A wearable optical sensor for continuous monitoring of cerebral blood flow in mice

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Abstracts will be considered for both poster and platform presentations

Stroke/Neurovascular

Continuous and longitudinal monitoring of cerebral blood flow (CBF) in animal models provides information for studying fundamental mechanisms and interventions of versatile brain diseases such as ischemic stroke and traumatic brain injury. Since anesthesia may affect brain hemodynamics/function, researchers are seeking wearable devices which can be installed on the head of conscious animals. We present a wearable ultra-small diffuse speckle contrast flowmeter (DSCF) sensor enabling noninvasive and continuous measurement of CBF in the mouse brain (up to 8 mm depth). The DSCF sensor consists of a small laser diode and an ultra-small CMOS camera chip, which are glued on a mouse head. The movement of red blood cells in the brain (i.e., CBF) produces continuous fluctuations of laser speckles, which are captured by the CMOS camera. Measurements of CBF variations in mice during transient ipsilateral arterial occlusions or forepaw electrical stimulations by our DSCF sensor are compared to standard laser Doppler flowmetry (LDF) and diffuse correlation spectroscopy (DCS), respectively. Significant correlations ($R2 > 0.80$, $p < 10\text{-}5$) and excellent linear relationships are observed among these measurements. Compared to conventional LDF and DCS sensors which commonly use rigid optical fibers for light delivery and detection, our DSCF sensor can be placed directly on the tissue surface without using any optical fiber. The connections between the DSCF sensor and a control unit are all flexible electrical wires/cables, which offer the potential for continuous monitoring of CBF variations in freely moving conscious rodents.