Ophthalmic artery Doppler velocimetry and the prediction of preeclampsia

Hypertensive syndromes in pregnancy are the leading cause of maternal death worldwide, particularly in developing countries. Understanding preeclampsia (PE) beyond placental insufficiency is a crucial step in contemporary obstetrics. The role of systemic endothelial dysfunction and cerebral hyperperfusion in the genesis of the disease is increasingly recognized. In the central nervous system, failure of vascular autoregulation mechanisms favors hyperflow and cerebral edema, factors closely associated with eclampsia seizures. In this context, methods capable of indirectly reflecting the state of cerebral perfusion gain clinical relevance.[1] Ophthalmic artery Doppler velocimetry thus emerges as a promising alternative, since its resistance index (RI) can function as an indirect marker of cerebral hemodynamics.[2]

Initial studies suggested significant reductions in the RI of the ophthalmic artery in pregnant women with PE, both early and late, compared to normotensive women.[3,4] However, diagnostic performance was limited, with low sensitivity and specificity after analysis by the Receiver Operating Characteristic (ROC) curve.[4] Such limitations reflect challenges inherent to the heterogeneity of preeclampsia, marked by multiple pathophysiological mechanisms and distinct clinical presentations, in addition to difficulties related to sample size and timing of evaluation.

Despite this, investigations have not stopped. Prospective studies with intermediate samples have shown divergent results; while some have reinforced the role of the ophthalmic artery Doppler velocimetry as a predictive tool, others have not demonstrated any benefits.[5-7] More recently, robust multicenter studies coordinated by the Fetal Medicine Foundation (FMF) have provided more consistent evidence. They observed that the ratio between the second and first peaks of the systolic velocity of the ophthalmic artery stands out as a statistically relevant index in predicting PE, especially in early-onset forms.[8-10] Although the addition of this parameter to screening with clinical and demographic data has modestly increased the detection rate, the finding reinforces the need not to discard the ophthalmic artery from this debate.

In this sense, the FMF has advanced its PE prediction guideline and is explicitly incorporating the ophthalmic artery Doppler velocimetry with normality curves for different gestational ages. These curves—based on large prospective cohorts—allow for the comparison of observed values with expected values according to specific percentiles for each point in pregnancy, which enables the detection of early deviations in the peak systolic index (ratio between the second and first peaks) and allows for a more standardized assessment of PE risk.[9,10] With this, the FMF proposes that, in addition to the already established clinical and biophysical markers, the normal curve of the ophthalmic artery should be integrated into the screening protocols in the first, second, and third trimesters as an auxiliary tool on the risk stratification.

In 2025, the FMF introduced the maternal ophthalmic artery Doppler velocimetry in the prediction of preeclampsia in its maternal risk calculation program, which uses various parameters such as maternal characteristics (age, body mass index, race, and smoking), current pregnancy data (spontaneous pregnancy, multiple pregnancy, and gestational age), maternal clinical and obstetric history, number of previous deliveries and their characteristics, ultrasound data, mean arterial pressure, the Doppler velocimetry of the uterine artery (pulsatility index), and biochemical markers [placental growth factor (PLGF) and soluble tyrosine kinase-1 factor (sFLT-1)].[11] This risk calculation is essential for preventive measures to be taken when a pregnant woman is found to be at high risk for preeclampsia, even when it is not possible to perform the ophthalmic artery Doppler velocimetry due to the absence of a qualified professional, in this case, the available parameters should be used. It is important to standardize the technique of the ophthalmic artery Doppler velocimetry from the care taken in performing it to the training of professionals.

Thus, the message that currently emerges is that there is untapped potential in the analysis of the ophthalmic artery flow pattern. The relationship between the second and first systolic peaks should not be seen as just another index among many, but as a window to understand the interaction between cerebral perfusion and the risk of preeclampsia. It is up to the scientific community to move forward with broader and more standardized studies capable of confirming or refuting the definitive role of this marker. The debate is open, and we may only be at the beginning of incorporating the ophthalmic artery as a key element

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in predicting preeclampsia, but to date there is no evidence that the ophthalmic artery Doppler velocimetry can be used as the sole marker of preeclampsia risk.

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An invitation from the Editor in Chief: Lygia Vanderlei

Alex Sandro Rolland Souza [1,2,3]
https://orcid.org/0000-0001-7039-2052

Gustavo Fonseca de Albuquerque Souza [1]
https://orcid.org/0000-0002-1794-701X

Silvia Loreto Faquini [1]
https://orcid.org/0000-0003-4247-0126

[1] Instituto de Medicina Integral Prof. Fernando Figueira. Rua dos Coelhos, 300. Boa Vista. Recife, PE, Brazil. CEP: 50.070-902.
E-mail: alexrolland@uol.com.br
[2] Universidade Católica de Pernambuco. Recife, PE, Brazil
[3] Universidade Federal de Pernambuco. Recife, PE, Brazil