Original Research Article

Correlation of placental laterality and uterine artery doppler in pre-eclampsia

Sindhu Murali[1], Nandini Gopalakrishna[1]*, Jessica Fernandes[2], Krunal Nazareth[1]

[1]Department of Obstetrics and Gynecology, Ramaiah Medical College and Hospitals, Bangalore, Karnataka, India
[2]Aster Hospital, Sharjah, UAE

Received: 15 May 2023
Accepted: 30 May 2023

*Correspondence:
Dr. Nandini Gopalakrishna,
E-mail: nandinigopalakrishna@gmail.com

ABSTRACT

Background: Pre-eclampsia is a complex condition associated with maternal and fetal mortality and morbidity. Various screening tests have been proposed for the prediction of pre-eclampsia with varying results. Non-invasive doppler velocimetry studies of uterine arteries in second trimester with abnormal forms can predict the occurrence of pre-eclampsia. This abnormal wave forms indicate defective uterine perfusion and is consequence of placental implantation laterally. The objective of this study was to correlate placental laterality and uterine artery doppler in pre-eclampsia.
Methods: It was prospective study from November 2019 to March 2021 at M S Ramaiah medical college and hospitals, Bangalore.
Results: In the present study, preeclampsia was seen in 36.5 % with lateral location of placenta, 19.3% with posterior location of placenta and 15.9% with anterior location of placenta. This was statistically significant with p<0.001. Uterine artery doppler, the pulsatility index (PI) was <95th centile in 88.1% and 11.9% had >95th centile The subjects with PI >95th centile, 65.5% developed preeclampsia and <95th centile, 13.1% developed pre-eclampsia. This was statistically significant. In this study, with PI at 1.68, the sensitivity was 53.19%, specificity was 92.86%, positive predictive value (PPV) of 64.1% and negative predictive value (NPV) was 89.2%.
Conclusions: USG is a simple, non-invasive, easy to perform and cost-effective method to locate the placenta. Every attempt should be made to do Uterine artery doppler at the same sitting. Both these are non-invasive and can predict the occurrence of pre-eclampsia. These patients can be managed as high risk and monitored more carefully. Surveillance will help in decreasing maternal and perinatal mortality and morbidity.

Keywords: Placental laterality, Uterine artery Doppler, Pre-eclampsia

INTRODUCTION

Pre-eclampsia is a complex syndrome involving multiple organ systems and still remains one of major causes of maternal and perinatal morbidity and mortality.[1]

The precise etiopathogenesis of pre-eclampsia remains to be a subject of extensive research and it is believed to be multifactorial.[2]

Placental abnormality is one of the initial events seen in patients who are destined to develop PIH.[3] The Placenta is located laterally in majority of the patients who have abnormal Doppler velocity waveforms.[4]

There is significant association with location of the placenta and intrauterine growth restriction.[5] The presence of placenta is mainly responsible for preeclampsia. This is due to failure of uteroplacental circulation with consequent hypoxia, oxidative stress and diminished placental function.[6]

Pre-eclampsia is defined as the development of hypertension and proteinuria after 20 weeks of gestation in

a previously normotensive woman. Several screening tests have been proposed to identify women at risk of developing pre-eclampsia.[7]

Some of these tests such as the cold pressure test, the isometric hand grip exercise and the roll over test which are not statistically significant.

Among the various predictors for preeclampsia, the placental location by ultrasound at 18 to 24 weeks is cost effective, non-invasive and has a good positive predictive value. There is significant association between placental location, uterine artery resistance and adverse outcome such as eclampsia and IUGR.

When the placenta is centrally located, the uteroplacental blood flow needs are met by equal contribution from both the uterine arteries, but when the placenta is laterally located, in majority of the cases, the uteroplacental blood flow needs are primarily met by one of the uterine arteries with minimal contribution from the other uterine artery via the collateral circulation.[8-10]

There are other tests such as measurement of urinary calcium which is indicative of biochemical alteration which occurs in preeclampsia.[12]

The pathophysiology of preeclampsia is complex and the fundamental disturbances decreased uteroplacental blood supply.[13]

Women with mild degree of hypertension can be managed conservatively and delivered at or near term with good neonatal outcome. In severe cases, iatrogenic premature delivery has to be done in view of maternal complications. This often compromises the baby and increases the neonatal morbidity and mortality. Infants of women with severe preeclampsia have 5-fold increase in mortality compared to infants of normotensive women.[14]

Non-invasive doppler velocimetry studies of uterine arteries in second trimester reveal abnormal waveforms suggestive of defective uterine perfusion due to placental implantation.[1]

Placental location can be documented by various means, but ultrasound has proved to be safest, easiest and most accurate method. Placenta may be lateral in women with abnormal waveforms and this has been implicated in pre-eclampsia and IUGR.[21,22]

Aims and objectives

The objectives of the study were a) to evaluate the relationship between the placental location and occurrence of gestational hypertension, b) to study the relationship of uterine artery doppler and pre-eclampsia and c) to correlate the placental laterality and uterine artery Doppler in preeclampsia.

METHODS

This was a prospective study at the department of obstetrics and gynaecology, Ramaiah medical college and hospitals from November 2019 to May 2021.

All pregnant women between 18 to 24 weeks of gestation attending the antenatal clinic were included in the study, who fulfilled the criteria and after taking informed consent. The sample size was 243.

These women were evaluated with USG for the location of placenta and uterine artery Doppler between 18 to 24 weeks of gestation. They were followed up by regular monitoring of blood pressure in the antenatal clinic. The patients were assessed for symptoms and signs of pre-eclampsia. On examination, if the blood pressure readings were high, they would undergo a urine examination for proteinuria and the other required tests.

Inclusion criteria

All pregnant women between 18 to 40 years with singleton pregnancy were included. They were included after confirming that they are willing to come for follow up till term.

Exclusion criteria

All pregnant women with twin gestation and uterine anomalies were excluded. Pre existing medical conditions like pregnant women with chronic/essential hypertension, diabetes, renal disease, thyrotoxicosis and connective tissue disorders were excluded. Those with history of smoking, alcohol and drugs were excluded.

Statistical analysis

The data was entered into Microsoft excel sheet and analysed using SPSS 22 version software. Categorically data was represented in the form of frequencies and proportion. Chi-square test was used as a test of significance for qualitative data. MS excel and MS word was used to obtain various types of graphs. $P < 0.05$ was considered as statistically significant.

RESULTS

The patients age, gravidity, period of gestation at the time of USG were noted. Detailed history to ascertain any risk factors were noted.

In our study, 44% were between 25 to 29 years and 31.7% were between 18 to 24 years (Table 1). This indicated that majority of them (75.7%) were below 30 years.

Primigravidae were 53.1% and multigravidae were 46.9% (Table 2). The patients between 18 to 20 weeks of gestation were 39.5% and between 21 to 22 weeks of gestation were 39.1%.

Regarding location of placenta, it was anterior in 39.9%, posterior in 34.2% and lateral in 25.9% (Table 3).

Table 1: Age group of patients (n=243).

Age (years)	N	Percentages (%)
18 to 24	77	31.7
25 to 29	107	44
30 to 34	49	20.2
35 to 40	10	4.1
Total	243	100

Table 2: Gravidity of patients (n=243).

Gravidity	N	Percentages (%)
Primigravidae	129	53.1
Mutigravidae	114	46.9
Total	243	100

Table 3: Placental location (n=243).

Placental location	N	Percentages (%)
Anterior	97	39.9
Posterior	83	34.2
Lateral	63	25.9
Total	243	100

The uterine artery PI was less than 95th percentile in 88.1% and greater than 95th percentile in 11.9% (Table 4).

Table 4: UT-PI percentile (n=243).

UT-PI percentile	N	Percentages (%)
<95th centile	214	88.1
>95th centile	29	11.9
Total	243	100

Gestational hypertension in 8.6% and pre-eclampsia in 19.34%.

Mode of delivery was vaginal in 53.5% and LSCS 46.5% (Table 5). Fetal complications like fetal growth restriction (FGR) seen in 4.5%, preterm delivery in 9.5%, intrauterine fetal demise (IUFD) due to abruption in 0.4% (Table 6).

Table 5: Mode of delivery (n=243).

Mode of delivery	N	Percentages (%)
Vaginal delivery	130	53.5
LSCS	113	46.5
Total	243	100

Table 6: Fetal complications (n=243).

Fetal complications	N	Percentages (%)
Absent	200	82.3
Abruption and term	3	1.2
FGR	11	4.5
FGR and preterm birth	5	2.1
IUFD with abruption	1	0.4
Preterm birth	23	9.5
Total	243	100

In the study, subjects with lateral location of placenta, 36.5% develop pre-eclampsia, with posterior placenta, 19.3% developed and with anterior location of placenta 15.5% developed preeclampsia. This was statistically significant and p<0.001.

In study, those with uterine artery PI>95th centile 65.5% developed pre-eclampsia and with PI<95th centile 13.1% developed pre-eclampsia it was statistically significant.

In the study, PI at 1.68 had highest sensitivity of 53.19% specificity of 92.86% PPV of 64.1% and NPV was 89.2% in the diagnosis of pre-eclampsia.

Table 7: Comparison of predictive value of placental laterality in present study with other studies.

Author	Year	N	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Pai et al[8]	2005	426	73	86	51	94
Balerao et al[1]	2013	281	75	81	48	96
Present study	2019	243	53.1	92.8	64.1	89.2

Table 8: Doppler in 2nd trimester.

Variables	Type of study	Sample size	Sensitivity	Specificity	PPV	NPV	+LR	-ve LR
Barati et al[20]	Prospective	379	79	95.5	88.2	98.9	5.06 (2.29, 11.18)	0.74 (0.59, 0.93)
Balerao et al[1]	Prospective	281	75	81	48	96	3.49	0.74
Present study	Prospective	243	53.19	92.86	64.1	89.2	-	-

DISCUSSION

Pre-eclampsia is one of the most common complication of pregnancy and is associated with maternal and fetal morbidity and mortality. Preeclampsia occurs only in the presence of placenta the only effective treatment is delivery various methods are tried to predict the occurrence of preeclampsia. Among them, location of placenta by USG and Doppler velocimetry of the uterine arteries is a simple method. It is hypothesised that the ability to predict those women at risk of preeclampsia early in pregnancy might decrease maternal and fetal morbidity true close surveillance programs. The exact etiology is unknown but failure of trophoblastic invasion and vascular endothelial damage are considered as the pathophysiology.[15] Reduced trophoblastic invasion in laterally located placenta may be responsible for development of preeclampsia.[16]

Pre-eclampsia is more common in primigravidae compared to multigravidae. In our study, 55.31% were primigravidae and 44.68% were multigravidae. In this study by Kannamani et al 81% were primigravidae.[14]

In our study, the incidence of preeclampsia was 19.34% which is higher compared to Rodriguesz et al 10.6%, Kumar et al 13.6% and Ramos et al reported as 14%.[23-25]

Pre-eclampsia here is common in extremes of age group. In our study, 4.1% were between 35 to 40 years and 31% were between 18 to 24 years.

In the present study, among subjects with lateral placenta 36.5% developed PE, with posterior placenta 19.3% and with anterior placenta 15.5% developed PE. There was significant association between lateral and posterior location of placenta. The p<0.001 and with posterior location it was 0.015 which was statistically significant.

In our study, with lateral location of placenta, sensitivity was 53.1%, specificity was 92.8%, positive predictive value (PPV) was 64.1% and negative predictive value (NPV) was 89.2%. In the study by Pai et al the sensitivity was 73%, specificity was 86%, PPV was 51% and NPV was 94%.[8] In the study by Ozcan et al sensitivity was 72%, specificity was 80%, PPV was the 52% and the NPV 94%.[26,28]

In our study, subjects with uterine artery PI >95th centile, 65.5% developed PE and <95th centile 13.1% developed PE. The sensitivity and specificity for uterine artery PI was 53.19% and 92.86% using PI >1.6 as the abnormal criteria. The PPV was 64.1% and NPV was 89.2%. This criteria of NPV was similar to the study by Espinoza et al.[30] The positive and negative likelihood ratio was 1.99 and 1.09 which was almost similar to the Espinoza et al.[30]

In the present study, subjects with PE, 78.7% were delivered by caesarean section, 40.4% were delivered before 37 weeks (preterm), 46.8% had low birth weight, 31.9% had APGAR score of <7 at 5 minutes, 42.6% required NICU admission. In the study by Sumathi et al 43.3% delivered vaginally and 56.7% underwent caesarean section.[13]

Limitations

All the patients were diagnosed as PE following the standard definition and investigations. Thrombophilia profile was not done due to financial constraints.

CONCLUSION

PE is a condition associated with maternal and perinatal morbidity and mortality. There are various screening tests to predict PE. Some tests are simple and some are expensive. USG is a simple, non invasive, easy to perform, low cost method to locate the placenta during second trimester. At the same time, uterine artery doppler can be done which is simple and easy to perform. Both these tests, together can be used to predict PE. These patients can be managed as high risk with careful surveillance.

ACKNOWLEDGEMENTS

REFERENCES

1. Balerao AV, Kulkarni S, Somalwar S. Lateral Placentation by Ultrasonography: A Simple Predictor of Preeclampsia. J South Asian Feder Obst Gynae. 2013;5(2):68-71.
2. Huppetz B. Plactenat Origins of Preeclampsia Challenging the Hypothesis. Hypertension. 2008;51:970-75.
3. Shivamurthy HM, Sharada KS, Giridhar SA, Himgire JR, Asaranna D. Placental laterality as a predictor of pre-eclampsia-An ultrasonic prospective study. J Pub Health Med Res. 2014;2(1):38-40.
4. Yousuf S, Ahmad A, Qadir S, Gul S, Tali SH, Shaheen F, et al. Utility of placental laterality and uterine artery Doppler abnormalities for prediction of preeclampsia. J Obstetr Gynecol India. 2016;66:212-6.
5. Pillay R, Sanam P. Association of Lateral Implantation of Placenta with Development of Pre-Eclampsia: A Prospective Study. J Evidence Based Med Healthcare. 2015;2(10):1504-8.
6. Aggarwal P, Kangjam P, Terhase N. Study on relation between placental laterality in second trimester ultrasound and development of preeclampsia at term. J Evolution Med Dental Scis. 2015;4(104):16926-9.

7. Chandra K, Maheshwari S. Placental laterality: as a predictor for the development of pre-eclampsia. J Dent Med Sci. 2016;15:6-10.
8. Pai MV, Pillai J. Placental laterality by ultrasound–a simple yet reliable predictive test for preeclampsia. J Obstetr Gynecol India. 2005;55(5):431-3.
9. Kore SJ, Khot R, Supe P, Kanavia D, Thunga C, Nandanwar Y. Prediction of pre-eclampsia: role of placental laterality by ultrasonography. Int J Reproduct Contracep Obstetr Gynecol. 2016;5(5):1433-8.
10. Bhattacharjee AK, Majumdar MK, Lucky B. Placental laterality by ultrasound and its correlation to development of preeclampsia. Sch J App Med Sci. 2017;5(10F):4197-200.
11. ACOG Committee on Obstetric Practice. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. Am College Obstetr Gynecologists. 2002;;77(1):67-75.
12. Sandhya K, Madhavi GB, Chandramathi M. Placental laterality as a predictor of pre-eclampsia. Am J Phytomed Clin Ther. 2015;3(3):231-6.
13. Sumathi N, Pavithra GR. Placental Laterality-A Simple yet reliable predictor of pre-eclampsia an ultrasonic prospective study. IOSR-JDMS. 2016;15(10):116-21.
14. Kannamani A, Narasimhan D. A study on analysis of validity of lateral placental location in prediction of preeclampsia. J Evolution Med Dental Sci. 2017;6(18):1401-4.
15. Gosh M, Gosh A, Sengupta P. A study to assess placental location by ultrasonography and evaluation of its relationship with development of preeclampsia and eclampsia. Int J Biomed Res. 2017;8:668-71.
16. Priyadarshini A, Upreti P, Nautiyal R, Goyal M. Placental location and development of preeclampsia: a longitudinal study. Int J Reprod Contracept Obstet Gynecol. 2019;8(4):2320-1770.
17. Patni M, Jain M, Rajoria L, Gupta S, Vyas G, Saini M. A Prospective Study to Assess Placental Location by Ultrasonography at 18-24 Weeks of Pregnancy and it's Relationship with Development of Hypertensive Disease of Pregnancy. Int J Med Res Prof. 2018; 4(6):211-15.
18. Ghadei R, Mohanty GS. Placental laterality as a predictor of preeclampsia. J Evolution Med Dental Sci. 2017;6(35):2885-8.
19. Kakkar T, Singh V, Razdan R, Digra SK, Gupta A, Kakkar M. Placental laterality as a predictor for development of preeclampsia. J Obstetr Gynecol India. 2013;63:22-5.
20. Barati M, Shahbazian N, Ahmadi L, Masihi S. Diagnostic evaluation of uterine artery Doppler sonography for the prediction of adverse pregnancy outcomes. J Res Med Sci. 2014;19(6):515.
21. Kofinas AD, Penry M, Swain M, Hatjis CG. Effect of placental laterality on uterine artery resistance and development of preeclampsia and intrauterine growth retardation. Am J Obstetr Gynecol. 1989;161(6):1536-9.
22. Kofinas AD, Penry M, Greiss Jr FC, Meis PJ, Nelson LH. The effect of placental location on uterine artery flow velocity waveforms. Am J Obstetr Gynecol. 1988;159(6):1504-8.
23. Rodriguez-Lopez M, Wagner P, Perez-Vicente R, Crispi F, Merlo J. Revisiting the discriminatory accuracy of traditional risk factors in preeclampsia screening. PLoS One. 2017;12(5):e0178528.
24. Ritukamra HD, Gupta KD, Natu SM. Role of Urinary calcium/creatinine ratio prediction of PIH. J Obset Gynecol India. 1997;47(4).
25. Sanchez-Ramos LU, Sandroni ST, Andres FJ, Kaunitz AM. Calcium excretion in preeclampsia. Obstetr Gynecol. 1991;77(4):510-3.
26. Ozcan T, Rinder HM, Murphy J, Kohn C, Copel JA, Magriples U. Genetic thrombophilia and hypertensive complications of pregnancy. Obstetr Gynecol. 2001;97(4):S40.
27. Cnossen JS, Morris RK, Ter Riet G, Mol BW, Van Der Post JA, Coomarasamy A, et al. Use of uterine artery Doppler ultrasonography to predict pre-eclampsia and intrauterine growth restriction: a systematic review and bivariable meta-analysis. CMAJ. 2008;178(6):701-11.
28. Papageorghiou AT, Christina KH, Nicolaides KH. The role of uterine artery Doppler in predicting adverse pregnancy outcome. Best Pract Res Clin Obstetr Gynaecol. 2004;18(3):383-96.
29. Ratanasiri T. Prediction of preeclampsia in a low-risk population using diastolic notch of uterine arteries. J Med Asso Thailand= Chotmaihet Thangphaet. 2004;87:S29-33.
30. Espinoza J, Kusanovic JP, Bahado-Singh R, Gervasi MT, Romero R, Lee W, et al. Should bilateral uterine artery notching be used in the risk assessment for preeclampsia, small-for-gestational-age, and gestational hypertension? J Ultrasound Med. 2010;29(7):1103-15.