

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

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Introduction

Consistent with patient needs, a fraction of inspired oxygen ($FiO_2 \leq 0.3$ or air (21% O_2)) should be used in high surgical airway fire risk cases. To conserve volatile anesthetics, a 2 L/min or less fresh gas flow (FGF) [1] is common. Modern anesthesia machines have design features that prevent dialing a hypoxic (<21% O_2) mixture. We evaluated if a FGF of 2 L/min air is sufficient to prevent development of hypoxic inspired gas concentrations.

Methods

A human patient simulator (HPS™; CAE, Sarasota, FL) set to consume 225 mL/min or 400 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) every 10 seconds for 5 minutes and repeated ten times. Data were analyzed to determine if and when a hypoxic inspired gas mixture occurred.

Results

A FGF of 2 L/min air is insufficient to prevent development of a hypoxic gas mixture for a simulated adult patient. The average time to an FiO_2 of 0.20 at an O_2 consumption rate of 225 mL/min was 122 ± 13.9 sec and, at 400 mL/min, was 84 ± 8.4 sec. A hypoxic gas mixture of 20% O_2 results sooner with a higher oxygen consumption (Figure 1).

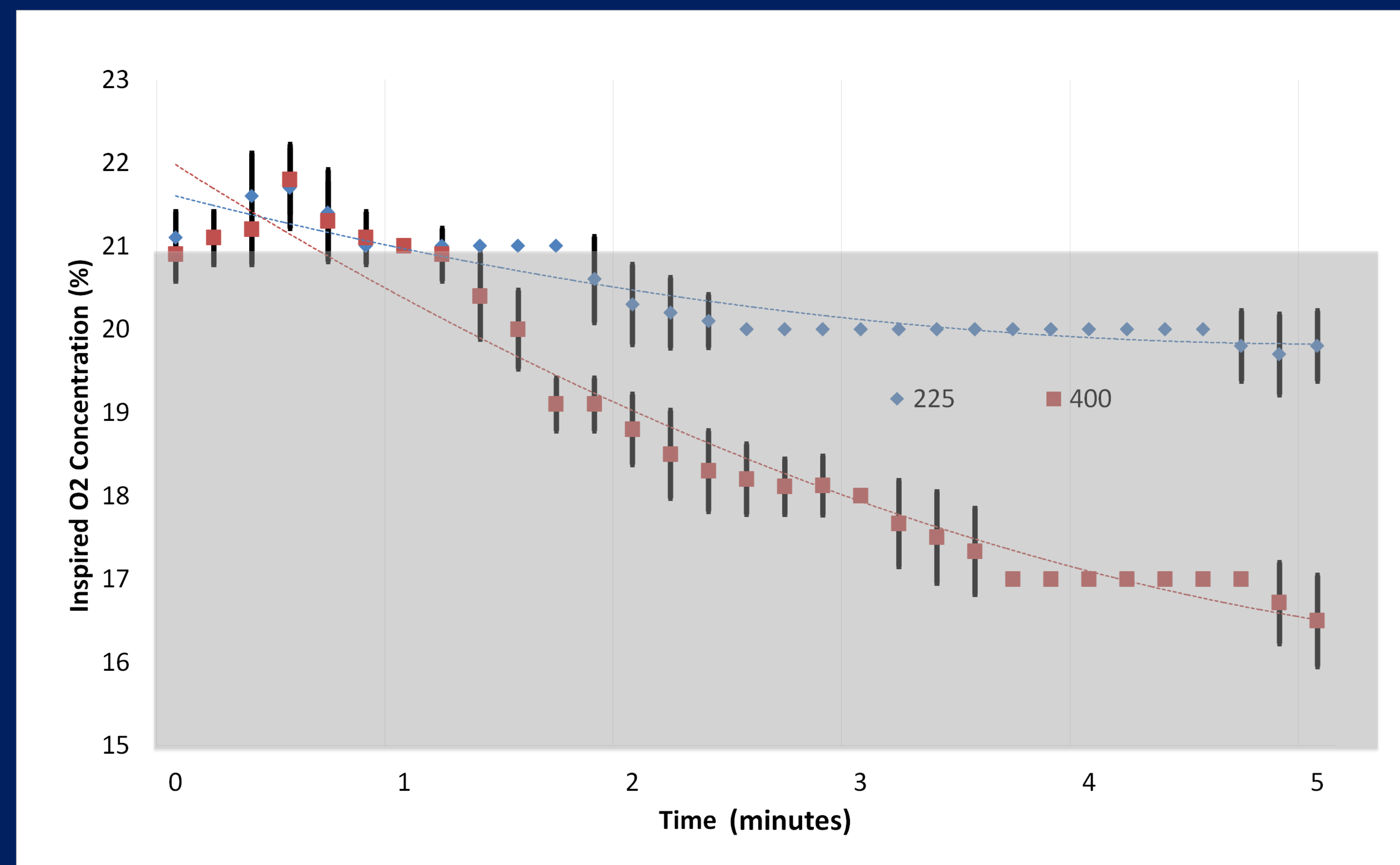


Figure 1: Inspired oxygen concentrations measured at Y-piece over time at a FGF of 2.0 L/min air at two different O_2 consumption rates. Area shaded gray denotes a hypoxic gas mixture. Black vertical lines indicate standard deviation.

Discussion

When FGF is lower than minute ventilation (MV), some rebreathing inevitably occurs. An unintended consequence at lower FGFs is partial rebreathing of exhaled oxygen which is less than 21% O_2 when breathing air and leads to the development of a hypoxic FiO_2 .

Conclusion

Air has been suggested as a FGF option for high surgical fire risk cases. To conserve expensive inhaled agents, a ≤ 2 L/min FGF is commonly used. Because 2 L/min air FGF evolves into a hypoxic (<21%) inspired gas mixture in a simulated adult, if air is to be used, we recommend a $FGF \geq MV$, to prevent inadvertent development of a hypoxic FiO_2 .

References

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