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IMPACT OF INSPIRED GAS MIXTURES ON OXYGENATION AND SURGICAL CONDITIONS DURING ONE LUNG VENTILATION

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Introduction: During thoracic surgery with one lung ventilation (OLV), the maintenance of adequate oxygenation and the optimization of surgical conditions are important. The shunting of blood in both the unventilated lung and in the dependent, ventilated lung (due to atelectasis) will compromise gas exchange. We hypothesized that the choice of inspiratory gas mixture used prior to OLV may influence conditions during OLV in thoracic surgical patients. Nitrogen is less soluble in blood than both oxygen and nitrous oxide. The use of a nitrogen/oxygen gas mixture prior to OLV was predicted to delay the development of atelectasis in the ventilated lung during OLV when compared to 100% oxygen (O2) and nitrous oxide/oxygen mixtures (N2O). The use of both N2O and 100% O2 have been implicated in the formation of atelectasis in anesthetized patients. The improved maintenance of functional residual capacity in the dependant lung ventilated with nitrogen/oxygen was predicted to maintain higher arterial pO2 during the period of OLV, due to decreased shunting. The solubility of gas mixtures could also affect surgical conditions. The more soluble gas mixtures (O2, N2O) were predicted to be more rapidly absorbed from alveoli of the non-ventilated lungs accelerating lung deflation.

Methods: Following approval by the hospital research ethics board, 74 consenting patients scheduled for lateral thoracotomy were entered into the study. Patients received a standardized intravenous general anesthetic of fentanyl, propofol and rocuronium. They were randomized to one of three groups of inspired gas mixtures. Prior to OLV, the AIR group received 40% oxygen/ 60% nitrogen, the N2O group received 40% oxygen/60% nitrous oxide and the O2 group received 100% oxygen. During OLV, all patients received 100% O2. Serial arterial blood gases were obtained on room air prior to induction (RA), two-lung ventilation (2LV) immediately before lung isolation and at 5 minute intervals for 30 minutes while on OLV. The operating surgeons, blinded to the gas mixtures, provided lung deflation scores using a non-parametric scale of 0 (no deflation) to 10 (complete collapse) at 10 and 20 minutes of OLV. Arterial pO2 were analyzed by 2-way ANOVA using Gas Mixture (AIR, N2O, O2) as the between groups factor and Time Period (RA, 2LV, T5 through T30) as the within groups factor. Significant effects were followed by separate Mann Whitney tests comparing the 3 groups using a Bonferroni Type I error rate correction for multiple significance tests.

Results: Mean arterial pO2 are shown in Figure 1. ANOVA showed a significant main effect for Gas Mixture and Time Period as well as a significant interaction effect. Post hoc tests showed that the O2 group differed significantly from N2O and AIR groups at the time of 2LV and the first 10 minutes of OLV only. Median lung deflation scores are shown in Figure 2 with 25th and 75th percentiles. Non-parametric tests showed that the AIR group had significantly lower lung scores than the N20 or O2 groups at both 10 and 20 minutes of OLV ($p<0.0009$).

Discussion: The use of a nitrogen/oxygen gas mixture prior to OLV offered no benefit to the maintenance of arterial oxygen level during OLV. In fact, none of the gas mixtures during the induction period to the initiation of OLV resulted in a significantly higher paO2 after 15 minutes of OLV. Lung deflation scores were significantly lower in the nitrogen/oxygen group when compared to nitrous oxide/oxygen and oxygen alone, reflecting less favorable operating conditions secondary to delayed atelectasis on the unventilated lung. No differences in lung deflation scores were noted between nitrous oxide/oxygen and oxygen alone.

FIGURE 1 ARTERIAL OXYGEN

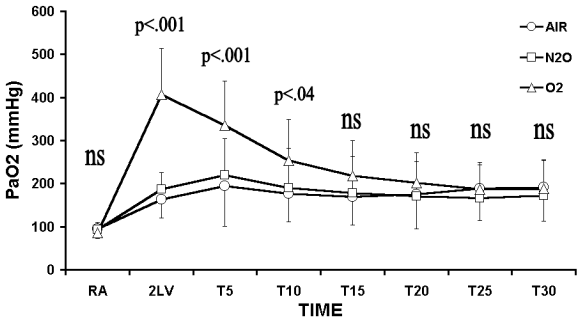

FIGURE 2 MEDIAN LUNG DEFLATION SCORES