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SOCIETY FOR NEUROSCIENCE IN ANESTHESIOLOGY AND CRITICAL CARE

ARTICLE OF THE MONTH

Individual Variability of Cerebral Autoregulation, Posterior Cerebral Circulation and White Matter Hyperintensity

Liu J, Tseng BY, Khan MA, Tarumi T, Hill C, Mirshams N, Hodics TM, Hynan LS, Zhang R.
J Physiol. 2016 Jun 1;594(11):3141-55. doi: 10.1113/JP271068.

Welcome to the November 2016 installment of the SNACC Article of the Month! The article presented here is a study by Liu et al looking at individual static variability of cerebral autoregulation in healthy older adults and its relationship with brain white matter hyperintensity lesions. The presence of high brain white matter hyperintensity (WMH) lesions is well recognized as a risk factor for age related cognitive decline and dementia. This month we have Dr Lingzhong(LZ) Meng sharing some of his thoughts on this article and on the subject of cerebral autoregulation.

Dr. Meng is a Professor in the Department of Anesthesiology at Yale University School of Medicine where he heads the Neuro Anesthesia Division. He obtained his MD degree from Peking Union Medical College in Beijing, China. His clinical work involves primarily anesthetic care for patients undergoing various neurological surgeries/procedures. His current research focuses on outcome improvement via advanced monitoring and optimized physiological management in the perioperative setting. His interests and publications are relevant to cerebral blood flow regulation and cerebral monitoring.

We encourage all of our readers to tell us what they think by joining us on SNACC LinkedIn feed the Twitter feed, or the Facebook page.

Oana Maties, MD

Commentary

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The paper “Individual variability of cerebral autoregulation, posterior cerebral circulation and white matter hyperintensity” by Liu et al (J Physiol 2016; 594: 3141-55) is an important contribution to our understanding of cerebral autoregulation.

Cerebral autoregulation is an important regulatory mechanism of cerebral blood flow (CBF) in the face of changing cerebral perfusion pressure (CPP). It has 3 main components: a plateau, lower and upper limits. The auregulatory plateau indicates a stable CBF for a range of CPP due to the precise adjustment of cerebrovascular resistance. We normally use

a binary approach to judge the integrity of cerebral autoregulation, i.e. normal or impaired. However, the work by Liu et al showed that the autoregulatory plateau follows 3 different patterns, i.e. normal (slope = 0), impaired (slope > 0), and over-reactive (slope < 0), in healthy older adults (Figure). Now, it may be time to adopt a trichotomic approach by adding another pattern of autoregulation, i.e. over-reactive autoregulation. Over-reactive autoregulation describes a pattern characterized by a decreased CBF when CPP is increased which is different to the other two patterns. As a matter of fact, Liu et al are not the first to discover this. The over-reactive pattern of autoregulation had already been observed by other investigators. Nonetheless, the underlying mechanism of over-reactive autoregulation remains unclear.

Liu et al's work also showed that the over-reactive, not the impaired, pattern of autoregulation of vertebral artery (posterior circulation) is associated with the severity of white matter hyperintensity (WMH), a type of white matter lesions related to cerebral small vessel disease (SVD) in older adults. This finding is intriguing. It suggests that the reduced CBF as a result of hypertension-mediated overzealous (or mal-functioning) cerebral vasoconstriction may play a role in the pathogenesis of WMH. However, the cause-effect relationship cannot be confirmed by this study.

Cerebral autoregulation is frequently referenced in clinical care. However, it is important to recognize that our knowledge about this important CBF regulatory mechanism is still very limited. Not only the plateau, but also the lower and upper limits of cerebral autoregulation, are dynamic and have large variations among individuals. The functionality of these key components of cerebral autoregulation depend on the physical, medical, and physiological conditions, as well as pharmacological interventions. The clinical care can be better guided when these features of cerebral autoregulation are taken into account.