Oxygen reserve index predicts early postoperative cognitive dysfunction in off-pump coronary artery bypass grafting

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Background & Goal

The early postoperative cognitive dysfunction (POCD) is a multifactorial event frequently complicating cardiac surgery. The development of POCD may be associated with perioperative abnormalities of gas exchange, including hyperoxia. Recently, Oxygen Reserve Index (ORI) has been introduced into the clinical practice for non-invasive oxygenation monitoring. The ORI values varying from 0 to 1 correspond to PaO₂ of 100–200 mm Hg (Figure 1). The goal of our study was to evaluate whether hyperoxia during cardiac surgery detected by ORI is associated with POCD and neuronal injury.

Methods

Twenty patients who underwent elective off-pump coronary artery bypass grafting (OPCAB) were enrolled into a prospective observational study. Intraoperatively, we registered ORI, haemodynamic parameters and gas exchange at multiple stages.

Alveolar recruitment manoeuvre was performed after the intubation by the augmentation of positive end-expiratory pressure to 15 cm H₂O for two minutes. The parameters of gas exchange and ORI were registered at 1 minute after accomplishing the recruitment.

Serum concentration of S100b protein was measured in 20 patients to assess the severity of neuronal injury before induction of anaesthesia, at Days 1 and Day 5 after surgery.

The cognitive function was assessed using Montreal Cognitive Assessment (MoCA) score at 12 hrs before surgery, and at Days 1 and 5 postoperatively. The decrease in MoCA exceeding 2 points was interpreted as a cognitive decline. The statistical analysis was performed using Mann–Whitney *U*-test, Spearman's *rho* correlation and ROC analysis. Data are presented as median (25th–75th percentiles). A *p* value < 0.05 was regarded as statistically significant.

Figure 1. The clinical value of Oxygen Reserve Index.

Scheeren TWL, Belda FJ, Perel A. The oxygen reserve index (ORI): a new tool to monitor oxygen therapy. *J Clin Monit Comput* 2018; 32: 379–389.

Figure 2. The changes in Montreal Cognitive Assessment Score throughout the study period.

* — *p* < 0.05 using Wilcoxon test. MoCA, Montreal Cognitive Assessment Score.

Figure 3. The correlation between ORI values and Montreal Cognitive Assessment Score at Day 1.

MoCA, Montreal Cognitive Assessment Score; ORI — Oxygen Reserve Index.

Figure 4. ROC-curve for the value of Oxygen Reserve Index, measured after the recruitment manoeuvre to predict early postoperative cognitive dysfunction.

AUC = 0.80; *p* = 0.013, cut-off point of ORI ≤ 0.21 (sensitivity 83 % and specificity 67 %).

Figure 5. The perioperative changes in the concentration of S100b protein.

* — *p* < 0.05 using Wilcoxon test.

Results & Discussion

Preoperative MoCA score was 24 (22–27) points with significant transient postoperative decrease (*p* < 0.001; Figure 2) at Day 1 after surgery. As shown in Figure 3, we found a correlation of ORI after the recruitment manoeuvre with MoCA score at Day 1 (*rho* = −0.60, *n* = 19, *p* < 0.007). The ROC-analysis has revealed the cut-off value of ORI exceeding 0.21 as a predictor of early cognitive decline (AUC 0.80; *p* = 0.01; sensitivity 83 %, specificity 67%). No such a prognostic value for PaO₂ 198 mm Hg corresponding to ORI 0.21 was found (AUC 0.60, *p* = 0.2).

As shown in Figure 5, the concentration of S100b protein increased by 67 % (*p* < 0.001) at Day 1 and returned to the preoperative values by Day 5.

The concentration of S100b protein at Days 1 and Day 5 correlated with ORI values during sternotomy and alveolar recruitment respectively (*n* = 10, *rho* = −0.72, *p* = 0.018 and *n* = 10, *rho* = −0.74, *p* = 0.015).

Conclusions

The value of ORI > 0.21 during OPCAB may be a sensitive but non-specific predictor of early POCD. Further evaluation of the role of hyperoxia in development of cognitive dysfunction after cardiac surgery is warranted.

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