Original Research Paper

Radiology

CORRELATION OF DOPPLER INDICES WITH FOETAL AND MATERNAL OUTCOME IN PREGNANCY INDUCED HYPERTENSION

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ABSTRACT Pregnancy induced hypertension (PIH) is a major cause of maternal as well as fetal morbidity. The normal placenta through implantation and development modifies the uterine circulation from one of low flow and high resistance to one of high flow and low resistance. Doppler ultrasound examination is a non-invasive method, which gives useful information about impaired blood flow to the fetus at risk among high risk patients. Several studies suggest a significant decrease in neonatal morbidity & mortality when Doppler evaluation was a part of fetal surveillance.

INTRODUCTION

Pregnancy induced hypertension (PIH) is a major cause of maternal as well as fetal morbidity. The normal placenta through implantation and development modifies the uterine circulation from one of low flow and high resistance to one of high flow and low resistance. The primary defect that predisposes pregnancy to uteroplacental complications appears to be abnormal placentation. Partial or complete failure of trophoblastic invasion of spiral arteries of uterus leads to increase in vascular resistance in uteroplacental circulation. Pregnancy induced hypertension is defined as the systolic blood pressure greater than 140 mmHg and diastolic blood pressure greater than 90 mmHg on at least two occasions, six hours apart. Pregnancy induced hypertension encompasses gestational hypertension in pregnancy (hypertension without proteinuria), pre-eclampsia (hypertension with proteinuria) and eclampsia (pre-eclampsia with convulsions) The most common complication of PIH is Intra uterine growth retardation (IUGR), perinatal deaths - including intrauterine and early neonatal deaths, hypoxic ischemic encephalopathy intraventricular hemorrhage, periventricular leukomalacia, pulmonary hemorrhage and necrotizing enterocolitis. Doppler ultrasound examination is a non-invasive method, which gives useful information about impaired blood flow to the fetus at risk among high risk patients. Several studies suggest a significant decrease in neonatal morbidity & mortality when Doppler evaluation was a part of fetal surveillance.

Colour Doppler assessment performed at 2nd trimester of gestational age is used for prediction of foetal and maternal adverse outcome in Pregnancy induced hypertension as changes of PIH in maternal as well as foetal circulation are prominent in second trimester. However those ladies who are at high risk of developing PIH shoulder undergo Doppler screening from first trimester and then follow up of such pregnancy should be done with Doppler assessment for earliest detection of abnormal changes in uteroplacental and fetoplacental circulation for timely intervention by clinicians. This early detection and timely intervention will reduce maternal and fetal morbidity as well as mortality which is associated with complications of PIH such as pre-eclampsia, eclampsia, intrauterine foetal growth restriction, preterm delivery, intrauterine foetal death. Diagnostic ultrasound is the integral part of antenatal care and is the modality of choice in the evaluation and management of obstetric patients. The 11-13 week scan is now an emerging screening protocol for surveillance of fetal chromosomal and structural defects. The anomaly scans performed at 18-22week of gestation further aids in detection of any fetal anomaly and pregnancy outcome. Estimation of fetal weight in utero using multiple ultrasound parameters and use of various fetal morphometric ratios and/or measurements of other fetal parameters provide additional useful information for diagnosis of fetal growth rate. Serial evaluation to assess interval growth is recommended for diagnosing IUGR.

MATERIAL AND METHODS

Type of study- Prospective study.

Place of study- MGM Medical College at its 'Mother And Child Care at Kalamboli, Navi Mumbai.

Period of study- November 2019 to September 2021.

Institute Ethics Committee approval will be obtained before start of study.

Written informed consent will be obtained from the patients.

Sample size: 100.

Plan Of The Study:
This is a prospective study to study Doppler indices of uterine artery, umbilical artery, middle cerebral artery and to evaluate correlation with maternal and fetal outcome in pregnancy induced hypertension.

The data was obtained from the antenatal cases coming to the obstetric unit of the mother and child care hospital of MGM at Kalamboli, Navi Mumbai. The ladies coming for their routine ultrasounds examinations for the ANC will be evaluated during their visits in the 1st trimester for the NT scan, the 2nd trimester for the targeted anomaly scan and the 3rd trimester for the doppler study; 100 cases will be studied and followed up. All the patients will be scanned strictly adhering to PCPNDT Act.

The details of present pregnancy were noted which included date of last menstrual period, first scan reports, follow up scans, betahCG levels, triple test reports, non fetal stress test and any relevant obstetric findings. The patients who reported in first trimester were followed up in 2nd and 3rd trimester in order to detect fetal growth. In cases with risk factors, serial monthly sonography was done to identify IUGR in fetus. Initial dating scan followed by second ultra-sound examination was done at around 34 to 36 weeks.All the cases were scanned for maternal and fetal parameters. The patients were scanned in supine position via transabdominal approach. The subjects were scanned on Voluson P8 machine with convex probe of 2-7 MHz. The patients were evaluated for Doppler in their third trimester apart from the routine biometry, strictly in accordance to the PCPNDT Act.

Doppler studies were done on Umbilical artery, Middle Cerebral Artery and Ductus venosus with a real time color Doppler ultra sound machine. Umbilical cord was located on the fetal aspect and identified at origin, mid-section and insertion in the amniotic pool. The umbilical artery doppler was performed at mid cord or placental insertion and values were recorded. Middle cerebral artery was localized in transverse section of fetal skull, at the level of thalamus in the Sylvian fissure. The ductus venosus was examined in the mid-sagittal section at the level of abdominal circumference section. It is identified as an aliasing vessel where it joins the umbilical vein to IVC. The Doppler examination was performed per abdominally and the transducer was adjusted appropriately till the vessel is identified and sampled accurately with corresponding waveform. Care was taken while performing the doppler study in order to avoid the contamination of signals from other adjacent vessels. The doppler study was performed till satisfactory quality in the form of waveform with uniform shape and amplitude was achieved. The signals were recorded for a minimum of 5 to 8 cycles in order to avoid the thermo sonic effects on fetus due to doppler waves. When an appropriate sample was achieved the image was frozen and the measurements were calculated by the automatic software in the machine. Rarely, the manual tracing of the spectral waveforms were done. All the parameters were analyzed which included PSV, RI, PI and a-waveform. The doppler study is labeled as abnormal if the a-wave form shows abnormality like reversed a- wave or absent a- wave. Cerebro placental ratio less than one was also taken as abnormal. Those with absent and reverse flow were taken up for termination of pregnancy. In those cases with low diastolic flow in umbilical artery, where fetal maturity adequate for survival was present, the pregnancy was terminated. Outcome of pregnancy was recorded in detail including the gestational age at delivery, birth weight, Apgar score at the time of birth, developmental stage, intra uterine death, presence of any congenital anomalies, presence of cardiac defects, any facial or cranial abnormalities, perinatal development and placental evaluation in terms of placental weight and pathology. The details were recorded from the registration of pregnancy to follow up scans during the interval the patient visited the OPD and ended with recording of detailed fetal outcome. All the data was collected in the assigned period of study and was statistically analyzed and evaluated. Procedure of Obstetric ultrasound examination and Doppler evaluation performed are given below.

Duration Of Study
November 2019 to September 2021

Inclusion Criteria
- All the pregnancies coming for the routine ANC scans to the department of Radiodiagnosis.
- The ANC ladies who are willing for the study.
- All the ANC ladies who are willing for the follow up till delivery.

Exclusion Criteria
- Pregnant subjects with chronic hypertension.
- Patient not willing for the study and follow up.
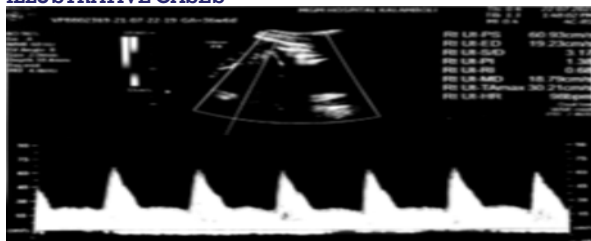
ILLUSTRATIVE CASES

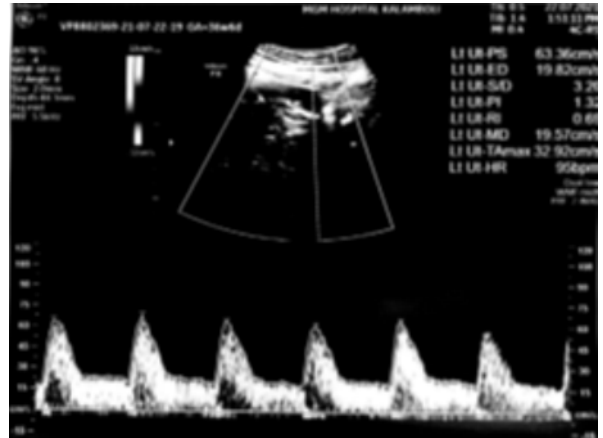Figure 1 – Abnormal right uterine artery Doppler sonogram

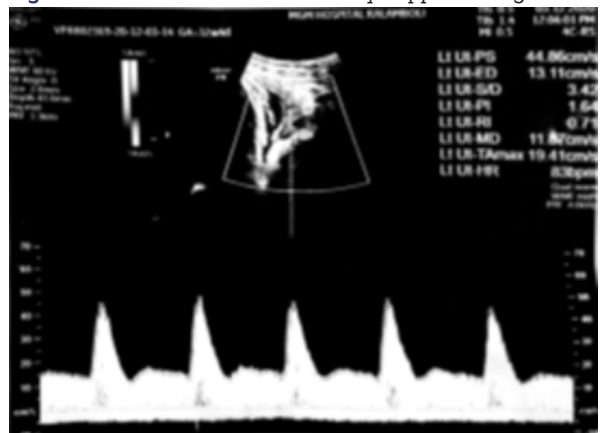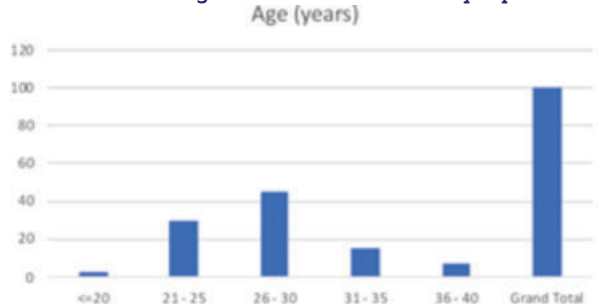Figure 2 – Abnormal Left Uterine Artery Doppler Sonogram

Figure 3 – Abnormal Uterine Artery Doppler Sonogram With Diastolic Notch

RESULTS
Table 1 Show The Age Distribution Of The Study Population.

Distribution of the age of the study population (Table 1)

Grouping	Count of PARITY	%
Primipara	39	39%
Multipara	61	61%
Grand Total	100	100%

Table 2 – Parity In Study Participants

Gestational History	Number of cases with Previous History	%
Cardiac	5	5.00%
Chromosomal	2	2.00%

IUD	13	13.00%
IUGR	6	6.00%
Normal	74	74.00%
Grand Total	100	

Table 3 – Gestational History In Study Participants

Fetometry	Count of FETOMETRY	% FETOMETRY
Abnormal	18	18.00%
Normal	82	82.00%
Grand Total	100	100%

Table 4 – Fetometry In Study Participants

PI	Number of cases	%
Normal	43	43.00%
Abnormal	57	57.00%
Grand Total	100	100%

Table 5 – Uterine PI Of Study Participants

RI	Count of RI	% of RI
<= 0.8	78	78.00%
> 0.8	22	22.00%
Grand Total	100	100%

Table 6 – Uterine RI Of Study Participants

Waveform	Number of cases	%
Abnormal	11	11.00%
Normal	89	89.00%
Grand Total	100	100%

Table 7 – Waveform Of Umbilical Artery Of Study Participants

PSV	Number of cases	%
Normal	96	96.00%
Abnormal	4	4.00%
Grand Total	100	100%

Table 8 – Waveform Of Middle Cerebral Artery Of Study Participants

Maternal outcome	%	Number of cases
Pre-eclampsia	34%	34
Eclampsia	9%	9
Normal	66%	66
Grand Total	100%	100%

Chart Title

■ Pre-edampsia ■ Eclampsia ■ Normal
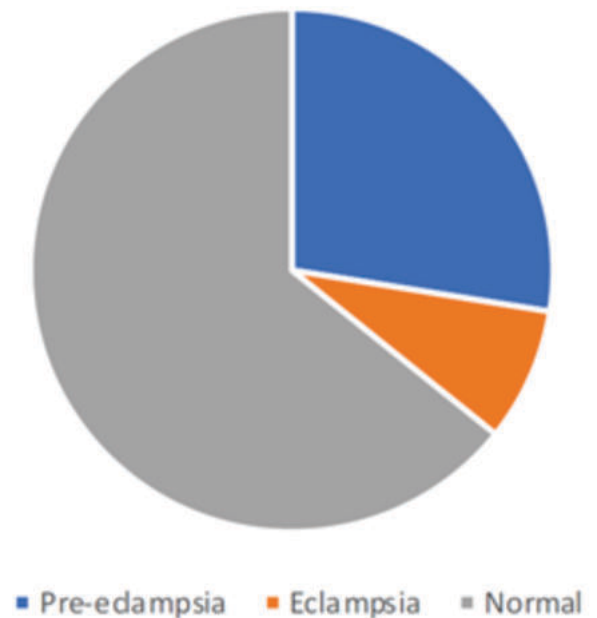
Table 9 – Maternal Outcome In Study Participants

Fetal outcome	%	Number of cases
Intrauterine growth restriction	22%	22
Preterm delivery	8%	8
Intrauterine death	4%	4
Normal	78%	78
Grand Total	100%	100

Table 12 – Foetal outcome in study participants

Table 10 – Foetal Outcome In Study Participants

Maternal outcome	Abnormal PI
Normal	28
Abnormal	29
Pre-eclampsia	29
Eclampsia	9

Table 10 – Correlation Of Maternal Outcome With Abnormal Uterine PI In Study Participants

Fetal outcome	Abnormal PI
Normal	41
Abnormal	16
IUGR	16
Preterm delivery	8
IUD	4

Table 11 – Correlation Of Foetal Outcome With Abnormal Uterine PI In Study Participants

DISCUSSION

The earliest changes of pregnancy induced hypertension can be detected with ultrasonography. However, fetometry by using B mode ultrasound is not sensitive enough to detect early circulatory changes of pregnancy induced hypertension. Color Doppler ultrasound and Doppler indices are very sensitive for detection of earliest abnormalities of pregnancy induced hypertension. This study analyzed the diagnostic capabilities of Doppler parameters such as Pulsatility Index, Resistivity Index, Peak systolic velocity in pregnancy induced hypertension. Doppler parameters of uterine artery, umbilical artery, middle cerebral artery were analyzed in this study.

The abnormalities in the Doppler indices of these vessels were correlated with abnormal maternal outcome in form of pregnancy induced hypertension, pre-eclampsia and eclampsia. The changes in Doppler parameters were correlated with adverse fetal outcome in form of preterm delivery, intrauterine grow restriction and intrauterine fetal death. In this study, maximum pregnant ladies are in age range of 26-30 years. This is similar to the study group of Yusuf[1] in Kano, where the median age was 27 years with age range of 18-45 years. This is also similar to the study by Groom et al[2] in Franzcog (USA) where the median maternal age was 28 years.Pulsatility Index of uterine artery is the most mportant parameter in diagnosing pregnancy induced hypertension. A study done by Melchiorre (2008: 135)[3] reported that uterine artery Doppler indices were significantly higher in women who developed preterm preeclampsia. In this study out of 100 patients, 57 patients showed raised PI above normal [4] level and rest 43 with normal PI values. This study showed uterine artery PI has high sensitivity of 85% for detection of abnormal maternal outcome with high negative predictive value of 88%. This study showed higher sensitivity of 85% as compared to the studies done by Coleman et al[5] and Caforio et al. On correlation with fetal outcome, this study showed uterine artery PI has sensitivity of 72% in detection of adverse fetal outcome with negative predictive value of 86%. Comparing the PI values in our study to the values in the study done by Gomez and colleagues, it showed that the Pl values decreased as gestation increased as is to be expected in a normal pregnancy.

Increased impedance to flow in the uterine arteries in pregnancies indicated by increased PI and RI was found in 57% of patients, out of these about 49% of patients subsequently develop preeclampsia and it identifies about 28% of those patients that subsequently develop IUGR. Shear[6] and colleagues (2005: 1119) reported a relationship between preeclampsia and FGR. Their study showed critical maternal complications more frequently in pre-eclamptic patients with associated FGR.

The results of our study confirm the work done by Pilalis[8] (2007

: 533) and Harrington[7] (2004:54) who both found that second trimester uterine artery Doppler screening has proven to be a sensitive and accurate tool for predicting pre-eclampsia and fetal growth restriction in high risk populations.

Spectral waveform of umbilical artery represents efficiency of feto-placental circulation. Normally umbilical artery has high diastolic flow to supply blood to fetus even in diastolic phase of cardiac cycle. Reduction in this diastolic flow or absent diastolic flow results in intrauterine growth restriction due to reduced fetal supply. Reversal of diastolic flow in umbilical artery is associated with high fetal mortality. In this study out of 100 cases, 11 cases showed abnormal umbilical artery waveform. On correlation of this abnormal waveform with fetal outcome this study showed that it has high specificity of 91% for predicting adverse fetal outcome in pregnancy induced hypertension. Hence umbilical artery waveform can be reliably used as screening tool to rule out feto-placental circulatory compromise in PIH. It is one of the most important parameter in cases with IUGR for planning whether to terminate the pregnancy or follow up the pregnancy for better fetal outcome. Middle cerebral artery is important vessel that supplies oxygen to foetal brain. In case of global foetal hypoxia, the flow to the brain is increased through MCA by brain sparing effect which is physiological phenomenon to protect brain from hypoxic injury. This increased flow results in abnormal high Peak Systolic Velocity value in Doppler assessment of MCA. Hence abnormally increased PSV in MCA indicates foetal hypoxia. In this study out of 100 cases, 4 cases showed abnormally high MCA PSV. On correlation of this parameter with foetal outcome this study showed that it has high specificity of 96% in diagnosing adverse fetal outcome. Hence MCA PSV can be used as screening Doppler parameter to rule out fetal hypoxia in follow up scans of patients with PIH.

CONCLUSION

Abnormal Doppler indices indicates abnormal utero-placental and feto-placental circulation which leads to maternal and fetal mortality and morbidity.

Obstetric Doppler is used as screening tool for early prediction of circulatory abnormalities in cases of patients with gestational hypertension.

Abnormal umbilical artery waveform in the form reversal of diastolic flow is important indicator for termination of pregnancy.

The middle cerebral artery evaluation is helpful for detection of fetal hypoxia.

Conflict Of Interest: None to declare

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