



**Description of Device:**

The QFlow 500 Perfusion Monitoring System consists of the Bowman Perfusion Monitor® (BPM), an umbilical cord and a minimally invasive QFlow 500™ Perfusion Probe. The BPM provides real-time continuous perfusion, in absolute physiological units (ml/100g-min). The BPM is the **only** technology that provides continuous, quantitative perfusion measurements at the bedside.



**QFlow 500™ Perfusion Probe:**

The minimally invasive QFlow 500™ Perfusion Probe measures tissue blood flow in the spherical volume surrounding the distal tip of the probe. The approximate 1 mm diameter flexible probe can be inserted into any soft tissue at the site where quantitative knowledge of perfusion is desired.

**Perfusion (CBF)** – is measured in absolute physiological units of ml of blood per 100g of tissue per minute.

**Absolute CBF values permit determination of functional thresholds**

| <b>Neurosurgeon/Neurologist/Neurointensivist-Neuro ICU</b>  |  |
|---|--|
| <b>SAH</b>  |  |
| <b>SAH Patients are at high risk of developing vasospasm</b>  |  |
| CBF below 15 ml/100g-min is considered by many to be clinical vasospasm <sup>(1)</sup>  |  |
| <b>ICU - FEATURE</b>  | <b>BENEFIT</b>   |
| <ul style="list-style-type: none"> <li>• Alerts clinician to onset of vasospasm in comatose patients</li> <li>• Shows restoration of flow after therapy</li> <li>• Demonstrates real-time interaction of drugs and adjunctive therapy on CBF</li> </ul> | <ul style="list-style-type: none"> <li>• Allows early intervention before permanent damage</li> <li>• Provides indication of when global perfusion imaging may be needed</li> <li>• Allows assessment of effectiveness of therapy</li> <li>• Reduces decision making burden on clinicians</li> </ul> |

## TBI

**TBI Patients are at high risk for developing swelling-induced ischemia**  
 Maintaining an adequate level of CBF is central to avoiding secondary injury

| ICU - FEATURE  | BENEFIT  |
|--|--|
| <ul style="list-style-type: none"> <li>Permits management of patient therapy to maintain CBF above threshold level</li> <li>Alerts clinician to onset of swelling-induced ischemia</li> <li>Shows restoration of flow after therapy</li> <li>Demonstrates real-time interaction of drugs and other therapies on CBF</li> </ul> | <ul style="list-style-type: none"> <li>Allows early intervention before secondary injury</li> <li>Provides insight to management of ABP to avoid unnecessarily high therapeutic hypertension and hypertension induced additional bleeds</li> <li>Allows assessment of effectiveness of therapy</li> <li>Reduces decision making burden on clinician</li> </ul> |

### Integrating Absolute CBF Values with other Brain Physiology: Multimodal Monitoring

| Impaired Autoregulation   | Cerebral Vascular Resistance (CVR)  |
|---|---|
| <p style="text-align: center;"><b>CBF and ICP (CPP) permits determination of impaired autoregulation</b></p> <p>Brain injured patients with impaired autoregulation experience worse outcomes</p> | <p style="text-align: center;"><b>CBF and ICP (CPP) permits determination of cerebral vascular resistance</b></p> <p>CVR = CPP/CBF; CVR has been shown to predict vasospasm 1 to 5 days before onset <sup>(1)</sup></p> |

### Neurosurgeon OR: Applications of Perfusion (CBF) Monitored in the OR

| Aneurysm Surgery   | EC/IC Bypass Surgery                                   |
|--|--|
| <p>Shows level of collateral CBF during Temporary Clipping and has been shown to predict the TAO clipping time to avoid infarct <sup>(2)</sup></p> | <p style="text-align: center;">Shows change in CBF</p> |

### Additional Features and Benefits Associated with other Parameters

| Brain Temperature - T (°C)   |
|--|
| <p style="text-align: center;"><b>Thermal diffusion based CBF quantification includes continuous temperature</b></p> <p style="text-align: center;">Early detection of fever reduces risk of temperature related brain injury</p>  |
| Thermal Conductivity - K (mw/cm-°C)  |
| <p style="text-align: center;"><b>Thermal diffusion based CBF includes tissue thermal conductivity determination</b></p> <p style="text-align: center;">Tissue thermal conductivity is a function of tissue water content</p> <p style="text-align: center;">Permits insight into brain water content and changing levels of tissue hydration <sup>(3)</sup></p> |

**References:**

- (1) - P. Vajkoczy, P. Horn, C. Thome, E. Munch, and P. Schmiedek, "Regional cerebral blood flow monitoring in the diagnosis of delayed ischemia following aneurysmal subarachnoid hemorrhage.," *Journal of neurosurgery*, vol. 98, no. 6, pp. 1227-34, Jun. 2003.
- (2) - C. Thomé, P. Vajkoczy, P. Horn, C. Bauhuf, U. Hübner, and P. Schmiedek, "Continuous monitoring of regional cerebral blood flow during temporary arterial occlusion in aneurysm surgery.," *Journal of neurosurgery*, vol. 95, no. 3, pp. 402-11, Sep-2001.
- (3) SB Ko, HA Choi, G Parikh, JM Schmidt, K Lee, N Badjatia, J Claassen, ES Connolly, and SA Mayer, "Real Time Estimation of Brain Water Content in Comatose Patients." *Annals of Neurology*. 72(3): 344-50, 2012.