Should cerebral oximetry be used as routine monitoring for cardiovascular surgical cases?

The Editor,

We appreciate Dr. Murat Cetin article[1] for monitoring cerebral oxygenation and presenting a study during cardiac catheterization cases.

The neurological outcome remains problematic in cardiac and vascular surgery and is associated with prolonged hospitalization, excessive operative morbidity/mortality, and higher hospital costs. The brain injury after cardiac surgery is multifactorial. The ischemia is the main factor leading to brain injury, which results from cerebral hypoperfusion and embolization that is exacerbated by inflammatory processes evoked from cardiopulmonary bypass injury, inflammatory responses, disorders in oxygen delivery resulting from anemia and postoperative cerebral hyperthermia, cardiac arrhythmias, and genetic predisposition.[2] The magnetic resonance imaging of the brain has revealed that brain infarction occurs in 45% of patients after cardiac surgery. It is found that 1–3% of patients with coronary artery bypass grafting develop strokes.[3]

To recognize cerebral ischemia different monitoring modalities are used in practice. One of them is cerebral oximetry, based on near-infrared spectroscopy (NIRS). It determines regional hemoglobin oxygen saturation (rSO_2) in the frontal lobes. Two probes are applied over the forehead. These probes contain diodes (light-emitting diode) or laser light sources which emit photons in the NIR spectrum. This light is partly reflected, partly redirected, scattered, and absorbed. Contact with hemoglobin molecules results in a change of light spectrum depending on the oxygenation status of hemoglobin. A fraction of this resultant light returns toward the surface and is captured by detectors. Monitor differentiates two forms of oxygenated and deoxygenated hemoglobin and determines the rSO_2 in the frontal lobes. A value of 60–80% is considered normal.[4] A decrease in baseline cerebral oximetry value is reported to cause the neurological deficit.[5] With cardiac and vascular surgery the unexpected fall in regional brain oxygen level may be the consequences of hemodynamic instability and anemia. The mechanical causes include malpositioned heart, obstruction in perfusion cannula, vascular clamp, or cardiac vent.[6,7] The volatile halogenated anesthetic agents, barbiturate, and propofol have profound cortical suppressant activity. A sudden decrease in cerebral rSO_2 may signify anesthetic effects.

During anesthesia, an absolute rSO_2 value $<50\%$ or a $>20\%$ drop from individual baseline rSO_2 is commonly considered as intervention trigger. Anesthesiologist using NIRS monitoring can intervene at the earliest. The proposed algorithm to treat low-rSO_2 events includes head and vascular cannula repositioning and an increase in the fraction of inspired oxygen. In addition, optimization of pump flow, mean arterial pressure, hemoglobin concentration, arterial oxygen, and carbon dioxide content are warranted. Furthermore, reduction in intracranial pressure, cerebral metabolism, and cerebral oxygen demand would help in improvement of cerebral oxygen saturation.[8]

NIRS-based cerebral oximetry permits early detection of cerebral hypoxia, and it would enable us to bring early interventions to avert a likely catastrophe. Monitoring of cerebral oxygenation and intervening to restore parameters during cardiac surgery is associated with a decrease in the incidence of neurological damage.[9] It improves clinician outcome, shortens Intensive Care Unit, and hospital stay.[10,11] It helps us to decrease total

financial expenses. Considering these factors, use of this technique seems to be cost effective.

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