Laser Doppler Flowmetry

Is used in hemodynamics research as a technique to partially quantify blood flow in human tissues such as skin. Within the clinical environment, the technology is often referred to as laser Doppler flowmetry (LDF). The beam from a low-power laser (usually a laser diode) penetrates the skin sufficiently to be scattered with a Doppler shift by the red blood cells and return to be concentrated on a detector. These measurements are useful to monitor the effect of exercise, drug treatments, environmental, or physical manipulations on targeted micro-sized vascular areas.

In a prospective single-institution nonrandomized trial, Sommer et al studied local cerebral microcirculation using the noninvasive laser-Doppler spectrophotometer “Oxygen-to-see” (O2C) in 20 consecutive patients (15 female, 5 male; median age: 60.5 ± 11.7 years) who were operated on for incidental cerebral aneurysms. Capillary-venous oxygenation (oxygen saturation [“SO2”]), postcapillary venous filling pressures (relative hemoglobin content [“rHb”]), blood cell velocity (“velo”), and blood flow (“flow”) were measured in 7-mm tissue depth using a subdural fiberoptic probe. Results Representative recordings were acquired immediately after dural opening over a median time span of 88 ± 21.8 seconds (range: 60-128 seconds) before surgical manipulation. Baseline values (median ± 2 standard deviations) of brain perfusion as measured with the O2C device were SO2, 39 ± 16.6%; rHb, 53 ± 18.6 arbitrary units (AU); velo, 60 ± 20.4 AU; and flow, 311 ± 72.8 AU. Placement of the self-retaining retractor led to a decrease in SO2 of 17% ± 29% ($p < .05$) and flow of 10% ± 11% ($p < .01$); rHb increased by 18% ± 20% ($p < .01$), and velo remained unchanged. Retractor removal caused the opposite with an increased flow of 10% ± 7% ($p < 0.001$) and velo (3% ± 6%, $p = 0.11$), but a decrease in SO2 of 24% ± 33% ($p = 0.09$) and rHb of 12% ± 20% ($p = 0.18$). No neurologic or surgical complications occurred.

Using this novel noninvasive system, they were able to measure local cerebral microcirculation during aneurysm surgery. The data indicate that this device is able to detect changes during routine neurosurgical maneuvers. Thus it may be useful for early detection of cerebral microcirculatory disturbances [1].

1)
Sommer B, Kreuzer M, Bischoff B, Wolf D, Schmitt H, Eyupoglu IY, Rössler K, Buchfelder M, Ganslandt O, Wiendieck K. Combined Laser-Doppler Flowmetry and Spectrophotometry: Feasibility Study of a Novel Device for Monitoring Local Cortical Microcirculation during Aneurysm Surgery. J Neurol Surg A Cent Eur Neurosurg. 2016 Jul 14. [Epub ahead of print] PubMed PMID: 27415594.