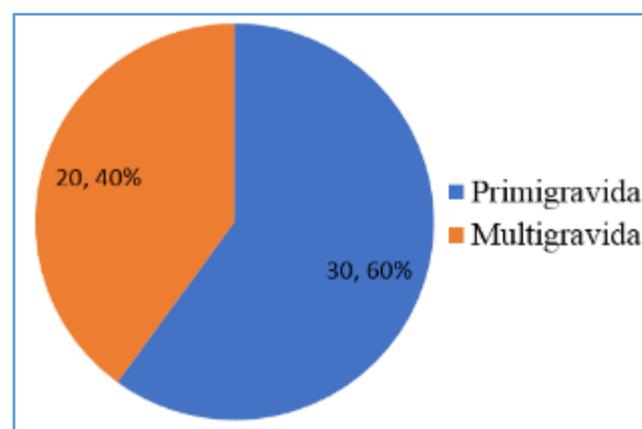


Figure 1. Distribution of Maternal Characteristics

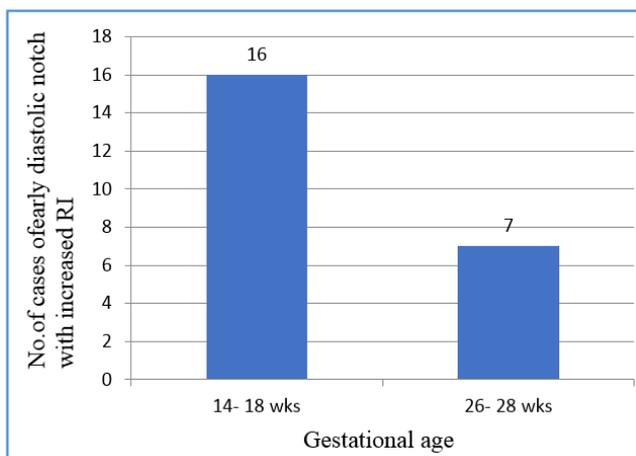


Figure 2. Doppler Characteristics at 14-28 Weeks of Gestation

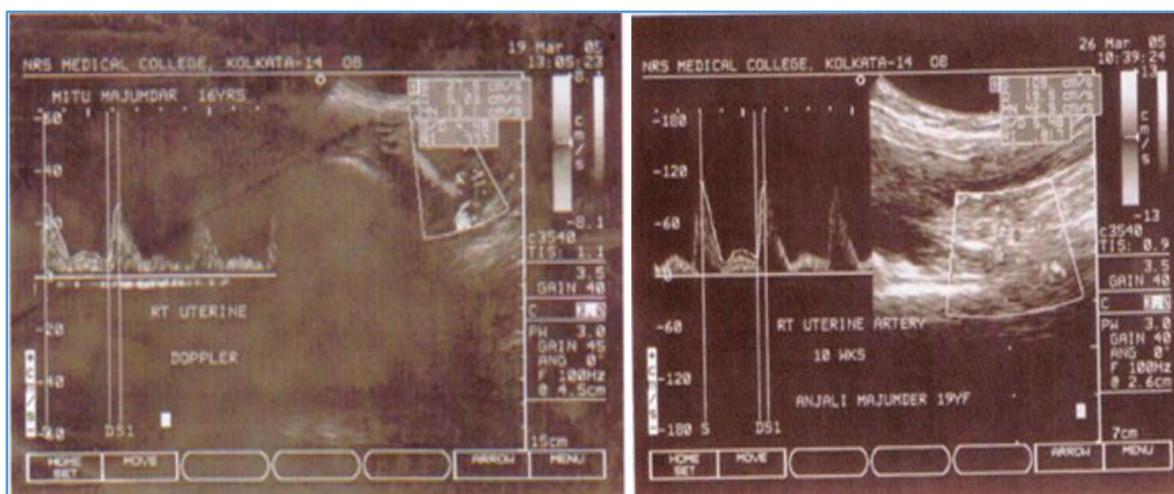


Figure 3. Doppler study of right uterine artery at 28 weeks showing Normal Pattern Early Diastolic Notch

Doppler Characteristics	Number of Cases	Percentage of Cases
Pre-eclampsia	2	4%

Table 1. Pre-eclampsia in Pregnant Mothers as per Doppler Characteristics

Pregnant Mothers	Number of Cases	Percentage of Cases
Pre-eclampsia	3	6%

Table 2. Actual Pre-eclampsia in Pregnant Mothers

Screening test (26-28 wks.)	Diagnosis		Total
	Pre-eclamptic toxemia present	Pre-eclamptic toxemia absent	
Positive	2	5	7
Negative	1	42	43
Total	3	47	50

Table 3. Results of Doppler in Predicting Pre-Eclampsia

Adverse Pregnancy Outcome	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Pre-eclampsia	66.6%	89.3%	28.5%	97.5%

Table 4. Diagnostic Accuracy of Uterine Artery Doppler in Predicting Pre-eclampsia

DISCUSSION

To detect placental insufficiency and prediction of pre-eclampsia in this study, two-stage screening test of uterine artery was done in fifty unselected pregnant women’s, who were recruited from antenatal outpatient department of NRS Medical College & Hospital. Pregnant mothers with multiple

gestation, congenital anomalies and preterm deliveries were excluded from the study. Uterine artery duplex colour doppler study was done between 14-18 wks. and further at 26-28 wks. of gestation. Mothers were followed up to the delivery to detect pre-eclampsia during pregnancy.

We found in our study that an early diastolic notch was normally present in uterine artery waveform at 14-18 wks. But if the early diastolic notch persists beyond 24 wks. with increased resistive index, it is predictive of pre-eclampsia. Increased impedance to flow in the uterine arteries at 26-28 wks. of gestation was in 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 pregnant mothers with increased impedance at 14-18 wks. of gestation but normal result at 26-28 wks., the

prevalence of pre-eclampsia was comparable to those with normal impedance at 14-18 wks.

With colour Doppler characteristics, pre-eclampsia was detected in 2 pregnant mothers, which accounted to 4% of cases. Pre-eclampsia is actually detected in 3 patients, which accounted to 6% of patients.

Similarly Bower et al, who studied uterine arteries as a predictor of pre-eclampsia gave the sensitivity, specificity, positive and negative predictive value.¹⁰ Results of Bower et al can be compared with our results for predicting pre-eclampsia in the following table.

Study	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Bower et al	78%	95%	22%	99%
Our study	66.6%	89.3%	28.5%	97.5%

Table 5. Comparison of Study Results

The difference is probably due to the smaller size of our sample.

CONCLUSION

There is ample evidence that Doppler indices from the foetal circulation can reliably predict adverse pregnancy outcome in an obstetric patient population with high prevalence of complications such as foetal growth restriction and pre-eclampsia. A higher risk of developing pre-eclampsia is seen in pregnant women with an early diastolic notch after 24 wks. of pregnancy. Pregnant mothers with normal uterine artery waveform during this period are unlikely to develop pre-eclampsia. There is association between increased impedance to flow in the uterine arteries with increased risk for subsequent development of pre-eclampsia. Women with normal impedance to flow in the uterine arteries constitute a group that have a minimal risk of developing obstetric complications related to uteroplacental insufficiency.

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