

Non-Invasive Absolute Cerebral Oximetry (FORE-SIGHT) during Shunting Procedure for Carotid Surgery

Kevin M. Lathouwers, M.D., Cathy S. De Deyne, M.D., Ph.D., Roel Mestrum, M.D., Geert Lauwers, M.D., René J. Heylen, M.D., Ph.D.

Department of Anesthesiology, Ziekenhuis Oost-Limburg, Genk, Belgium

Introduction

Cerebral oximetry, based on NIRS, measures regional cerebral tissue oxygen saturation (SctO₂) non-invasively at the microvascular level. The FORE-SIGHT absolute cerebral oximeter, a recently introduced monitoring device, uses 4 precise wavelengths to determine absolute SctO₂. In pts suffering from acute cerebral symptoms or from bilateral high-grade stenosis, a high risk (to 25%) for insufficient collateral circulation during carotid clamping for carotid endarterectomy (CEA) is reported. In these high risk pts, elective shunting can be preferred to avoid intra-operative stroke due to hypoperfusion. As the FORE-SIGHT provides an absolute value of SctO₂, we could evaluate (or establish) threshold SctO₂ values during these critical conditions of carotid clamping in these high risk patients, with possible implications as to future decisions concerning shunt insertion.

Patients and Methods

With IRB approval, 24 pts scheduled for CEA with elective intraluminal shunting were included. In all pts, CEA was performed under general anesthesia. FORE SIGHT was used to measure bilateral SctO₂, together with routine EEG monitoring to detect intra-operative cerebral ischemia. During CEA procedure, SctO₂ and EEG readings were blinded for interpretation to the anesthesiologist as well as to the surgeon.

Results

Mean ipsilateral SctO₂ immediately before clamping was 69.3% (64%-77%) and decreased significantly ($p:0.0031$) by a mean of 9.1% (4%-29%) after cross-clamping. In 2 pts, SctO₂ decreased to values between 55% and 60%, while in 7 pts SctO₂ was below 55% after cross clamping. In 4 of these 9 pts, EEG change indicative of ongoing cerebral ischemia were observed. Contralateral starting SctO₂ was not different (66% - 76%, $m72\%$) and did not change significantly after cross-clamping. Ipsilateral mean SctO₂ before shunt opening was 60.4% (50%-77%) and increased significantly ($p:0.0039$) to mean 68.3% (52%-78%) after opening. No significant changes were observed in contralateral SctO₂ after shunt opening. Ipsilateral mean SctO₂ before shunt closure was 66.1% (59%-75%) and decreased significantly ($p:0.0039$) to mean 62.9% (54%-70%) after shunt closure. In 3 of 24 pts, SctO₂ decreased to 55% or lower after shunt closure, without any changes in EEG recordings. Final clamp release resulted in a significant increase in ipsilateral SctO₂ ($m71.4\%$; 66%-78%), without any significant change in contralateral SctO₂. In all pts, systolic blood pressure was maintained at individually predetermined normotensive level, and no pt experienced arterial hypotension. Therefore, no change in SctO₂ could be related to changes in arterial blood pressure. One pt revealed a new neurological deficit at emergence of anesthesia. In this pt, no changes in EEG readings were detected, while SctO₂ values remained below 55%, even after shunting procedure.

Conclusions

Absolute non-invasive cerebral oximetry seems most promising for its use during CEA procedures. Critical threshold determination as to cerebral ischemia may be difficult, but at least, unique information as to the adequacy of shunt opening may be obtained.

From Proceedings of the 2009 Annual Meeting of the American Society Anesthesiologists.