

Cerebral Oximetry as Part of Brain Health in Cardiac Surgery

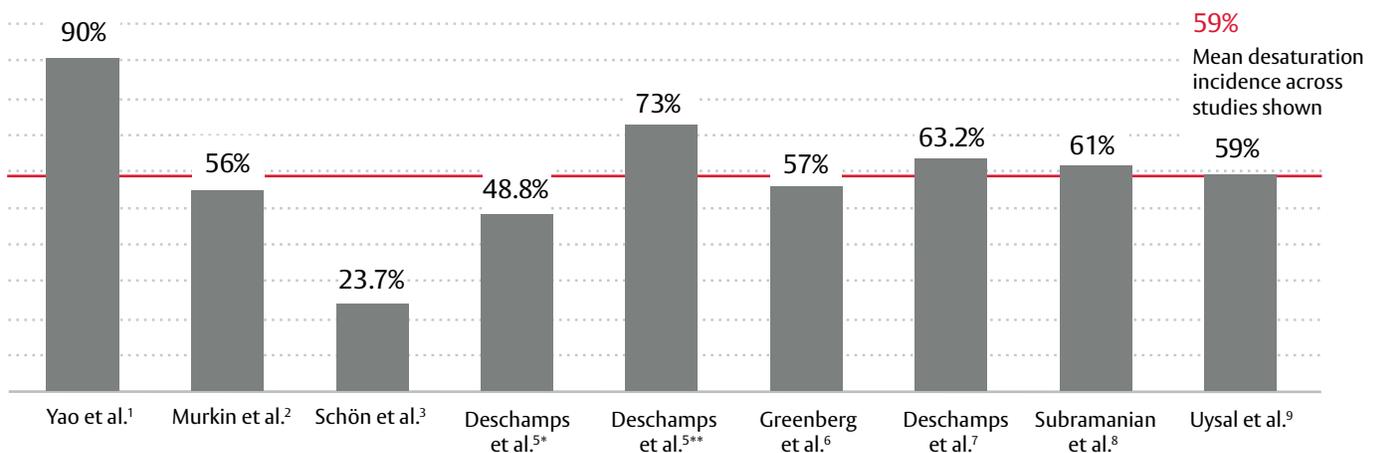
The cardiac surgical population has demonstrated a significant incidence of cerebral desaturation,¹⁻⁹ which has in turn been associated with a wide range of negative outcomes including increased morbidity and mortality,^{2,10} postoperative neurocognitive disorders,^{4,11} increased length of stay in both the ICU and hospital,^{3,10,12} and increased incidence of stroke.³ Evidence suggests that efforts to reduce the depth and duration of these desaturations can positively impact these outcomes.^{2,6,7,9,13,14} Cerebral oximetry remains the only technology that monitors cerebral oxygenation noninvasively and continuously – allowing clinicians to detect problems and optimize perfusion before these negative outcomes and/or irreversible brain damage develop.¹⁵

Cerebral desaturations are common

Incidence

Research has consistently shown that cerebral desaturations occur during cardiac surgery across a variety of procedures and patient populations.

Patient incidence of desaturations during cardiac surgery



Note: Each publication has an independent definition of desaturation including absolute vs. relative change, duration of time, oximeter used, etc.

*Denotes incidence in prospective arm of publication

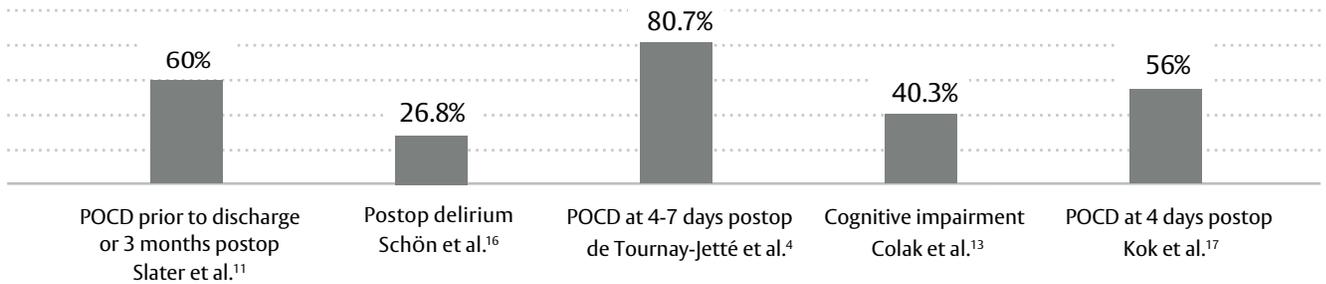
**Denotes incidence in randomized arm of publication



Edwards

Desaturations can cause harm

Patient incidence of certain neurological outcomes for cardiac surgery patients



Importantly, poor neurocognitive outcomes related to coronary artery bypass grafting (CABG) and valve surgeries utilizing cardio pulmonary bypass (CPB) remain an issue despite declining mortality rates for those procedures.¹⁵

Impact of cerebral desaturations among cardiac surgical patients

Neurological

Intraoperative desaturations were linked to the following neurological outcomes:

- 7.69 X** increased risk of developing postoperative cognitive dysfunction (POCD) within one week following surgery⁴
- 3.32 X** increased risk of developing POCD within three months following surgery⁴
- 2.22 X** POCD within three months following surgery¹⁰
- 30-day** increase in mortality risk with mean pre-bypass rSO₂ under 63%¹⁸

Length of Stay

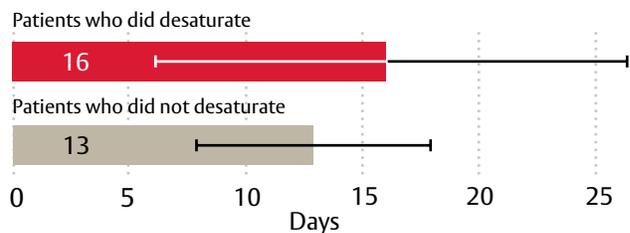
Results from Schön et al.³

SctO₂ < 50% = **3-day** increase in median length of hospital stay[†]

[†]Other studies may vary in LOS.

Results from Hong et al.¹²

Length of Stay (days) for patients with or without desaturations.¹²



Patients with greater duration of low SctO₂ and showing greater integrals of low SctO₂ over time for the SctO₂ threshold values of 65% and 60% were significantly more likely to have longer LOS in the ICU.

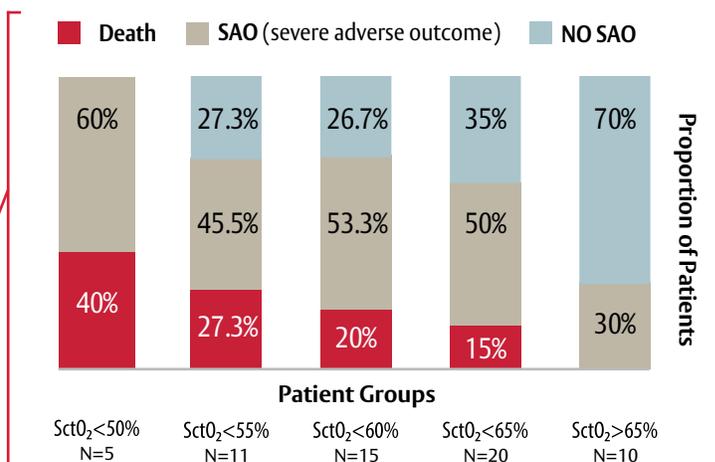
MOMM

Major organ morbidity and mortality (MOMM) has been demonstrated to be associated with:

- Lower baseline saturations²
- Significantly profound desaturations^{2,10}
- More prolonged desaturations²
- Higher cerebral desaturation load¹

Fischer et al. data¹⁰ shows the relationship between lower cerebral saturations, severe adverse outcomes, and even death.

Fischer 2011: Time under threshold and negative outcomes

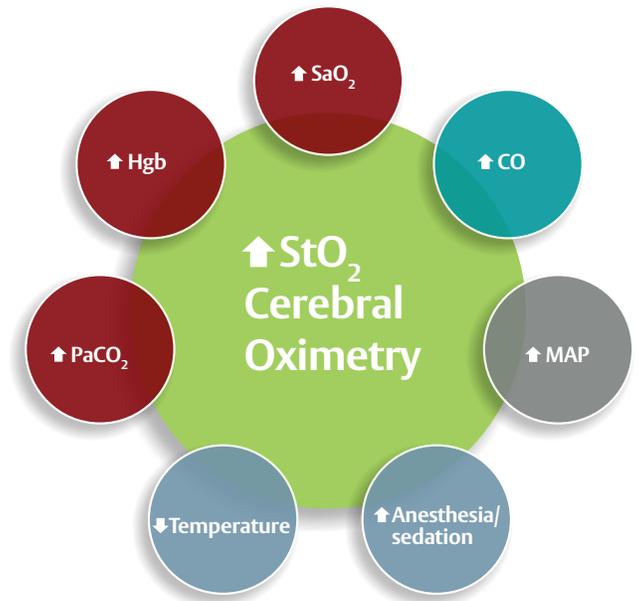


Aortic arch surgery patients with at least 10 minutes spent below a given SctO₂ threshold.

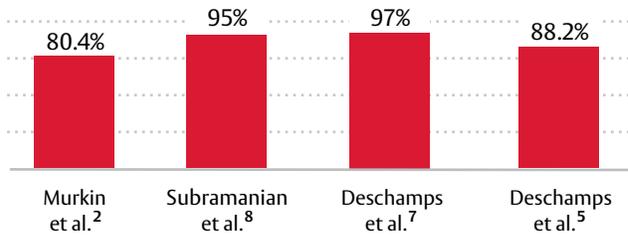
Desaturations may be reversed

Interventions

While these correlations paint a bleak picture, research has also shown that these desaturations can be detected utilizing cerebral oximetry and reversed or corrected through routine interventions to reduce the cerebral desaturation load during surgery.

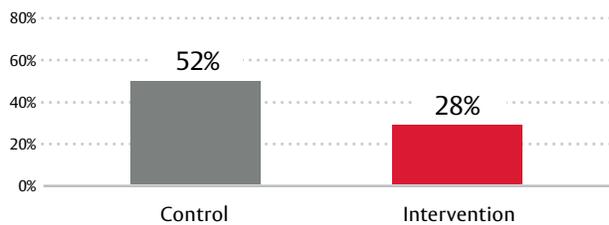


Success of Interventions to Reverse Desaturations



Reversing desaturations can improve outcomes

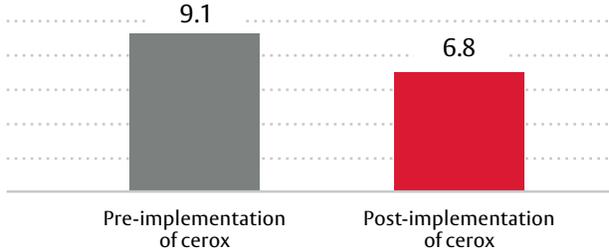
Incidence of Cognitive Decline¹³



ICU Length of Stay (days)²



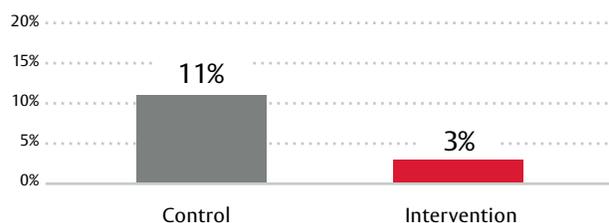
Hospital Length of Stay (days)^{14*}



↓ **2.3 day** reduction for NYHA Class I recipients of CABG/Valve surgery despite overall sicker population

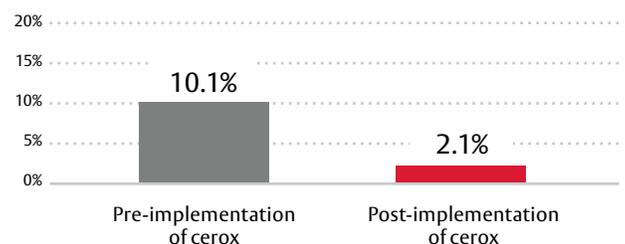
*NYHA class I

MOMM²



Intervention = ↓ **73%** reduction in MOMM

Prolonged Mechanical Ventilation Needed¹⁴



For NYHA Class I recipients of CABG/Valve surgery despite overall sicker population

Summary

“Diffuse hypoperfusion of the brain can be avoided only by very careful planning; if something goes wrong, the only hope is early detection and immediate restoration of adequate perfusion before irreversible brain damage develops. For this purpose, sensitive, real-time monitoring of brain ischemia during such surgical procedures is needed. At the present time, cerebral oximetry can fulfill this role as the only feasible technology that monitors cerebral hypoxia and/or cerebral ischemia noninvasively and continuously.” –Fischer et al.¹⁵

Glossary

CABG: Coronary Artery Bypass Grafting

CDE: Cerebral Desaturation Event

CDL: Cerebral Desaturation Load (*measurement of duration and depth of cerebral saturations under a threshold*)

Cerebral Desaturation: Decrease in cerebral saturations below a certain value or relative threshold

CPB: Cardio Pulmonary Bypass

LOS: Length of Stay

MOMM: Major Organ Morbidity and Mortality

NYHA: New York Heart Association

OR: Operating Room

POCD: Postoperative Cognitive Dysfunction

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