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**Persistent cerebral desaturation  
on near-infrared spectroscopy  
without neurological insult**

Sir,

Near-infrared spectroscopy (NIRS), a noninvasive technique to monitor cerebral oxygenation, provides rapid evaluation of cerebral oxygenation, leading

to its popularity in procedures requiring cerebral oxygenation monitoring. However, NIRS may be associated with poor specificity in certain situations. We describe one such case where NIRS monitoring using cerebral INVOS™ (Somanetics Corp. Troy, MI) revealed persistent cerebral oxygen desaturation but was not associated with any postoperative neurological deficit in an elderly gentleman undergoing repair for type B aortic dissection.

An elderly gentleman, with no history of neurological disorder, presented with type B aortic dissection and underwent a hybrid procedure with a carotid-carotid bypass and an endovascular stent to treat the condition. Neurological monitoring was performed with INVOS™ (Somanetics Corp. Troy, MI) cerebral oximeter. Fresh sensors were applied and reliable recording quality was confirmed by signal strength index. Baseline bilateral cerebral oxygen saturation (rSO<sub>2</sub>) was low (Channel 1: 47%; Channel 2: 41%) [Figure 1]. The rSO<sub>2</sub> did not reach 50% at any point during the procedure. A systematic approach to this unexplained cerebral desaturation was performed based on the algorithm proposed by Denault *et al.*<sup>[1]</sup> The rSO<sub>2</sub> remained persistently and critically low with a mean of 38% in Channel 1 and 35% in Channel 2 during entire procedure. The patient did not have any major or minor neurological event during the hospital stay or at 6 months follow-up.

NIRS with the INVOS™ monitoring system has become increasingly popular for cerebral oxygen monitoring. It is based on the fact that oxygenated and deoxygenated haemoglobin have characteristic absorption spectra and light in the range of 650–1100 nm and has an absorbance that is proportional to the relative concentrations of these two chromophores.<sup>[2]</sup> The INVOS monitor is a saturation monitor that measures the ratio of haemoglobin and oxyhaemoglobin by using a single light-emitting diode and displays a single unitless value defined as “regional haemoglobin oxygen saturation (rSO<sub>2</sub>).”<sup>[3]</sup> The typical acceptable range of rSO<sub>2</sub> is 55–80%. It has been reported that rSO<sub>2</sub> values below 59 provide 100% sensitivity and 47% specificity.<sup>[4]</sup> As seen in our case where the mean values were significantly lower with no postoperative neurological impairment, it is the specificity that is

Channel	rSO <sub>2</sub> Range	Baseline	Avg rSO <sub>2</sub>
Ch1	28 - 48	47	38
Ch2	15 - 48	41	35

**Figure 1:** Baseline bilateral cerebral oxygen saturation (rSO<sub>2</sub>)

of major concern. Interestingly, in our case the rSO<sub>2</sub> remained low throughout, and no considerable drop was seen during the procedure phase compared to the preprocedure evaluation. To address similar situation, it has been proposed that along with absolute numbers, perhaps a percentage decrease from baseline might be a useful criterion for cerebral ischaemia. A proposed cutoff value of 20% was reported to have 83% sensitivity and 83% specificity for cerebral ischaemia.<sup>[4]</sup>

Artificially low rSO<sub>2</sub> values may be attributable to cranial bone anomaly or frontal sinus inflammation, presence of infrared-absorbing intracranial or intravascular pigments or dyes, optode positioning over an intracranial photon sink (i.e., intracranial venous sinus or haematoma), excessive photon scattering (i.e., hair or hair follicles), or dyshaemoglobinemias.<sup>[5]</sup> In this particular patient, despite critical evaluation, we were unable to find a definite cause for the low rSO<sub>2</sub> values. However, it has been shown that during hypothermic cardiopulmonary bypass, as needed in this case, the rSO<sub>2</sub> values can be paradoxically low and may have been the cause for the persistent low rSO<sub>2</sub> value seen.<sup>[6]</sup>

NIRS may produce not only artificially low rSO<sub>2</sub> values but can also fail to detect cerebral ischaemia in certain cases. It is possible that the placement of sensors on the forehead may not be able to detect ischaemia of parietal or deeper lobes without reflecting any changes in the monitored frontal lobe. Infarct of the middle cerebral artery with an entirely satisfactory rSO<sub>2</sub> values have been reported in the literature. Moreover, as NIRS reflects the balance between regional oxygen supply and demand, saturation may be near-normal in infarcted nonmetabolizing brain.

The problem with NIRS or any other monitoring system for cerebral ischaemia is absence of an objective gold standard with no single monitoring method providing perfect sensitivity and specificity.

Transcranial Doppler sonography and carotid artery stump pressure are the other monitoring techniques currently available; however, no single method has been proved to be superior to others. Considering that NIRS is easy to carry out and provides comparable accuracy, this should perhaps continue to be the technique of choice. However, rather than relying only on absolute rSO<sub>2</sub> values of 50%, a 20% drop from baseline rSO<sub>2</sub> values should also be incorporated in

order to increase the specificity of this diagnostic tool for cerebral ischaemia.

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#### Conflicts of interest

There are no conflicts of interest.

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