Evaluating diagnostic test accuracy of cerebral oximeter to diagnose brain ischemia

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Background: Cerebral oximetry has been used clinically to monitor brain oxygen saturation and thereby to inform brain ischemia for more than two decades especially during cardiac surgery. However the definition of cerebral desaturation and the diagnostic profile of cerebral oximetry to inform brain ischemia are yet to be determined.

Methods: We performed a prospective cohort study using a novel hybrid optical system that combined diffuse correlation spectroscopy with broadband near-infrared spectroscopy to continuously monitor tissue saturation (S_tO_2) and the oxidation state of cytochrome c oxidase (oxCCO) – a direct marker of oxidative metabolism, during cardiac surgery. An absolute drop of oxidation state of cytochrome c oxidase (oxCCO) $<$ 0.5 µM is defined as brain ischemia. The best cut-off value of cerebral desaturation to diagnose brain ischemia is determined by receiver operating characteristic curve (ROC).

Results: Nine adult cardiac surgical patients were monitored with successful simultaneous recording levels of S_tO_2 and oxCCO. The diagnostic profiles of cerebral oximetry using different cut-off values to diagnose brain ischemia are listed in Table 1 and Figure 1. Cerebral oximetry appears to have high specificity but low sensitivity regardless of the cut-off values. The ROC area is 0.594 (95% CI: 0.589 - 0.599).

Conclusions: The diagnostic accuracy of cerebral desaturation to inform brain ischemia as defined by oxCCO was low. Further studies are required to evaluate the accuracy of cerebral desaturation as a marker to reflect brain ischemia.

Reference

J. M. Murkin, et al, Near-infrared spectroscopy as an index of brain and tissue oxygenation, Br J Anaesth. 2009 Dec;103 Suppl 1:i3-13

Table 1. Detailed report of sensitivity and specificity of different cut-off values of cerebral desaturation to diagnose brain ischemia

Cutpoint	Sensitivity	Specificity	Correctly Classified	LR+	LR-
< 60%	44.04%	76.90%	72.47%	1.9069	0.7276
< 55%	25.90%	84.55%	76.64%	1.6770	0.8763
< 50%	9.78%	89.66%	78.88%	0.9461	1.0062
< 45%	3.55%	94.21%	81.97%	0.6132	1.0238
< 40%	2.14%	97.39%	84.54%	0.8208	1.0048

Figure 1. Receiver-operating-curve of different cut-off values of cerebral desaturation to diagnose brain ischemia

Area under ROC curve = 0.5940