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Commentary: Measurement of real-time cerebral blood flow during cardiac surgery—A useful tool?

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CENTRAL MESSAGE

Real-time monitoring of cerebral blood flow during cardiac surgery provides another modality to assess methods of neuroprotection. The utility of such a measurement remains unclear.

In this article from Boston, Zavriyev and colleagues[1] look to demonstrate the benefits and use of real-time noninvasive monitoring of cerebral blood flow during cardiac surgery requiring hypothermic circulatory arrest in adult cardiac surgical patients. The authors monitored cerebral blood flow during different brain-protection techniques using diffuse correlation spectroscopy in 12 patients undergoing cardiac surgery with hypothermic circulatory arrest. Diffuse correlation spectroscopy differs from the widely used NIRS (near-infrared spectroscopy) by providing an index of cerebral blood flow.

Using this technique, the authors were able to measure cerebral oxygen saturation, cerebral blood flow, and cerebral metabolic rate of oxygen consumption ($CMRO_2$) during cardiac surgery with hypothermic circulatory arrest. Measurements revealed that negligible amounts of blood were delivered to the brain during circulatory arrest with retrograde cerebral perfusion or circulatory arrest alone. Cerebral blood flow was significantly greater during the use of antegrade cerebral perfusion, however. The authors concluded that this technique could be a powerful tool to optimize cerebral perfusion and that retrograde cerebral perfusion needs to be further examined to confirm its efficacy.

The article demonstrates a new technique for noninvasive, real-time measurement of cerebral blood flow. With the concurrent use of NIRS, this also gives the ability to calculate $CMRO_2$. These measurements have been widely studied in the laboratory using animal models but not typically in a real-time clinical environment. The applicability of such a technique could theoretically be beneficial for more accurate monitoring of neurologic status in the operating room during cardiac surgery.

There is no shortage of cerebral monitoring available in the operating room during periods of circulatory arrest or regional cerebral blood flow. The unique aspect of this technique is the potential for real-time measurement of cerebral blood flow. Unfortunately, in a small study like this one, it is difficult to assess the validity and reliability of the technique. Other limitations include the distinction that changes in cerebral blood flow and $CMRO_2$ have never been reliably associated with clinical neurologic outcomes. This is something that is very much needed but difficult to study. Multiple studies have found no difference in neurologic outcomes using hypothermic circulatory arrest or some form of regional cerebral perfusion during cardiac surgery.[2,3] We can demonstrate improved NIRS or even improved cerebral blood flow during different techniques for neurologic protection compared with deep hypothermic circulatory arrest, but what does that mean? At significant hypothermic temperatures, increased cerebral blood flow may be luxuriant and have unclear effects.[4] Until we are able to accurately validate any correlation between monitoring of cerebral blood flow and clinical neurologic outcomes, these measures remain purely speculative.

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