E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/15.02.35

Original Research Article

Ophthalmic Artery Pulsatility Index Between 24-34 Weeks as a Diagnostic Predictor for Late-Onset Preeclampsia: High ROC Accuracy Despite Non-Significant Mean Differences

Meghna Deka[1], Saswati Sanyal Choudhury[2], Dibya Jyoti Gharphalia[3], Mandeep Bayan[4], Pinku Talukdar[5]

[1]PGT, Department of Obstetrics & Gynaecology, Gauhati Medical College & Hospital, Guwahati-32, Assam, India

[2]Professor, Department of Obstetrics & Gynaecology, Gauhati Medical College & Hospital, Guwahati-32, Assam, India

[3]Associate Professor, Department of Obstetrics & Gynaecology, Gauhati Medical College & Hospital, Guwahati-32, Assam, India

[4],Assistant Professor, Department of Obstetrics & Gynaecology, Gauhati Medical College & Hospital, Guwahati-32, Assam, India

[5]Scientist B, Multidisciplinary Research Unit, Gauhati Medical College & Hospital, Guwahati-32, Assam, India

Corresponding author details: Dr. Meghna Deka

Received: 15.04.25, Revised: 19.05.25, Accepted: 26.06.25

ABSTRACT

Background: Late-onset preeclampsia remains a diagnostic challenge. Maternal ophthalmic artery Doppler Pulsatility Index (PI) has emerged as a non-invasive surrogate marker for systemic vascular resistance. **Objective:** To evaluate the predictive utility of maternal ophthalmic artery PI between 24–34 weeks of gestation in forecasting late-onset preeclampsia. **Methods:** In this prospective case-control study, 57 women who developed late-onset preeclampsia were compared with 130 normotensive controls. Ophthalmic artery PI was measured using transorbital Doppler ultrasonography. **Results:** Mean PI was higher in controls (2.98 ±0.94) than in cases (2.13 ±0.29), but this difference was statistically non-significant ($p > 0.05$). However, ROC analysis of PI revealed an AUC of 0.87, with a sensitivity of 94.7% and specificity of 86.9% for predicting preeclampsia. **Conclusion:** Despite a non-significant difference in mean PI between cases and controls, ophthalmic artery PI demonstrated excellent predictive accuracy on ROC analysis. It may be a valuable adjunct screening tool for late-onset preeclampsia.

Keywords: Preeclampsia, Pulsatility Index, Ophthalmic Artery Doppler, ROC Curve, Prediction, Screening

INTRODUCTION

Preeclampsia is a hypertensive disorder of pregnancy that contributes significantly to maternal and fetal morbidity and mortality worldwide. It is defined by the onset of hypertension and proteinuria after 20 weeks of gestation. Despite extensive research, the pathophysiology of preeclampsia remains incompletely understood, and its prediction—particularly in late-onset cases—remains a clinical challenge.

Traditionally, screening for preeclampsia has focused on maternal characteristics, mean arterial pressure, biochemical markers, and uterine artery Doppler indices. While uterine artery Doppler provides insight into placental perfusion and is useful for detecting early-onset preeclampsia, its utility is limited in predicting late-onset cases. Therefore, alternative vascular biomarkers are under investigation.

The ophthalmic artery, a branch of the internal carotid artery, has emerged as a novel target for Doppler studies in preeclampsia prediction. Owing to its cerebrovascular relevance and shared hemodynamic characteristics with the uteroplacental circulation, it serves as a surrogate for systemic endothelial function. The Pulsatility

Index (PI), reflects downstream resistance and vascular compliance.

Because preeclampsia involves systemic endothelial dysfunction and vasoconstriction, evaluating ophthalmic artery PI between 24 and 34 weeks—an important transitional period in maternal cardiovascular adaptation—may provide early cues before clinical signs appear. This study evaluates whether ophthalmic artery PI can predict late-onset preeclampsia in a North East Indian cohort .

Materials and Methods

A prospective observational study was

conducted at Gauhati Medical College and Hospital. A total of 187 antenatal women were enrolled (57 cases, 130 controls). All underwent transorbital ophthalmic artery Doppler assessment for PI measurement. Statistical comparison of means was performed using the independent t-test, and diagnostic performance was evaluated using ROC analysis.

Study Population

Pregnant women between 24 to 34 weeks of gestation attending antenatal clinics or emergency

services were screened. After applying inclusion and exclusion criteria, a total of 187 women were enrolled—57 who later developed preeclampsia (cases) and 130 who remained normotensive (controls).

Inclusion Criteria

* Singleton pregnancy between 24 and 34 weeks of gestation
* Willingness to participate and provide informed consent

Exclusion Criteria

* Chronic hypertension or history of preeclampsia
* Ocular disorders
* Pre-existing renal or cardiovascular diseases
* Thrombophilia
* Fetal anomalies or intrauterine death* Preterm labor

Data Collection and Procedure

A detailed medical history and physical examination were recorded. Ophthalmic artery Doppler

assessment was performed transorbitally using a 5–10 MHz linear probe, with patients in a supine position and eyes closed.

Results

A total of 187 antenatal women were studied between 24–34 weeks of gestation. Among them, 57 women developed preeclampsia (cases), and 130 remained normotensive (controls).

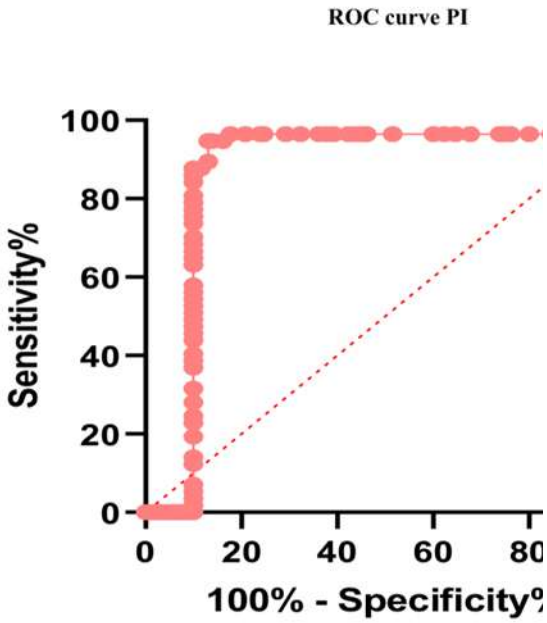
- Mean Ophthalmic Artery PI (±SD):
  - Cases: 2.13 ±0.29
  - Controls: 2.98 ±0.94

Despite the numerical difference showing lower PI in the preeclamptic group, this finding was not statistically significant ($p > 0.05$).

However, Receiver Operating Characteristic (ROC) curve analysis revealed:

- Area Under the Curve (AUC): 0.87
- Sensitivity: 94.7%
- Specificity: 86.9%

These figures suggest that PI, though not significantly different in mean values, showed excellent diagnostic accuracy in predicting late-onset preeclampsia when analyzed via ROC curve .



Area Under the Curve

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
PI	0.87	.044	0.0001	0.7995	0.9308

- Despite no statistically significant difference in mean PI between groups, ROC analysis demonstrated high diagnostic accuracy.

Based on the ROC curve analysis, the optimal cutoff value for PI was determined to be 1.86, which maximized the Youden Index (sensitivity + specificity - 1). At this threshold, the sensitivity was 94.74 and specificity of 86.92. The area under the ROC curve (AUC) was 0.87, indicating an excellent discriminative ability.

Discussion

The present study aimed to explore the diagnostic value of maternal ophthalmic artery Doppler—specifically PI—between 24–34 weeks for predicting late-onset preeclampsia. While the mean PI values did not differ significantly between cases and controls, the ROC curve analysis yielded an AUC of 0.87, indicating high diagnostic utility.

This apparent contradiction emphasizes a key point: the predictive power of a variable should not be solely evaluated based on mean differences. The ability to discriminate between two conditions may still be strong, as reflected in a high AUC, even when mean values overlap.

Prior studies have similarly observed that ophthalmic artery PI may not always show group-wise significance but performs well in individual risk stratification . PI reflects vascular resistance, which may be influenced by transient hemodynamic factors, interindividual variability, or measurement timing. This variability could explain the wide standard deviation in control PI values (±0.94) in our study.

Several mechanisms may explain the lower mean PI in preeclamptic women:

- Loss of autoregulation in cerebral

circulation.
- Widespread vasospasm leading to
- reducing peripheral resistance in certain vascular beds.

The findings support the idea that ophthalmic artery PI is not a standalone marker, but may be used alongside other parameters—like peak systolic velocity (PSV), PR ratio, or uterine artery Doppler—for a composite predictive model.

Furthermore, the high sensitivity (94.7%) and specificity (86.9%) make ophthalmic artery PI a clinically relevant adjunct, particularly in settings lacking access to advanced biochemical markers or in populations with poor antenatal follow-up.

Conclusion

This study explored the diagnostic utility of maternal ophthalmic artery Doppler Pulsatility Index (PI) between 24 to 34 weeks of gestation in predicting late-onset preeclampsia. Although the mean PI was lower in women who later developed preeclampsia compared to normotensive controls, this difference was not statistically significant. Despite this, the Receiver Operating Characteristic (ROC) curve analysis demonstrated excellent diagnostic performance, with an area under the curve (AUC) of 0.87, sensitivity of 94.7%, and specificity of 86.9%.

These findings highlight an important clinical insight: the diagnostic potential of a test

cannot be solely assessed by comparing group mean values. In this case, even with overlapping distributions, the ophthalmic artery PI showed substantial discriminatory ability in identifying pregnancies at risk for preeclampsia. The high sensitivity and specificity observed in ROC analysis suggest that PI may serve as a valuable screening adjunct, particularly when used in combination with other clinical parameters or Doppler indices.

Given its non-invasive nature, relative ease of performance, and cost-effectiveness, ophthalmic artery Doppler could be integrated into routine antenatal care in both tertiary and peripheral healthcare settings. However, due to the lack of statistical significance in mean PI differences, it should not be used in isolation. Further large-

vascular remodeling.
- Systemic endothelial dysfunction

scale, multicentric studies are recommended to validate these findings and explore the role of PI within a multimodal predictive model.

In summary, while ophthalmic artery PI may not reflect consistent intergroup differences, it shows promise as a diagnostic tool for individual risk prediction of late-onset preeclampsia and could contribute meaningfully to early detection strategies aimed at improving maternal and fetal outcomes.

Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.

References

1. Sibai BM. Preeclampsia as a cause of preterm and late preterm birth. Semin Perinatol. 2011;35(5):292–297.
2. Tranquilli AL, Brown MA, Zeeman GG, et al. The definition of severe and early-onset preeclampsia. Pregnancy Hypertens. 2013;3(1):44–47.
3. Alves JA, et al. Ophthalmic artery Doppler as a predictor of preeclampsia in the first trimester. Hypertens Pregnancy. 2011;30(2):142–149.
4. Sarno M, et al. Ophthalmic artery Doppler and late preeclampsia prediction. Ultrasound Obstet Gynecol. 2021;58(2):211–218.
5. Sapantzoglou I, et al. Prediction of preeclampsia using ophthalmic artery Doppler. BJOG. 2021;128(7):1234–1242.
6. Nicolaides KH. A model for prediction of preeclampsia. Prenat Diagn. 2013;33(7):614–623.
7. Gana N, et al. Early prediction of preeclampsia using ophthalmic artery Doppler and biomarkers. Placenta. 2022;119:1–8.
8. Matias DS, et al. Ophthalmic artery Doppler in hypertensive disorders of pregnancy. Int J Gynaecol Obstet. 2020;151(3):396–401.
9. Souza PC, et al. Predictive value of ophthalmic artery and uterine artery Doppler. Rev Bras Ginecol Obstet. 2016;38(9):443–448.
10. Lau KG, et al. Use of OA PSV-ratio in differentiating types of hypertension in pregnancy. Pregnancy Hypertens. 2022;30:100–106.