



## RESEARCH ARTICLE

### STUDY OF DOPPLER CHANGES IN PREGNANCY INDUCED HYPERTENSION

Dr. Chandni Mehta<sup>1</sup>, Dr. Kinjal Savani<sup>2</sup> and Dr. Namrata Shah<sup>3</sup>

<sup>1</sup>M. S., D. N. B. Obstetrics and Gynaecology, Assistant Professor, Department of Obstetrics and Gynaecology, B. J. Medical college, Ahmedabad; <sup>2</sup>M. S. Obstetrics and Gynaecology, Senior Resident, Department of Obstetrics and Gynaecology, B. J. Medical college, Ahmedabad; <sup>3</sup>3<sup>rd</sup> year post graduate student, Department of Obstetrics and Gynaecology, B. J. Medical college, Ahmedabad

#### ARTICLE INFO

##### Article History:

Received 20<sup>th</sup> October, 2024  
Received in revised form  
17<sup>th</sup> November, 2024  
Accepted 24<sup>th</sup> December, 2024  
Published online 24<sup>th</sup> January, 2025

##### Key Words:

Pregnancy Induced Hypertension,  
Doppler, Pulsatility Index,  
Cerebroplacental Ratio, Perinatal  
Outcome.

\*Corresponding author:  
Dr. Chandni Mehta

#### ABSTRACT

**Background:** Pregnancy induced hypertension is a high risk pregnancy that threatens the health of the mother or her foetus. The recent introduction of colour Doppler flow imaging provides opportunity for non-invasive monitoring during pregnancy. **Objective:** The aim of present study was to know the significance of Doppler in pregnancy induced hypertension and to analyse their role in predicting perinatal outcome. **Materials and Methods:** It was a prospective study conducted amongst 180 women diagnosed with PIH from August 2018 to November 2019 in a general hospital which is a tertiary level referral centre having well equipped Neonatal Intensive Care Unit (NICU). All pregnant women diagnosed with PIH after 20 weeks of gestation were included in the study. Pulsatility Index (PI) in uterine, umbilical and middle cerebral artery were noted and end diastolic flow in umbilical artery doppler was also noted. Their perinatal outcome was noted. **Results:** It is observed that maximum number of pregnant women were in the age group of 20-24 years. 144 patients suffering from PIH had mild disease whereas 36 patients had severe disease. 31 patients had diastolic notch in uterine artery. 33 patients had elevated umbilical artery PI while 147 patient had normal PI. 2 patients showed reversal and 28 patients showed absent end diastolic flow. 34 patients had decreased MCA PI while 146 patients had normal PI. 35 patients had abnormal MCA/Umbilical artery PI ratio whereas 145 patients had normal ratio. 41 had adverse perinatal outcome and 139 had uneventful outcome. 21 patients had elevated uterine artery PI as well as adverse perinatal outcome. 23 patients had uterine artery diastolic notch as well as adverse perinatal outcome. 29 patients had elevated umbilical artery PI as well as adverse perinatal outcome. 31 patients had decreased MCA PI as well as adverse perinatal outcome. 32 patients had MCA/Umbilical artery PI ratio less than 1.08 as well as adverse perinatal outcome. **Conclusion:** The knowledge of uterine, umbilical and middle cerebral artery waveform may help to improve pregnancy management and permit identification of pregnancy induced hypertension at earliest gestation age. Doppler plays an important role in monitoring growth restricted foetus and thereby may help to determine the optimal time for delivery.

Copyright©2025, Chandni Mehta et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Dr. Chandni Mehta, Dr. Kinjal Savani and Dr. Namrata Shah. 2025. "Study of doppler changes in pregnancy induced hypertension". *International Journal of Current Research*, 17, (01), 31192-31195.

## INTRODUCTION

Pregnancy induced hypertension is a high risk pregnancy that threatens the health of the mother or her fetus. Antepartum fetal surveillance is of immense importance for detection of fetal compromise in utero in such high risk pregnancies (1). The recent introduction of color Doppler flow imaging offers new insight into the dynamic studies of blood flow and provides opportunity for repetitive, noninvasive hemodynamic monitoring in pregnancy(2). The use of Doppler ultrasound for evaluation for fetal well-being is based on the physical principle of change in frequency of the sound wave when it is reflected by blood flow in fetal vessels.

It aims to evaluate blood flow in the vessels supplying the placenta and the fetus. The blood vessels most often used for evaluation in pregnancy are uterine, umbilical and middle cerebral arteries in the fetus. Significant Doppler changes occur with the reduction in fetal growth at a time when other fetal well-being test are still normal (1) These vascular Doppler predominantly plays role in decision making process in high risk obstetric cases. Even though uterine artery Doppler is predominantly used for screening of preeclampsia, its evaluation was included as it gives idea about maternoplacental circulation and to study correlation with the adverse perinatal outcome.

The aim of present study was to know the significance of umbilical, middle cerebral and uterine artery Doppler in pregnancy induced hypertension and to analyze their role in predicting perinatal outcome.

## MATERIALS AND METHODS

“Study of doppler changes in PIH” was a prospective study conducted amongst 180 women diagnosed with PIH from August 2018 to November 2019 in a general hospital which is a tertiary level referral centre having well equipped Neonatal Intensive Care Unit (NICU).

**INCLUSION CRITERIA:** All pregnant women diagnosed with PIH after 20 weeks of gestation.

**EXCLUSION CRITERIA:** Multiple pregnancy, hydramnios, vesicular mole, pregnant women with hypertension due to other medical conditions like chronic hypertension, renal disorder, diabetes mellitus and other chronic disorders.

In this study, personal history, menstrual history, obstetric history as well as complaints of patients were noted in detail. USG for fetal assessment, liquor adequacy, doppler analysis was carried out. The vessels which were scanned were: i. Uterine artery ii. Fetal Umbilical artery iii. Fetal Middle cerebral artery. Pulsatility Index (PI) in uterine, umbilical and middle cerebral artery were noted and end diastolic flow in umbilical artery doppler was also noted. All the patients were observed and perinatal outcome was noted in terms of birth weight of neonate, APGAR Score, NICU admission. Follow up Doppler studies were performed if indicated to determine and monitor a favorable or worsening fetal wellbeing status. However only the results of last Doppler ultrasound within one week of delivery were used for analysis. Further management of the cases was decided to depend on the clinical status of the patient and the Doppler report. The pregnancies were terminated according to obstetric indications. Patients are followed up till delivery. Further the maternal and perinatal outcome was studied.

## RESULTS

In this study, 88 patients out of 180 belonged to age group of 20-24 years. Mean age was 24.15 years.

**Table 1. Age wise distribution of patients**

Age in years	Number	Percentage
<20	21	11.66
20-24	88	48.88
25-29	59	32.77
30-35	10	5.55
>35	2	1.11
Total	180	100

144 patients suffered from mild disease whereas 36 patients suffered from severe PIH.

**Table 2. Distribution of patients according to severity of PIH**

Severity	Number	Percentage
Mild	144	80
Severe	36	20

85% patients had uterine artery PI within the normal range while 15% patients had elevated uterine artery PI values. 33 patients had elevated umbilical artery PI while 147 patient had normal umbilical artery PI. 34 patients had decreased MCA PI while 146 patients had normal MCA PI.

**Table 3. Distribution of patients according to uterine artery PI, Umbilical artery PI and middle cerebral artery PI**

Uterine artery PI	Number	Percentage	Umbilical artery PI	Number	Percentage	Middle cerebral artery PI	Number	Percentage
Elevated	27	15	Elevated	33	18.33	Decreased	34	18.88
Normal	153	85	Normal	147	81.66	Normal	146	81.11
Total	180	100	Total	180	100	Total	180	100

31 patients had diastolic notch in uterine artery. 149 patients had normal uterine artery flow.

**Table 4. Distribution of patients with persistent early diastolic notch in uterine artery**

Diastolic notch	Number	Percentage
Present	31	17.22
Absent	149	82.77
Total	180	100

2 patients showed reverse end diastolic flow in umbilical artery. 28 patients showed absent end diastolic flow.

**Table 5. Distribution of patients according to umbilical artery end diastolic flow pattern**

End diastolic flow pattern	Number	Percentage
Absent	28	15.55
Reversal	2	1.11
Normal	150	83.33
Total	180	100

35 patients had abnormal MCA/Umbilical artery PI ratio while in 145 patients, ratio was normal.

**Table 6. Distribution of patients according to Ratio of MCA PI to Umbilical artery PI values**

MCA PI/Umbilical A PI	Number	Percentage
<1.08	35	19.44
Normal	145	80.55
Total	180	100

Out of 180 patients 41 had adverse perinatal outcome and 139 had uneventful outcome. 39 patients required NICU admission. Out of them 26 had low APGAR score, 12 had meconium stained liquor and 31 were low birth weight.

**Table 7. Distribution of perinatal outcome**

Perinatal outcome	Number	Total Number
Adverse		41
Low Birth Weight	31	
APGAR < 7	26	
NICU Admission	39	
Still Birth	2	
Meconium Stained Liquor	12	
Uneventful	139	139

Table 8: Table showing comparison of Doppler indices with adverse perinatal outcome. 21 patients had elevated uterine artery PI as well as adverse perinatal outcome (true positive). 6 patients had elevated uterine artery PI but uneventful perinatal outcome (false positive).

Doppler index	TP	TN	FP	FN	Sensitivity	Specificity	PPV	NPV	Diagnostic
Uterine Artery PI	21	13 3	6	20	51.21	95.68	77.7 7	86.9 2	85.55
Uterine Artery diastolic	23	13 1	8	18	56.09	94.24	74.1 9	87.9 1	85.55
Umbilical Artery PI	29	13 5	4	12	70.73	97.12	87.8 7	91.8 3	91.11
MCA PI	31	13	3	10	75.6	97.84	91.1	93.1	92.77
MCA/ Umbilical	32	13 6	3	9	78.04	97.84	91.4 2	93.7 9	93.33

133 patients had normal uterine artery PI and uneventful perinatal outcome (true negative). 20 patients had normal uterine artery PI but adverse perinatal outcome (false negative). 23 patients had elevated uterine artery diastolic notch as well as adverse perinatal outcome (true positive). 8 patients had elevated uterine artery diastolic notch but uneventful perinatal outcome (false positive).

131 patients had normal uterine artery diastolic notch and uneventful perinatal outcome (true negative). 18 patients had normal uterine artery diastolic notch but adverse perinatal outcome (false negative). 29 patients had elevated umbilical artery PI as well as adverse perinatal outcome (true positive). 4 patients had elevated umbilical artery PI but uneventful perinatal outcome (false positive). 135 patients had normal umbilical artery PI and uneventful perinatal outcome (true negative). 12 patients had normal umbilical artery PI but adverse perinatal outcome (false negative). 31 patients had decreased MCA PI as well as adverse perinatal outcome (true positive). 3 patients had decreased MCA PI but uneventful perinatal outcome (false positive). 136 patients had normal MCA PI and uneventful perinatal outcome (true negative). 10 patients had normal MCA PI but adverse perinatal outcome (false negative). 32 patients had MCA/Umbilical artery PI ratio less than 1.08 as well as adverse perinatal outcome (true positive). 3 patients had MCA/Umbilical artery PI ratio less than 1.08 but uneventful perinatal outcome (false positive). 136 patients had MCA/Umbilical artery PI ratio more than 1.08 and uneventful perinatal outcome (true negative). 9 patients had MCA/Umbilical artery PI ratio more than 1.08 but adverse perinatal outcome (false negative). Based on above findings, sensitivity, specificity, PPV, NPV and diagnostic accuracy were calculated. MCA/Umbilical artery PI ratio had the highest sensitivity, PPV, NPV and diagnostic accuracy in predicting perinatal outcome in patients of PIH. Specificity of MCA PI and MCA/Umbilical artery PI ratio was found to be the same.

## DISCUSSION

It is observed that maximum number of pregnant women were in the age group of 20-24 years (48.88%). It was found that 144 patients (80%) suffering from PIH had mild disease whereas 36(20%) patients had severe disease.

**Persistent early diastolic notch in predicting perinatal outcome:** Study by Coleman et al<sup>3</sup> reported a sensitivity of 76%, Farett et al<sup>4</sup> reported 88%, and the present study reported 56.09%.

**Uterine Artery PI in predicting perinatal outcome:** Study by BN Lakhkar et al<sup>5</sup> reported a sensitivity of 50%, Ochi et al<sup>6</sup> reported 64%, and the present study reported 51.21%.

**Umbilical artery PI in predicting perinatal outcome:** Study by D Gramellini et al<sup>7</sup> reported a sensitivity of 64%, K W Fong et al<sup>8</sup> reported 44.7%, BN Lakhkar et al<sup>5</sup> reported 50%, and the present study reported 70.73%.

**Middle cerebral artery PI in predicting perinatal outcome:** Study by K.W Fong et al<sup>8</sup> reported a sensitivity of 72.4%, Arduini and Rizzo<sup>9</sup> reported 68%, BN Lakhkar et al<sup>5</sup> reported 41.6%, and the present study reported 75.6%.

**MCA PI / Umbilical PI ratio in predicting perinatal outcome:** Study by Gramellini et al<sup>7</sup> reported a sensitivity of 68%, BN Lakhkar et al<sup>5</sup> reported 47.2%, and the present study reported 78.04%.

**Comparison of MCA/ Umbilical Artery PI in predicting adverse perinatal outcome:** Study by BN Lakhkar et al<sup>5</sup> reported sensitivity of 47.2%, specificity of 86.3%, PPV of 85%, NPV of 50%, and diagnostic accuracy of 65.5%. Gramellini et al<sup>7</sup> reported sensitivity of 68%, specificity of 98.4%, PPV of 94.4%, NPV of 88.8%, and diagnostic accuracy of 90%. The present study reported sensitivity of 78.04%, specificity of 97.84%, PPV of 91.42%, NPV of 93.79%, and diagnostic accuracy of 93.33%.

**Comparison of Umbilical Artery PI in predicting adverse perinatal outcome:** Study by BN Lakhkar et al<sup>5</sup> reported sensitivity of 50%, specificity of 59%, PPV of 66.6%, NPV of 45.4%, and diagnostic accuracy of 52.2%. Gramellini et al<sup>7</sup> reported sensitivity of 64%, specificity of 90.7%, PPV of 72.7%, NPV of 86.7%, and diagnostic accuracy of 81.8%. Fong KW et al<sup>8</sup> reported sensitivity of 44.7%, specificity of 86.6%, PPV of 54%, NPV of 81.7%, and diagnostic accuracy of 70.4%. The present study reported sensitivity of 70.73%, specificity of 97.12%, PPV of 87.87%, NPV of 91.83%, and diagnostic accuracy of 91.11%.

**Comparison of MCA PI in predicting adverse perinatal outcome:** Study by BN Lakhkar et al<sup>5</sup> reported sensitivity of 41.6%, specificity of 90.9%, PPV of 88.2%, NPV of 48.7%, and diagnostic accuracy of 65.5%. Gramellini et al<sup>7</sup> reported sensitivity of 24%, specificity of 100%, PPV of 100%, NPV of 77.3%, and diagnostic accuracy of 83.3%. Fong KW et al<sup>8</sup> reported sensitivity of 72.4%, specificity of 58.1%, PPV of 37.7%, NPV of 85.7%, and diagnostic accuracy of 61.9%. The present study reported sensitivity of 75.6%, specificity of 97.84%, PPV of 91.17%, NPV of 93.15%, and diagnostic accuracy of 92.77%.

**Comparison of diagnostic accuracies:** MCA/Umbilical Artery PI ratio had a diagnostic accuracy of 90% in Gramellini et al's<sup>7</sup> study and 93.33% in the present study. Umbilical Artery PI had a diagnostic accuracy of 83.3% in Gramellini et al's<sup>7</sup> study and 91.11% in the present study. MCA PI had a

diagnostic accuracy of 78.6% in Gramellini et al's<sup>7</sup> study and 92.77% in the present study.

**Comparison of adverse perinatal outcome in cases with abnormal Doppler and abnormal Doppler with normal Non-Stress Test (NST):** The present study reported low birth weight in 17.22% of cases, APGAR < 7 in 14.44% of cases, NICU admission in 21.66% of cases, stillbirth in 1.11% of cases, and meconium-stained liquor in 6.66% of cases.

## CONCLUSION

- The knowledge of uterine, umbilical and middle cerebral artery waveform may help to improve pregnancy management and permit identification and assessment of pregnancy induced hypertension at earliest gestation age as compared to other antepartum test modalities. Early identification creates possibility of early intervention and therapy.
- The Doppler patterns follow a longitudinal trend with early changes in the uterine and umbilical artery followed by middle cerebral artery and other peripheral arteries. Doppler investigation plays an important role in monitoring the growth restricted fetus and thereby may help to determine the optimal time for delivery.
- In the present study, the findings of absent and reverse end diastolic flow were associated with significant perinatal morbidity and mortality. These are ominous signs in Doppler study and prompt action for intervention is necessary in these cases.
- In the present study cerebroplacental ratio showed highest sensitivity, specificity and diagnostic accuracy in predicting adverse perinatal outcome and is better than MCA PI, Uterine artery PI or umbilical artery PI alone. Considering the high specificity and diagnostic accuracy of all parameters in predicting adverse perinatal outcome, combination of various parameters can be useful in decision making process especially to decide the timing of delivery.

**Conflicts of Interests:** None

**Source of funding:** None

## GLOSSARY OF ABBREVIATIONS

1. **APGAR:** Appearance, Pulse, Grimace, Activity, Respiration (score)
2. **ART:** Assisted Reproductive Technology
3. **IUGR:** Intrauterine Growth Restriction
4. **MCA:** Middle Cerebral Artery
5. **NICU:** Neonatal Intensive Care Unit
6. **PI:** Pulsatility Index
7. **PIH:** Pregnancy-Induced Hypertension

## REFERENCES

- Choudhury N, Sharma B, Kanungo B, Yadav R, Rahman H. Assessment of Doppler velocimetry versus nonstress test in antepartum surveillance of high risk pregnancy. *Int J Reprod Contracept Obstet Gynecol.* 2017 Jan 31;6:663.
- Great Britain, Department of Health. Why mothers die? 6th report of the confidential enquiries into maternal deaths in the United Kingdom. London: RCOG; 2004.
- Coleman MA, McCowan LM, North RA. Mid-trimester uterine artery Doppler screening as a predictor of adverse pregnancy outcome in high-risk women. *Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol.* 2000 Jan;15(1):7–12.
- Intrapartum umbilical artery Doppler velocimetry as a predictor of adverse perinatal outcome: a systematic review - Farrell - 1999 - BJOG: An International Journal of Obstetrics & Gynaecology - Wiley Online Library [Internet]. [cited 2020 Dec 6]. Available from: <https://obgyn.onlinelibrary.wiley.com/doi/full/10.1111/j.1471-0528.1999.tb08398.x>
- Lakhkar B, Rajagopal K, Gourisankar P. Doppler prediction of adverse perinatal outcome in PIH and IUGR. *Indian J Radiol Imaging.* 2006;16(1):109.
- Ochi H, Kusanagi Y, Katayama T, Matsubara K, Ito M. Clinical significance of normalization of uterine artery pulsatility index with maternal heart rate for the evaluation of uterine circulation in pregnancy-induced hypertension. *Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol.* 2003 May;21(5):459–63.
- Gramellini D, Folli MC, Raboni S, Vadora E, Merialdi A. Cerebral-umbilical Doppler ratio as a predictor of adverse perinatal outcome. *Obstet Gynecol.* 1992 Mar;79(3):416–20.
- Fong KW, Ohlsson A, Hannah ME, Grisaru S, Kingdom J, Cohen H, et al. Prediction of perinatal outcome in fetuses suspected to have intrauterine growth restriction: Doppler US study of fetal cerebral, renal, and umbilical arteries. *Radiology.* 1999 Dec;213(3):681–9.
- Arduini D, Rizzo G. Normal values of Pulsatility Index from fetal vessels: a cross-sectional study on 1556 healthy fetuses. *J Perinat Med.* 1990;18(3):165–72.

\*\*\*\*\*