Studying Brain Dynamics Using Near-Infrared Light

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Recent advances in photonics lead to development of wearable and bedside techniques for non-invasive monitoring of dynamic changes in the brain using near-infrared light. The key cerebral dynamic variables that can be measured directly by near-infrared spectroscopy, diffuse correlation spectroscopy, and laser Doppler flowmetry are the microvascular blood velocity, oxy- and deoxy-hemoglobin concentrations, microvascular blood volume, and an intracellular oxygen consumption biomarker cytochrome C oxidase. A more resent research direction is the assessment of the whole spectrum of cerebral microvascular and metabolic parameters, such as cerebral blood flow, cerebral metabolic rate of oxygen, hemoglobin concentration in blood, rate of oxygen diffusion, capillary and venule oxygen saturation, and others, using near-infrared measurements and quantitative hemometabolic models. In my talk I review the resent advancements in near-infrared dynamic brain imaging using novel hemometabolic models and new knowledge obtained using these techniques. As an example, I discuss applications of near-infrared methods in critical clinical situations such as cardiac surgery and cardiac arrest.