Hypoxic Inspired Gas Concentrations Are Readily Created by a Fresh Gas Flow of 2 L/min Air

Drew B. Gonsalves, BS[1]; AJ Tucker, BS[2];
Samsun Lampotang, PhD[1]; Nikolaus Gravenstein, MD[1]

[1]Department of Anesthesiology, University of Florida College of Medicine, and Center for Safety, Simulation & Advanced Learning Technologies,
[2]University of Florida, Gainesville, Florida

Introduction

It is recommended that FiO_2 is limited to ≤ 0.3 or that air (21% O_2) is used in cases where an airway fire is possible. To conserve potent inhaled agent, it is common to use a 2 L/min or less fresh gas flow (FGF) [1]. Modern anesthesia machines have design features that prevent administering a hypoxic (<21% O_2) mixture. We evaluated whether an FGF of 2 L/min air is sufficient to prevent delivery of hypoxic inspired gas concentrations.

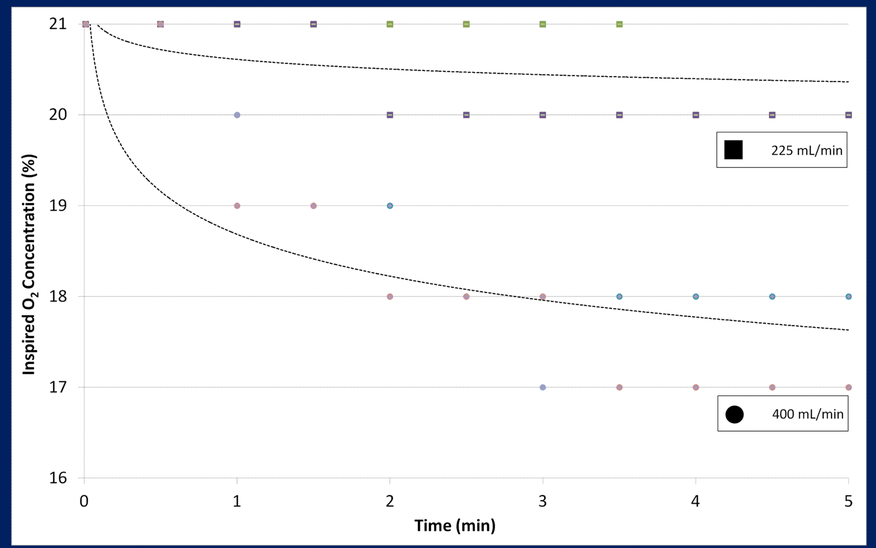
Methods

A human patient simulator (HPS; CAE, Sarasota, FL) set to consume 225 mL/min oxygen [2] was ventilated by an anesthesia machine (Aestiva S/5, GE Healthcare, Madison, WI) at 2 L/min air FGF, RR 10 bpm, and VT 500 mL. Inspired and expired O_2 concentrations were recorded at the Y-piece from a Capnomac Ultima ULTI.09.EN, Datex (GE Healthcare, USA) every 30 seconds for 5 minutes and repeated four times. A second set of data with the same ventilation parameters but with oxygen consumption set at 400 mL/min was also run four times. Data were analyzed to determine if a hypoxic inspired gas mixture occurred and, if so, the time to reach an FiO_2 of 0.2 (20%).

Results

A FGF of 2 L/min air is insufficient to prevent the administration of a hypoxic gas mixture for a typical adult patient. The time to an FiO_2 of 0.20 at an O_2 consumption rate of 225 mL/min was 187 ± 51 sec and at 400 mL/min was 59 ± 3 sec. Fit trend equations for aggregate data resulted in $y = 20.612x^{-0.007}$ ($R^2 = 0.2762$) at 225 mL/min and $y = 18.686x^{-0.036}$ ($R^2 = 0.6468$) at 400 mL/min. An inspired gas mixture of 20% O_2 results sooner with a higher oxygen consumption (Figure 1).

Figure 1



Discussion

When FGF is lower than the patient's minute ventilation, some rebreathing inevitably occurs. An unintended consequence at lower FGFs is partial rebreathing of exhaled oxygen, which necessarily is less than 21% O_2 because of oxygen uptake that is simulated in the HPS.

Conclusion

It is recommended that the FiO_2 is limited or that air is used when airway fires are possible. To conserve potent inhaled agents, it is common to use a 2 L/min or less FGF. We found that 2 L/min air creates a hypoxic (<21%) inspired gas mixture in a simulated adult (225 mL/min O_2 and 400 mL/min O_2 consumption).

References

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Samsun (Sem) Lampotang, PhD slampotang@anest.ufl.edu