Mild hypercapnia is associated with higher cerebral oxygen saturation in patients undergoing major surgery: a prospective, single centre, randomised controlled trial

Primary Author: Clarence Wong Doctor of Medicine
Austin Hospital, Heidelberg, Victoria, Australia

Co-Authors: Brett Pearce, Chong Tan, David Tremewen, Dean Cowie, Dharshi Karalipillai, Laurence Weinberg, BSc, MBCh, MRCP, DPCritCareEcho, FANZCA, MD; Leonid Churilov, Param Pillai, Raymond Hu, Rinaldo Bellomo

Aim
The effects of hypercapnia on regional cerebral oxygen saturation (rSO2) during surgery are unknown. We hypothesised that, compared with targeted normocapnia (TN), targeted mild hypercapnia (TMH) during elective major surgery would increase rSO2.

Methods
We performed a single centre, single blinded, prospective randomised controlled trial in adult participants undergoing elective major surgery at a University teaching hospital. TMH (PaCO2 45-55 mmHg) or TN (PaCO2 35-40 mmHg) was delivered via controlled ventilation throughout surgery. Non-invasive near-infrared spectroscopy (NIRS) based cerebral oximetry was used to measure rSO2. The primary endpoint was percentage change of rSO2 from baseline over the duration of surgery. Secondary endpoints included the incidence of postoperative delirium and length of stay (LOS) in hospital.

Results
We randomised 40 participants [20 to TMH and 20 to TN]. The median (IQR) PaCO2 in the TMH group was 51.5 mmHg (46.9:60.9) vs. 34.8 mmHg (32.8:38.1) in the TN group (p<0.001). Percentage change of rSO2 from baseline oximetry was 19.0% higher in both hemisphere with TMH (p<0.001). The TMH group had a 0.04% (p<0.001) (left) and 0.05% (p<0.001) (right) average increase in percentage change of rSO2 over every minute during surgery compared to the TN group. Postoperative delirium was present in 0 participants in the TMH group and 6 participants (30%) in the TN group (p=0.022). Length of stay was similar between groups (5 days vs. 5 days; p = 0.988).

Conclusion
This study provides preliminary evidence that in patients undergoing major surgery, TMH is associated with a larger increase in rSO2 from baseline on both the left and right cerebral cortex and lower incidence of early post-operative delirium. Our findings provide the rationale for larger studies of TMH during surgery.