A Comparative Study of Relationship of Placental Localization by Ultrasonography in Pregnancy Induced Hypertension and Normotensive Pregnant Women in Third Trimester

Jeruha Kadium¹, Sudha Bindu Tirumani²

¹Assistant Professor, Department of Obstetrics and Gynaecology, Osmania Medical College, Hyderabad, Telangana.  
²Associate Professor, Department of Radiodiagnosis, Osmania Medical College, Hyderabad, Telangana.

ABSTRACT

BACKGROUND
Hypertensive disorders are the most common medical complications of pregnancy affecting 7% to 15% of all gestations and account for a quarter of all prenatal admissions. The localisation of placenta has a role in predicting the occurrence of pre-eclampsia in the prenatal scans. We wanted to evaluate the relationship between placental location and occurrence of pregnancy induced hypertension.

METHODS
In our study, during a period of 1 yr. (October 2018 to September 2019) 81 women diagnosed with pregnancy induced hypertension (gestational hypertension, preeclampsia, eclampsia) according to ACOG and 81 normotensive women in their third trimester were examined with ultrasound for localisation of placenta. Ultrasound evaluation was done with 5 MHz linear array transducer on Esoate my lab 50 machine.

RESULTS
Out of 162 patients, the most common age of presentation was 20 to 25 yrs. When placental location was compared between women with PIH and normotensive, it has been seen that 69.13% of PIH women had laterally implanted placenta and 30.9% had centrally located placenta. Whereas in normotenesives 74.1% had centrally located placenta and 25.9% had laterally located placenta. This shows that there is significant association between site of implantation of placenta and the occurrence of PIH. The efficacy of using placental laterality by ultrasonogram as a predictor of PIH has a sensitivity of 78.1% which though low is better than most other tests, specificity of 74% and positive predictive value of 73%. However, it has a low negative predictive value of 70.5% when compared with other tests.

CONCLUSIONS
Placental localisation as seen in ultrasonogram is strongly associated with pregnancy induced hypertension with a strong statistical significance. Laterally located placenta is 6.4 times more commonly seen in women with pregnancy induced hypertension when compared to that in normotensive women. Placental laterality by ultrasonography can be used as a predictor of pregnancy induced hypertension with good sensitivity, specificity, positive and negative predictive values. Thus, as ultrasonography is a simple, cost effective, easily available and easy to perform non-invasive test, the sonologist while conducting the regular antenatal ultrasonography, should look for location of placenta, and when found to be laterally located can caution the women regarding the likeliness of developing PIH and educate them for regular antenatal check-ups.

KEYWORDS
Placental Lateralisation, Preeclampsia, Ultrasonography
BACKGROUND

Hypertensive disorders represent the most common medical complications of pregnancy affecting 7% to 15% of all gestations and account for a quarter of all antenatal admissions. According to World health organization (WHO) systematic review on maternal mortality worldwide, hypertensive disease remains a leading cause of direct maternal mortality. Together with haemorrhage and infection hypertension forms the deadly triad that contributes to morbidity and mortality during pregnancy and childbirth. Although maternal mortality is lower in developed countries than in developing countries the incidence of preeclampsia is on a rise in the USA, due to rise in predisposing disorders like chronic hypertension, diabetes, obesity. About 16% of maternal deaths have been attributed to hypertensive disorders in developed countries and over half of these hypertension related deaths were preventable. In India 24% of all maternal deaths are due to preeclampsia. Hypertensive disorders also have long term impact on the health of women in the form of chronic hypertension and increased lifetime cardiovascular risk. Hypertensive disorders also carry the risk to the foetus. Preeclampsia is strongly associated with still birth, foetal growth restriction, low birth weight, spontaneous iatrogenic preterm delivery, respiratory distress syndrome and admission to neonatal intensive care. Therefore a method of protecting women from hypertensive disorders based on insight into the pathogenesis would thus be of great benefit to both mother and baby. Quality antenatal care, thorough knowledge of hypertensive disorders, a high index of suspicion, is the key for early diagnosis and timely intervention. Search to identify the women at risk, who need to be evaluated and monitored for prophylactic therapies by accurate, sensitive, clinically acceptable clinical tests prior to or during pregnancy before the pathology sets in is the need of the day. Preeclampsia occurs only in the presence of placenta.

A number of studies have shown that placental location has been found to correlate with foetal position and presentation, length of gestation, course of labour, presence of preeclampsia, intrauterine growth restriction and pregnancy outcome. During pregnancy, the uterine site of placental implantation is an important determinant of placental blood flow. Placental location can be documented by various methods, like X-ray, isotopic placentography, etc. In the past two decades ultrasonography has proved to be the safest, easiest and the most accurate method for assessing placental location. It has been shown that in humans, both uterine arteries supply the corresponding side of the uterus through its branches. Although anastomoses between the two uterine arteries exist, there is no proof that these are functional.

When the placenta is centrally located, the utero placental blood flow needs are met by equal contribution from both uterine arteries. However, when the placenta is laterally located, in the majority of the patients, the utero placental blood flow needs are met primarily by one of the uterine arteries, with some contribution by the other uterine artery via collateral circulation. This degree of collateral circulation, however, may not be the same in all patients and deficient contribution may facilitate the development of preeclampsia, IUGR or both. This is evidenced by the Doppler studies of uterine arteries wherein, when the placenta is laterally located, the uterine artery close to the placenta has lower resistance than the one opposite. In patients with centrally located placenta, both uterine arteries demonstrate similar resistance.

In the light of these observations, we designed a comparative cross sectional study to find out the relationship between lateral location of placenta and the occurrence of preeclampsia by comparing placental location in women with pregnancy induced hypertension with that in normotensive women as seen by ultrasound in their third trimester and thus to know whether placental localisation can be used to predict the development of preeclampsia.

Objectives
1. To evaluate relationship between placental location and occurrence of pregnancy induced hypertension.
2. To compare the incidence of lateral implantation of placenta in women with pregnancy induced hypertension with that in normotensive women.
3. To find out whether placental laterality as determined by ultrasound can be used as a predictor for the development of preeclampsia.

METHODS

This study was conducted in Government maternity hospital, Sultan bazar, Hyderabad, for a duration of one year (October 2018 to September 2019. This study included 81 women diagnosed with pregnancy induced hypertension (Gestational hypertension, preeclampsia, eclampsia) according to ACOG and 81 normotensive women in their third trimester. Pregnant women with pregnancy induced hypertension, Normotensive pregnant women, Singleton pregnancy, Women giving consent for the study were the inclusion criteria. Pregnant women with Twin gestation, Uterine anomalies, Previous history of preeclampsia or eclampsia, Diabetes, Renal disease, those women not willing for follow up were excluded from the study.

Methods of Data Collection
In this study, after informed consent, A total of 162 women, attending the department of obstetrics and gynaecology, Government maternity hospital, Sultan Bazar, 81 women diagnosed with PIH (Gestational hypertension, preeclampsia, eclampsia) according to ACOG guidelines and 81 normotensive women who are fulfilling the inclusion criteria were included in the study. Detailed clinical history of the antenatal women was taken. General physical examination done. Height and weight of the women noted, and Body Mass Index calculated. BMI= weight in kgs / (height in metres). The women are classified according to...
their BMI (Kg/m²) into underweight, normal, overweight and obese according to the classification given by National Institute of Health in 2000. Temperature, Pulse rate, examination of CVS and Respiratory system done. Neck, breast, spine and gait examined. Blood pressure is recorded with the women in an upright position with their right arm supported in horizontal position at the level of the heart after 10 minutes or longer rest period.

Ideally BP recorded with mercury sphygmomanometer with appropriate size cuff. Beginning of heart sounds (Korotkoff’s phase I) is taken as systolic reading and disappearance of heart sounds (Korotkoff’s phase v) is taken as diastolic reading. Women were enquired regarding the imminent signs of eclampsia like headache, nausea, vomiting, epigastric pain, urine output, deep tendon reflexes examined. The women then were accordingly classified into non-severe and severe preeclampsia. Detailed obstetric examination of the women is performed. Investigations like Blood grouping and typing, complete blood picture, platelet count, Random Blood sugars, Renal Function Tests, Liver function tests, clotting time, Bleeding time, Prothrombin count, Random Blood sugars, Renal Function Tests, clotting time, Partial Thromboplastin Time and serology done. Complete urine examination, 24-hour urinary protein estimation done. Fundoscopy done for indicated cases. Obstetric Ultrasound examination done for fetal gestational age, lie, presentation, biometry, AFI and placental examination done. The location of placenta is noted. Obstetric ultrasonography performed using Esoate my lab 50 ultrasound scanner with a 5 MHz convex probe.

The placenta is classified as central when it is equally distributed between the right and left side of the uterus irrespective of anterior, posterior or fundal position. When more than 75% of the placental mass is to one side of the midline, it is classified as unilateral right or left placenta. Doppler flow velocity wave forms are obtained from arterial and venous beds in the foetus. These included umbilical, midline cerebral and ductus venous. The arterial Doppler wave forms used to measure the peak systolic (S), peak diastolic (D) and mean volumes (M).

From these S/D ratio= peak systolic/peak diastolic ratio, Pulsatility Index (PI)= (S-D)/M, Resistance Index (RI)= (S-D)/S are calculated.

Abnormal Doppler studies include raised S/D ratio, reduced, absent or reversed end diastolic flow of the umbilical artery, increased diastolic velocity or decreased S/D ratio or decreased PI of the middle cerebral artery. Intraterine growth of the foetus less than the 10th percentile for that gestational age is taken as IUGR. Women with absent foetal heart is taken as IUD. Women who had antepartum haemorrhage with evidence of placental separation is taken as abruption placenta. The pregnancy outcome, mode of delivery noted. Foetal birth weight and Apgar score at 5 minutes and 10 minutes noted. All the new-born babies with birth weight less than 2500 gms is taken as low birth weight.

### RESULTS

<table>
<thead>
<tr>
<th>Parity</th>
<th>No. of PIH Cases n (%)</th>
<th>No. of Controls (Normotensive) n (%)</th>
<th>Total n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primigravida</td>
<td></td>
<td></td>
<td>80 (49.4%)</td>
</tr>
<tr>
<td>Second gravid</td>
<td>24 (30%)</td>
<td>27 (33.3%)</td>
<td>51 (31.5%)</td>
</tr>
<tr>
<td>multiparous</td>
<td>11 (13.2%)</td>
<td>20 (24.7%)</td>
<td>31 (19%)</td>
</tr>
<tr>
<td>Total</td>
<td>81 (100%)</td>
<td>81 (100%)</td>
<td>162 (100%)</td>
</tr>
</tbody>
</table>

Table 1. Distribution of Study Subjects According to Parity of the Women (n=81)

<table>
<thead>
<tr>
<th>Location of Placenta</th>
<th>Non-Severe PIH n (%)</th>
<th>Severe PIH n (%)</th>
<th>Total n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>30 (59%)</td>
<td>26 (87%)</td>
<td>56 (69.2%)</td>
</tr>
<tr>
<td>Central</td>
<td>21 (41%)</td>
<td>4 (13%)</td>
<td>25 (30.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>51 (53%)</td>
<td>30 (37%)</td>
<td>81(100%)</td>
</tr>
</tbody>
</table>

Table 2. Comparison of Placental Location between Pregnancy Induced Hypertension and Normotensive Women (n=81)

<table>
<thead>
<tr>
<th>Placental Location</th>
<th>IUGR n (%)</th>
<th>Intrauterine Death n (%)</th>
<th>Abruption n (%)</th>
<th>Preterm n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>26 (93%)</td>
<td>6 (100%)</td>
<td>1 (33.3%)</td>
<td>22 (88%)</td>
</tr>
<tr>
<td>Central</td>
<td>4 (7%)</td>
<td>0</td>
<td>2 (66.7%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Total</td>
<td>28(34.5%)</td>
<td>6 (7.4%)</td>
<td>3 (3.7%)</td>
<td>25 (30.8%)</td>
</tr>
</tbody>
</table>

Table 3. Relationship between Placental Location and Severity of PIH (n=81)

Table 4 shows the relationship between placental location and complications of PIH.

Table 5. Doppler Changes in Relation to Pregnancy Induced Hypertension

Table-1 shows the distribution of study subjects according to the parity of the women. The distribution is found to be similar, with no statistical significance (p=0.1008). Primigravida formed the largest group in the study being 56.8% and 42% in cases and controls respectively. Table-2 shows the comparison of placental location between women with PIH and normotensive women. Among the 81 women with PIH 69.1% had laterally located placenta and 30.9% had centrally located placenta. Whereas in normotensive women 74.1% had centrally located placenta and 25.9% had laterally located placenta. From table-3 it can be seen that out of 81 women of PIH 30(37%) had severe PIH and 51(63%) had non-severe PIH. Among the severe PIH 87% had laterally located placenta and 13% had centrally located placenta. Among the non-severe PIH 59% had laterally located placenta whereas 41% had centrally located placenta. Table-4 shows the relationship between placental location and complications of PIH. Of the 81 women with PIH 28 (34.5%) had IUGR, 6(7.4%) had IUD, 3.7% had abruption placenta, 25 (30.8%)
had preterm deliveries. Among women with intrauterine growth restriction 93% had laterally located and 7% had centrally located placenta. Among the PIH women with abortion, 33.3% had laterally located placenta and 66.7% had centrally located placenta and among the 30.8% of preterm, 88% had laterally located placenta and 12% had centrally located placenta. Table-5 shows the relationship of placental location and Doppler studies. Among the 81 PIH women, 17(21%) women had abnormal Doppler study with raised S/D ratio or decreased, absent or reversal diastolic flow of umbilical artery. Among them 94% had laterally located placenta and 6% had centrally located placenta.

DISCUSSION

Pregnancy induced hypertension is a complex clinical syndrome involving multiple organ systems and still remains the principle cause of maternal and perinatal mortality and morbidity. The search for an ideal predictive test and preventive measure still remain challenging. In this study 81 women with Pregnancy induced hypertension is compared with 81 normotensive women. In this study, the distribution of women according to age group among PIH cases and controls are comparable and has no statistical significance. It is similar to the distribution of age among the study groups of Kakkar Tania et al (2012), Mallikarjunappa B et al. (2013) and Sandhya et al (2015).

In this study the incidence of PIH was more in women who were overweight i.e., 48% and 6.4% were obese. Whereas in normotensive most of them were normal weight i.e., 74%. According to the study of Kakkar Tania et al. (2012) the distribution of women according to BMI were 13.3% underweight, 31.3% normal weight, 50% were overweight and 4.7% were obese. This distribution of BMI is comparable to the present study. In this study most of the cases were primigravida i.e., 56.8%, 30% were second gravida and 13.2% were multigravida. Among the controls 42% were primigravida, 33% second gravida and 25% multigravida. The groups are comparable and have no statistical significance. This study is similar to the studies of Pai Muralidhar V et al (2005), Lavanya Rai et al (2010) and Shivamurthy H.M et al (2012) study.

Regarding the distribution of study subjects according to the gestational age, women diagnosed with PIH according to ACOG guidelines and admitted in the antenatal ward are included in the study. Among them 16% belonged to 28-32 weeks of gestation, 14.8% belonged to gestational age of 33-36 weeks and 69.2% were between 37-40 weeks. Whereas in case of normotensive, all the women included in the study belonged to gestational age of 37-40 weeks. The study did not include normotensive women before 37 weeks of gestation because some of these women may later develop PIH thus altering the observations and results. In this study, of the 81 women with PIH 69.1% had laterally located placenta and 30.9% had centrally located placenta.

In case of controls, 74% had centrally located placenta and 26% had laterally located placenta. This comparison is statistically significant with p value of <0.0001. Of the 81 cases 51 developed non severe preeclampsia and 30 developed severe preeclampsia. Among the severe preeclampsia 87% had laterally located placenta and 13% had centrally located. In non-severe preeclampsia 59% had laterally located placenta and 41% had centrally located placenta. These observations are similar to the studies done by Kakkar Tania et al (2012) and Sandhya et al (2015). Among the 81 cases of PIH, 28 i.e., 34.5% developed intrauterine growth restriction of which 78.5% had laterally implanted placenta and 21.5% had centrally implanted placenta. This is similar to the Kofinas et al study where among the 41 IUGR, 75% had laterally located placenta and 25% had central placenta. In this study among 81 cases of PIH 6 (7.4%) had IUD of which 100% had laterally located placenta. The incidence of IUD is similar to the studies of Kurt Hecher MD et al and Lavanya Rai et al. In this study the incidence of abortion was 3.7%. It is in between the incidences, according to the studies of Harrington K et al and Lindqvist PG et al. In this study there were 30.8% of preterm deliveries of which 84% had laterally located placenta and 16% had centrally located placenta. This observation is similar to the studies of Lavanya Rai et al and Mallikarjunappa.

In this study 17 cases of PIH had abnormal Doppler studies of which 94% had laterally implanted placenta and 6% had centrally implanted placenta. This study can be compared to the studies of Kofinas et al, Mallikarjunappa B. et al. In this study among PIH women 69% of the cases were delivered by caesarean section and 31% delivered vaginally. This is similar to the studies of Lucy et al and Lavanya Rai et al. Whereas in case of controls 42% delivered vaginally and 58% delivered by caesarean section. In the study by Szymonowicz W. 71% delivered vaginally and 29% delivered by LSCS. In Lucy et al study 26% are delivered by LSCS. The increased rate of caesarean section in controls in the present study is because this institute being a referral centre, the incidence of obstetric high-risk cases is more. Out of 81 cases 32(40%) of them delivered low birth babies of whom 81.2% had laterally located placenta and 18.8% had centrally located placenta. This study is similar to the study by Bhale rao et al. In this study the incidence of newborn with Apgar score at 5 minutes <7 are 10 i.e., 13.3 %. In Kurt Hecher MD et al study the incidence was 6.5%. Among the babies with birth asphyxia 80% had lateral placenta and 20% had centrally located placenta.

According to Pai Muralidhar V et al study, the sensitivity of using location of placenta based on ultrasound as a predictive test was 73%, the specificity 86%, positive predictive value 51% and negative predictive value of 94%. In this study the sensitivity of the test is 69%, specificity is 74%, positive predictive value is 73% and negative predictive value is 71%. It is comparable to Pai Muralidhar V et al study with minor variations. When compared with the other predictors of PIH, placental laterality has a sensitivity of 69% which is better than that of other studies.
except the study of Pai Muralidhar V et al.\textsuperscript{27} specificity is 74% only which is lower than that of other studies. Its positive predictive value is 73% which is far better than the other studies. Its negative predictive value is 71% less than that of other studies. However, ultrasonography is a simple, cost effective, easily available, easily acceptable non-invasive test which makes it highly recommendable as a predictive test for PIH. Further studies are however needed to evaluate the efficacy of this simple test as a predictor.

**Summary**
This study included 162 women of whom 81 women had pregnancy induced hypertension and 81 women were normotensives. The distribution of age in the study group were comparable, with most women between 20-25 years. This comparison had no statistical significance. When BMI of the women was considered 48% of the women with PIH were overweight and 6.4% were obese. Whereas in normotensives, 74% of the women had normal weight. This comparison had statistical significance with p value <0.001. This indicates that PIH is more common in overweight women in this study. The distribution of study group based on parity was also comparable with 56.8% of nullipara, 30% of primipara and 13.2% of multiparous women in PIH women. In controls 42% were nullipara, 33.3% were primipara and 24.7% were multipara.

This comparison had no statistical significance. Among PIH 16% belonged to gestational age between 28-32 weeks, 14.8% between 33-36 weeks, 69.2% between 37-40 weeks. Among normotensives 100% belonged to gestational age between 37-40 weeks. This observation had statistical significance with p value <0.05. When placental location was compared between women with PIH and normotensives, it has been seen that 69.13% of PIH women had laterally implanted placenta and 30.9% had centrally located placenta. Whereas in normotensives 74.1% had centrally located placenta and 25.9% had laterally located placenta. This comparison has statistical significance with chi-square 28.6 and p value <0.0001. Its odds ratio is 6.4 with 95% CI. This shows that there is significant association between site of implantation of placenta and the occurrence of PIH. Among the 81 women with PIH 51 had non-severe preeclampsia and 30 had severe preeclampsia. In women with severe preeclampsia 87% had laterally located placenta and 13% had centrally located placenta. In women with non-severe preeclampsia, 59% had laterally located and 41% had centrally located placenta indicating that severity of preeclampsia also is related to lateral implantation of placenta. This observation has statistical significance with p value <0.05. Among the 81 women with PIH, 34.5% had IUGR, 7.4% had IUDs, 3.7% had abruptio placenta and 30.8% had preterm deliveries. 93% of the women with IUGR, 100% of IUDs, 33.3% of abruptio placenta and 88% of preterm had laterally located placenta. This relationship had statistical significance with p<0.05. 21% of the women with PIH had abnormal Doppler study of whom 94% had laterally located placenta and 6% had centrally located placenta which is statistically significant with p<0.05. Among the 81 women with PIH, 66% delivered by caesarean section and 31% delivered vaginally. Whereas in normotensives women 58% delivered by caesarean section and 42% delivered by vaginal delivery. This has no statistical significance. Among the babies born to PIH women 39.5% had low birth weight of which 81.2% had laterally located placenta and 18.8% had centrally located placenta. Whereas in babies born to normotensives women only 6% had low birth weight babies of whom 60% had laterally located and 40% had centrally located placenta. There were 7.4% of stillbirth of whom 100% had laterally located placenta and is statistically significant with p <0.05. The efficacy of using placental laterality by ultrasonogram as a predictor of PIH has the sensitivity of 78.1% which though low is better than most other tests, specificity of 74% and positive predictive value of 73%. However, it has a low negative predictive value of 70.5% when compared with other tests. Placental laterality by ultrasonogram is a very useful, cost effective, easily available, easily acceptable and easy to perform non-invasive test.

**CONCLUSIONS**
Placental localisation as seen in ultrasonogram is strongly associated with pregnancy induced hypertension with a strong statistical significance. Laterally located placenta is 6.4 times more commonly seen in women with pregnancy induced hypertension when compared to that in normotensives women. Placental laterality by ultrasonography can be used as a predictor of pregnancy induced hypertension with good sensitivity, specificity, positive and negative predictive values. As ultrasonography is a simple, cost effective, easily available and easy to perform non-invasive test, the sonologist while conducting the regular antenatal ultrasonography, should look for location of placenta, and when found to be laterally located can caution the women regarding the likelihood of developing PIH and educate them for regular antenatal check-ups.

**REFERENCES**


