

## **Non-Invasive Absolute Cerebral Oximetry (FORE-SIGHT) during Carotid Endarterectomy**

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### Introduction

During carotid endarterectomy (CEA), the incidence of intra-operative stroke due to clamping-induced cerebral ischemia or embolization remains significant (3-5%). Temporary occlusion of the carotid artery always carries the risk of severe brain damage, as poor collateral circulation will result in cerebral ischemia. Detection of cerebral ischemia before it becomes irreversible would be of great benefit. Cerebral oximetry, based on NIRS, measures regional cerebral tissue oxygen saturation (SctO<sub>2</sub>) non-invasively at the microvascular level. The FORE-SIGHT cerebral oximeter, a recently introduced monitoring device, uses 4 precise wavelengths to determine absolute SctO<sub>2</sub>. In this study, we evaluated the changes in absolute SctO<sub>2</sub> values during carotid clamping for CEA.

### Patients and Methods

Over a one year period, 73 pts scheduled for CEA were included with IRB approval. In all pts, CEA was performed under general anesthesia. FORE SIGHT monitoring was used to measure bilateral SctO<sub>2</sub>, together with routine EEG monitoring to detect intra-operative cerebral ischemia. EEG changes indicative of ongoing cerebral ischemia, occurring after carotid clamping, guided the decision for shunt insertion. SctO<sub>2</sub> readings were blinded for interpretation and could not interfere with the decision for shunt placement. In this report, only patients revealing no EEG changes indicative of ongoing cerebral ischemia (and without shunting procedure) were included.

### Results

Mean ipsilateral SctO<sub>2</sub> immediately before clamping was 71.2.% (62%-80%) and decreased significantly (p:0.0042) by a mean of 6.56% (2%-20%) after cross-clamping. Lowest SctO<sub>2</sub> values were observed at a mean of 102 seconds (22-264 sec) after cross clamping. Validation studies proved a stable correlation between SctO<sub>2</sub> and jugular bulb saturation (SjO<sub>2</sub>) with SctO<sub>2</sub> 10% higher than SjO<sub>2</sub>. As it is accepted that SjO<sub>2</sub> has a normal safe limit of 45%, the absolute Fore-Sight SctO<sub>2</sub> threshold is estimated to be approximately 55%. In 11 pts, we observed ipsilateral SctO<sub>2</sub> values between 55%-60%, while in 3 pts, ipsilateral SctO<sub>2</sub> decreased below 55%. Mean contralateral SctO<sub>2</sub> before clamping was 71.8% (65%-78%) and no significant changes were observed after carotid cross clamping. During cross clamping, ipsilateral SctO<sub>2</sub> remained stable without any further significant decreases. Mean ipsilateral SctO<sub>2</sub> before clamp release was 67.1% (58%-78%) and increased significantly (p:0.0181) by a mean of 5.52% (2%-15%). Mean ipsilateral SctO<sub>2</sub> after clamp release was 72.5% (63%-87%). We observed no significant changes in contralateral SctO<sub>2</sub> values after clamp release. Rigorous blood pressure management assured stable hemodynamic conditions (without any hypotensive episodes) in all pts. Finally, all 73 pts experienced an uneventful neurological recovery.

### Conclusions

Non-invasive absolute cerebral oximetry revealed significant ipsilateral decreases in cerebral saturation after carotid cross clamping. The use of SctO<sub>2</sub> threshold levels, indicative of ongoing cerebral ischemia, seems difficult, as we found that almost 1 on 5 pt developed SctO<sub>2</sub> values below 60% after cross clamping, without any EEG changes and with an uneventful neurological outcome.

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