Bedside monitoring of cerebral perfusion is important for a variety of diseases, including traumatic brain injury, hydrocephalus, sepsis, and stroke, where inadequate perfusion can lead to ischemia and neuronal damage. The healthy brain can regulate and maintain constant blood flow even during episodic changes in cerebral perfusion pressure, which is a function of intracranial pressure (ICP). Optimizing perfusion pressure in order to maintain blood flow regulation improves neurological outcome in traumatic brain injury patients. However, the relationship between neurovascular coupling, autoregulation, and pressure regulation is not well understood, partly because quantification of ICP is currently only possible with invasive pressure probes. Knowledge of ICP changes is therefore limited to traumatic brain injury where ICP sensing is part of clinical routine. Diffuse optical methods in connection with electroencephalography are uniquely positioned to address questions about neurovascular coupling in relationship to pressure changes. For this, we have recently developed non-invasive methods to measure ICP, which are based on hemodynamic signals measured with near-infrared spectroscopy (NIRS) and diffuse correlation spectroscopy (DCS). We further have established means to quantify the relationship between changes in neurovascular coupling and elevated ICP. I will describe our advances in measuring ICP with optical methods and will emphasize the relationship between neuronal changes and cerebral perfusion pressure.