

Research Article

Placental laterality and uterine artery resistance as predictor of preeclampsia: a prospective study at GMERS Medical College, Dharpur-Patan, North Gujarat, India

Parul S. Jani¹, Uday M. Patel¹, Mayur R. Gandhi¹,
Nilesh C. Thakor^{2*}, C. R. Kakani

¹Department of Obstetrics and Gynecology, ²Department of Community Medicine, GMERS Medical College, Dharpur-Patan, 384265, Gujarat, India

Received: 21 April 2015

Accepted: 08 May 2015

*Correspondence:

Dr. Nilesh C. Thakor,

E-mail: drnileshthakor@yahoo.co.in

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Placental abnormality is one of the initial events seen in patients who are destined to develop preeclampsia. The objective was to study whether ultrasonically identified; placental laterality and uterine artery resistance can be used as a predictor for development of preeclampsia.

Methods: This prospective observational study was conducted at GMERS Medical College, Dharpur-Patan tertiary care teaching institute in North Gujarat from January 2013 to December 2014. A total 400 non high risk primigravida with singleton pregnancy were included, all patients with diabetes, hypertension, renal disease, and history of smoking were excluded. In all these patients, location of placenta was determined by ultrasonography at 18 to 22 weeks of gestation. Patients who had lateral placenta were subjected for colour Doppler study for determining uterine artery resistance index. All 400 patients were followed till delivery for occurrence of preeclampsia as per ACOG guidelines. All data was analyzed and statistical significance was determined by χ^2 test and value of $p < 0.05$ is considered significant.

Results: Out of 400 cases, 80 (20%) cases had laterally located placenta on ultra sound examination done at 18-24 weeks of gestation. Out of the 80 women with laterally located placenta, 28 (35%) developed preeclampsia. This relationship was statistically significant. All 80 patients who had lateral placenta, 26 patients had raised uterine artery resistance and out of those 26 patients, 22 developed preeclampsia and 54 had no change in uterine artery resistance. Out of those 54 only 6 had preeclampsia ($p < 0.001$). The sensitivity of determining uterine artery resistance as a predictive test was 84.6%, the specificity 88.8 %, positive predictive value 78.5 % and negative predictive value 92.3%.

Conclusion: A chance of preeclampsia is more in patients with lateral placenta but its sensitivity and specificity increases significantly when it is combined with uterine artery velocimetric waveform study, and we can predict preeclampsia in patient who is having lateral placenta and raised uterine artery resistance.

Keywords: Placenta location, Ultra sonography, Pre eclampsia, Uterine artery resistance, Placental laterality

INTRODUCTION

Preeclampsia is a complex clinical syndrome involving multiple organ systems and still remains the principle cause of maternal and perinatal mortality and morbidity. Preeclampsia occurs only in the presence of placenta.¹

Preeclampsia is rise of blood pressure more than or equal to 140/90 mmHg recorded on two occasions 6 hours apart with Proteinuria (0.3 gms or more protein in 24 hour collected urine sample with 1+ or greater on urine dipstick test) after 20 weeks of gestation involving multiple organ systems.

The poorly perfused placenta may be the origin of factors which gain access to maternal vasculature and cause endothelial cell dysfunction. Reduced placental perfusion in preeclampsia is thought to result from failure of the trophoblasts to invade maternal spiral arteries. Noninvasive doppler velocimetric studies of the uterine arteries in the second trimester reveal that abnormal wave forms indicating defective uterine perfusion is primarily a consequence of placental implantation when one uterine artery is the dominant supply of the intervillous flow.^{2,3}

Several tests have been proposed to identify women at risk of developing preeclampsia. Some of these tests such as the cold pressor test, the isometric hand grip exercise, and the roll over test depend on the presence of some pathophysiological changes that occur in preeclampsia. Other tests such as the measurement of urinary calcium or plasma fibronectin are based on the presence of biochemical alterations peculiar to this disease. Among the various predictors for preeclampsia, the placental location by ultrasound at 18–24 weeks is very cost effective, noninvasive, and has a good positive predictive value.⁴

In the light of these observations, we designed a prospective study to find relation of placental laterality and uterine artery resistance and development of preeclampsia.

METHODS

This prospective observational study was conducted at GMERS Medical College, Dharpur-Patan tertiary care teaching institute in North Gujarat from January 2013 to December 2014. A total 400 non high risk primigravida with singleton pregnancy were included, all patients with diabetes, hypertension, renal disease, and history of smoking were excluded. Mid trimester blood pressure was noted in all patients. In all these patients, location of placenta was determined by ultrasonography at 18 to 22 weeks of gestation. When more than 75% or more of the placental mass was on one side of uterus it was classified as lateral placenta, rests other were classified as central placenta. Patients who had lateral placenta were subjected for colour Doppler study for determining uterine artery resistance index. All 400 patients were followed till delivery for occurrence of preeclampsia as per ACOG guidelines. All data was analyzed and statistical significance was determined by x² test and value of p<0.05 is considered significant.

RESULTS

Out of the total 400 women, 292 (73%) were in the age group of 19-24 years. Higher incidence of preeclampsia was found in patients with age group of >30 years (Table 1). Out of 400 cases, 320 (80%) cases had centrally located placenta, while 80 (20%) cases had laterally located placenta on ultra sound examination done at 18-24 weeks of gestation. Out of the 80 women with laterally located placenta, 28 (35%) developed

preeclampsia. This relationship was statistically significant (Table 2). All 80 patients who had lateral placenta, 26 patients had raised uterine artery resistance and out of those 26 patients, 22 developed preeclampsia and 54 had no change in uterine artery resistance. Out of those 54 only 6 had preeclampsia (p<0.001) (Table 3).

Table 1: Distribution of patients according to age (in years) and occurrence of preeclampsia.

| Age group (In Years) | Patients with preeclampsia | Total (n=400) | Percent age | (By using Fisher's exact test) p-value |
|----------------------|----------------------------|---------------|-------------|--|
| ≤ 18 | 0 | 2 | 0 | 0.207* |
| 19 – 24 | 42 | 292 | 14.3 | |
| 25 - 29 | 16 | 92 | 17.3 | |
| >30 | 6 | 14 | 42.8 | |

Table 2: Distribution of patients according to occurrence of preeclampsia and site of placenta.

| Site of placenta | Preeclampsia | | Percentage % | Total | (By using Fisher's exact test) p value |
|------------------|--------------|--------|--------------|-------|--|
| | Present | Absent | | | |
| Central | 36 | 284 | 11.3 | 320 | < 0.001 |
| Lateral | 28 | 52 | 35 | 80 | |

Table 3: Distribution of patients according to occurrence of preeclampsia and changes in colour doppler in patients with laterally situated placenta.

| Preeclampsia | Changes in colour doppler | | Total | P-value |
|--------------|---------------------------|-------------|-------|---------|
| | Yes | No | | |
| Present | 22 (78.57%) | 6 (21.43%) | 28 | < 0.001 |
| Absent | 4 (7.69%) | 48 (92.31%) | 52 | |

The sensitivity of determining uterine artery resistance as a predictive test was 84.6%, the specificity 88.8%, positive predictive value 78.5% and negative predictive value 92.3%.

DISCUSSION

Preeclampsia is a complex clinical syndrome involving multiple organ systems and still remains the principal cause of maternal and perinatal mortality and morbidity. The search for an ideal predictive test and preventive measure remain challenging. It has been shown that in humans both uterine arteries have a significant number of branches and that each supply the corresponding side of the uterus. Although anastomoses between the two

uterine arteries exist, there is no proof that these are functional. When the placenta is laterally located, the uterine artery closer to the placenta has lower resistance than the one opposite to it. In patients with centrally located placentas both uterine arteries demonstrated similar resistance.⁵ When the placenta is centrally located, the uteroplacental blood flow needs are met by equal contribution from both uterine arteries. However when the placenta is laterally located, in the majority of cases the uteroplacental blood flow needs are met primarily by one of the uterine arteries with some contribution from the other uterine artery via the collateral circulation. The degree of collateral circulation may not be the same in all patients and deficient contribution may facilitate the development of preeclampsia, intrauterine growth retardation or both. The significance of normal placentation for this cytotrophoblastic invasion is high and the cytotrophoblasts fail to adopt a vascular adhesion phenotype in preeclampsia. This may explain the reduced trophoblastic invasion in laterally situated placenta when the uteroplacental blood flow needs are mainly met by one side uterine artery.

In our study, out of 400 cases, 320 (80%) cases had centrally located placenta, while 80 (20%) cases had laterally located placenta on ultra sound examination done at 18-24 weeks of gestation. Out of the 80 women with laterally located placenta, 28 (35%) developed preeclampsia. This result is in accordance with the study of Kofinas et al⁵ who state that of their preeclamptic women, 74% (20/34) had unilateral placental location. Our study shows that women with unilateral placental location had a 3.09 fold increase in the incidence of preeclampsia. This is similar to 2.8 fold risk of preeclampsia with unilaterally located placenta reported by Kofinas et al⁵.

The results of the present study were also comparable to those of Muralidhar et al.⁶ In his study, a total of 426 unselected singleton pregnant women were included. Out of 426 women, 324 had centrally located placenta and 102 had unilateral placenta. A total of 71 women developed preeclampsia of which 52 (74%) had unilaterally located placenta. The relationship was found to be statistically significant $p < 0.0001$.

The results of the present study were also comparable to the study done by Kalanithi LE et al.,⁷ the results of which showed that development of PIH and IUGR pregnancies were nearly fourfold more in lateral placentation.

In Studies of H valensies et al,⁸ Palma-Dias et al⁹ and Gómez O¹⁰ et al uterine artery with colour Doppler had shown significant association of preeclampsia with raised uterine artery resistance.

The study by Itskovitz J et al has been shown that both uterine arteries have significant number of branches and each supply corresponding side of uterus. There is anastomosis in-between but it is not functional. Hence

when placenta is situated laterally, in the majority of cases the utero placental blood flow needs are met with primarily by uterine artery of same side with some contribution from opposite side by collateral circulation. The degree of collateral circulation is not same in all individuals and deficient contribution may facilitate preeclampsia and IUGR.¹¹

In our study all 80 patient who had lateral placenta, 26 patient had raised uterine artery resistance and out of those 26 patients, 22 developed preeclampsia and 54 had no change in uterine artery resistance. This relationship was statistically significant.

CONCLUSION

In case of unilateral placenta, the absence or insufficient trophoblastic invasion of arteries on contralateral side would make them retain their sensitivity to vasoactive substance during pregnancy. Ultra sonography is simple, non-invasive, easy to perform, cost effective, diagnostic method to identify high risk cases. Our data suggests that chance of preeclampsia is more in patients with lateral placenta but its sensitivity and specificity increases significantly when it is combined with uterine artery Velocimetric waveform study, and we can predict preeclampsia in patient who is having lateral placenta and raised uterine artery resistance. By identifying such patients appropriate treatment can be initiated and the patients are regularly followed up.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Walker JJ. Current thoughts on the pathophysiology of preeclampsia/ eclampsia. In: Studd J, editor. Progress in obstetrics and gynecology. Edinburgh: Livingstone-Churchill; 1998. p. 177-88.
2. Fleischer A, Schulman H, Farmakides G, et al. Uterine artery Doppler velocimetry in pregnant women with hypertension. Am J Obstet Gynecol. 1986;154:806-13.
3. Schulman H, Winter D, Farmakides G, et al. Pregnancy surveillance with Doppler velocimetry of uterine and umbilical arteries. Am J Obstet Gynecol. 1989;160:192-6.
4. Cunningham FG, Leveno KJ, Bloom SL, et al. Williams obstetrics. 22nd ed. New York: McGraw-Hill; 2005. p. 761-808.
5. Kofinas A, Penry M, Swain M, Christos G. et al. Effect of placental laterality on uterine artery resistance and development of preeclampsia and intra uterine growth retardation. American Journal of Obstetrics and Gynaecology 1989; 161: 153-69.
6. Pai Muralidhar V, Pillai J. Placental laterality by ultrasonography as predictive marker for preeclampsia. Journal of Obstetrics and Gynaecology of India; 2005, 55(5) ;431-33.

7. Kalanithi LE, Illuzzi JL, Nossov VB, et al. Intrauterine growth restriction and placental location. *J Ultrasound Med* 2007; 26: 1481–9.
8. Velensise H, Bezzeccherri V, Rizzo G, Tranquilli L, Garzetti G et al, doppler velocimetry of the uterine artery as a screening test for gestational hypertension. *Ultrasound in obstetrics and Gynaecology* 1993; 3: 18-22.
9. Palma-Dias, Screening for placental insufficiency by transvaginal uterine artery Doppler at 22-24 weeks of gestation. *Fetal Diagn Ther.* 2008;24(4): 462- 9.
10. Gómez O, Sequential changes in uterine artery blood flow pattern between the first and second trimesters of gestation in relation to pregnancy outcome. *Ultrasound Obstet Gynecol.* 2006 Nov;28(6):802-8.
11. Itskovitz J. Arterial anastomosis in pregnant uterus. *Obstetrics and Gynaecol* 1980;55-76.

DOI: 10.18203/2320-6012.ijrms20150172

Cite this article as: Jani PS, Patel UM, Gandhi MR, Thakor NC, Kakani CR. Placental laterality and uterine artery resistance as predictor of preeclampsia: a prospective study at GMERS Medical College, Dharpur-Patan, North Gujarat, India. *Int J Res Med Sci* 2015;3:1484-7.