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CLINICAL ARTICLE

Ophthalmic artery Doppler as a measure of severe pre-eclampsia

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Abstract

Objective: To identify differences in orbital flow behavior in mild and severe pre-eclamptic women compared with healthy pregnant women, demonstrated by ophthalmic artery Doppler indexes. *Methods:* Ophthalmic artery Doppler indexes of 20 mild and 20 severe pre-eclamptic women were compared with 51 healthy pregnant women. Right and left eye Doppler index means were evaluated and the resistance index (RI), pulsatility index (PI), peak systolic velocity (PSV), end diastolic velocity (EDV), and peak ratio (PR) were calculated. *Results:* Statistically significant differences were observed between PR, PSV, and EDV ($P=0.0009$, $P=0.0020$, $P=0.0001$) ophthalmic artery Doppler in a comparison of women with mild and severe pre-eclampsia. Statistically significant differences were seen between all Doppler indexes of the study group and healthy pregnant women. Ophthalmic PR, PSV, and EDV were significantly higher in severe pre-eclamptic cases but other index parameters did not show any difference. An elevation of diastolic and systolic flow occurred when pre-eclampsia became severe. *Conclusion:* Orbital vascular impedance reduction with orbital hyperperfusion was present in severe pre-eclamptic women compared with mild pre-eclamptic and healthy pregnant women. Ophthalmic Doppler is a novel parameter that may be useful in the diagnosis of severe pre-eclampsia.

1. Introduction

The study of pre-eclampsia is of fundamental importance in obstetrics due to its high incidence, ranging from 5% to 10% [1], worldwide mortality rate [2–4] and its high index of maternal and perinatal morbidity. Ophthalmic artery Doppler is a novel noninvasive examination used to study central territory vascular flow during pregnancy. The ophthalmic artery has embryologic, anatomic, and functional similarities to central nervous system arteriolar vessels [5,6]; it is therefore possible to analyze the hemodynamic behavior of intracranial arteries by performing ophthalmic artery Doppler.

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Hata et al. [7] were the first to report on the use of orbital vascular Doppler in pre-eclamptic women. They found a reduction of the ophthalmic artery pulsatility index (PI), opposing the initial physiopathologic hypothesis of vasoconstriction in the ocular vasculature. The presence of vasodilatory signs in the ophthalmic artery related to orbital hyperperfusion in pre-eclamptic women has been confirmed in other studies [8–15] by identifying changes in the resistive index (RI), peak ratio (PR), peak systolic velocity (PSV), and final diastolic velocity (FDV). However, there is no agreement on orbital artery Doppler velocimetric patterns in mild and severe pre-eclamptic women [11–13].

Since the ability to prevent pre-eclampsia is limited, management has focused on identifying women at higher risk, followed by close clinical and laboratory monitoring to recognize the disease process in its early stages. Several clinical and laboratory parameters have classically been used for defining the severity of pre-eclampsia [16]. Current determination of more severe cases depends mostly on the pressure levels and proteinuria associated with symptoms such as headache, epigastric pain, and visual disturbances. Identifying new parameters to determine serious cases of pre-eclampsia is of great practical applicability to establish a more intensive treatment for pregnant women. Furthermore, the evaluation of ophthalmic artery flow patterns is likely to provide new perspectives concerning the physiopathology, diagnosis, and severity of pre-eclampsia; it can also be useful as a parameter for studying vasoactive drugs used for the treatment of the condition.

The aim of this study was to verify differences in the orbital flow behavior in mild and severe pre-eclamptic women compared with healthy pregnant women, demonstrated by ophthalmic artery Doppler indexes.

2. Methods

The study was analyzed and approved by the Committee of Ethics for University Research. A cross-sectional study was conducted to compare ophthalmic artery Doppler indexes of 20 mild and 20 severe pre-eclamptic women (study group) with 51 healthy pregnant women. The patients were selected from the Clinical Hospital of the Federal University of Uberlândia, Brazil. Pre-eclampsia was diagnosed and evaluation of its severity was done on day of admission, followed by ophthalmic artery Doppler assessment. The healthy pregnant women in the control group were selected at prenatal ambulatory consultations at the same University and were matched with the study group by gestational age. All patients gave their informed consent.

Pre-eclamptic women, as established by the National High Blood Pressure Education Program criteria [16] (NHBPEP, 2000), were included in the study group. Pre-eclampsia was determined by increased blood pressure accompanied by proteinuria after the 20th week of pregnancy. Gestation blood pressure elevation was defined as blood pressure >140 mm Hg systolic or >90 mm Hg diastolic in a woman who was normotensive before 20 weeks of gestation. Severe pre-eclampsia was determined in the presence of one or more of the following signs and symptoms: blood pressure >160×110 mm Hg; proteinuria >2 g in 24 h; increased serum creatinine level >1.2 mg/dL; platelet count <100,000 cells/mm^3; elevated hepatic enzyme activities; epigastric pain; persistent headache or other cerebral or visual disturbances. Patients suffering from pre-eclampsia without any of the above severe parameters were classified as mild pre-eclamptic women (NHBPEP, 2000).

Exclusion criteria for pregnant women were: use of antihypertensive drugs and anticonvulsant therapy; mellitus or gestational diabetes; glaucoma or other previously diagnosed ocular disorders; twin gestation; smoking; chronic hypertension; drug abuse; significant cardiac disease; signs of internal carotid artery disease; eclampsia; and labor.

Orbital vascular Doppler was performed using an electronic linear probe in a frequency ranging from 7 to 10 MHz as described by Diniz et al. [17]. The women were examined in a dorsal position after a 5-minute rest in bed; after a gel drop, patients were asked to keep their eyes closed and the probe was positioned transversely on the upper eyelids. The examiner made some movements in the craniocaudal direction to identify the vessels without pressing the probe to avoid alterations in Doppler results. Scanning was performed in both eyes. The ophthalmic artery was identified and its flow was registered approximately 15 mm from the optic disc, medial to the optic nerve. Six waves without any pattern change were registered. The angle used for the Doppler study was kept below 20°C; a

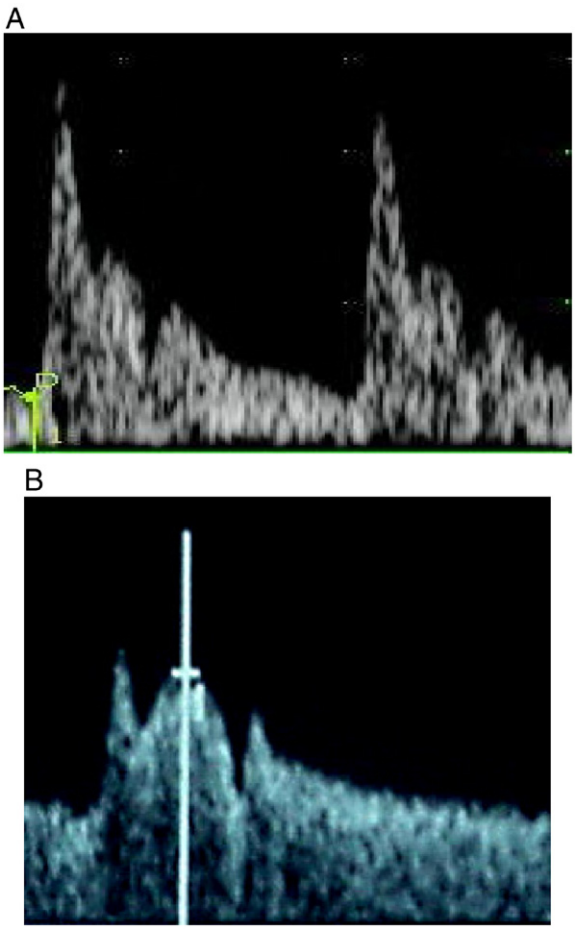

Figure 1 A: Ophthalmic artery Doppler waveform in normal pregnant woman with low diastolic flow and a small elevation of the second velocity peak after the protodiastolic notch. B: Doppler waveform in pre-eclamptic woman with high diastolic flow associated with a characteristic large hump-shaped second peak after the protodiastolic notch.