Using Ophthalmodynamometry, Transcranial Doppler and Carotid Duplex Ultrasound to Prevent Stroke and Blindness

Ophthalmodynamometry (ODM) is a noninvasive eye procedure that measures central retinal artery pressure (CRAP) (1). Applanation force is applied to the eye while pulsation of the central retinal artery is observed. Both the systolic (SCRAP) and the diastolic central retinal artery pressure (DCRAP) are measured. The weighted mean central retinal artery pressure (MCRAP) is calculated using the equation below:

$$MCRAP = \frac{SCRAP + 2 \cdot DCRAP}{3}$$

The eye is an anatomical extension of the brain and the retina is part of the central nervous system. Blood flow into the eye is dependent on the health of the cerebral and pre-cerebral vascular system. The ophthalmic artery is the first branch of the internal carotid artery and the eye is the most distal organ that receives blood flow from the carotid vascular system. **The eye is an organ which is at significant risk when pre-cerebral and cerebral vascular disease is present (2).**

The United States Food and Drug Administration (USFDA) cleared the Falck Medical, Inc. ODM for clinical use under FDA510k151491. This is the first and only ODM procedure cleared for clinical use by the USFDA.

ODM force application and CRA pulsation observation is an automated process performed by the Falck Multifunction Device. User input of ipsilateral brachial artery blood pressure is required. The device calculates and stores brachial mean arterial pressure (BMAP). MCRAP should be greater than 0.6 times ipsilateral BMAP (2). **A value less than 60% of BMAP is a sign of ocular ischemia and can be a sign of cerebral ischemia and cerebral/pre-cerebral vascular disease.** Ocular ischemia is a risk factor for blindness. Cerebral/pre-cerebral vascular disease is risk factor for stroke (3).

If MCRAP is reduced, a full evaluation of the carotid vascular system should be carried out. Identifying where and what type of vascular disease exists provides the practitioner with the information necessary to initiate the appropriate therapy to prevent blindness and stroke.

Carotid duplex ultrasound (CUS) scanning is used to evaluate the external carotid artery. Transcranial doppler ultrasound (TCD) scanning is used to investigate the internal carotid, the circle of Willis, and the ophthalmic artery. Both CUS and TCD measure blood velocity to gauge the degree of stenosis. TCD is capable of monitoring for micro-emboli and vasomotor reactivity, both of which can assist in identifying patients at high risk of stroke from carotid stenosis (4).

In an ongoing Falck Medical, Inc. prospective study of asymptomatic patients with vascular risk factors and decreased ODM, the probability of an abnormal CUS and/or TCD is 74%. Within the abnormal findings, 23% were on the TCD scan only, 59% percent were on CUS scan only and 18% were on both the TCD and the CUS scan. This data supports the need to perform a complete evaluation of both the pre-cerebral and cerebral vascular system.

A recent published case report describes reversed ophthalmic artery flow found on TCD due to carotid stenosis found on CUS (5). After carotid stenting the ophthalmic artery flow normalized reducing the risk of blindness in the affected eye.

Medicare performed an audit of 235 patients that had TCD performed after an abnormal ODM. The indications for ODM were a history of vascular risk factors and/or signs of cerebral/pre-cerebral vascular disease. Data from the ODM and TCD was used for patient management. The conclusion from the Medicare medical consultant was the abnormal ODM justified the need for the TCD (6).

It is the responsibility of the ordering physician to identify and document the applicable and correct indications when ordering any procedure. In general, indications include relevant signs/symptoms and that the procedure is necessary to guide therapy.

With ODM, eye care providers can play a critical role preventing stroke and blindness.

References:

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5. Murillo B A, Cheng A M, Tsai J, et al. (May 20, 2024) Decreased Ocular Perfusion Pressure Associated With Reverse Ophthalmic Artery Flow on Transcranial Doppler Ultrasonography. Cureus 16(5): e60706. doi:10.7759/cureus.60706.
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