

CORRESPONDENCE

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Hazards of Supplying Supplementary Oxygen through Main Gas Flowmeters

To the Editor:—Supplementary oxygen frequently is used *via* face mask or nasal cannula during procedures involving local or regional anesthesia or sedation for monitored care. Using the main gas flowmeter of the anesthesia machine as the source of oxygen may be hazardous, as exemplified by the following case.

Case Report

A 26-yr-old ASA physical status 1 man had metacarpal fracture fixation with an axillary block as the primary anesthetic. Supplemental oxygen by nasal cannula was supplied *via* the anesthesia machine fresh gas outlet. Despite only 1 mg midazolam and 100 µg fentanyl, the patient appeared heavily sedated. It was then discovered that 4 L/m N₂O and 2 L/m O₂ had been flowing through the nasal cannula instead of the intended 2 L/m O₂. Discontinuing N₂O by nasal cannula resulted in greater patient alertness.

The wrong or contaminated gas can be delivered from the main flowmeter by a leaking or activated vaporizer or by inadvertently turning on a flowmeter to another gas, *e.g.*, N₂O or helium. If the oxygen to a face mask or nasal cannula is obtained from the fresh gas outlet, the circle system is bypassed and no gas monitoring will be present to warn if a hypoxic or anesthetic gas mixture is present. An oxygen ratio monitor/controller cannot guarantee the absence of hypoxic gas mixtures because some anesthesia machines allow them to be silenced or overridden, as in the "all gases" mode on some North American Drager Narkomed machines. Further, to obtain gas directly from the fresh gas outlet, the circle must be disconnected. If the circle system is not reconnected before administering positive pressure ventilation by face mask or endotracheal tube, a leak will be present, resulting in confusion as to the source of the leak or problem or delay in administering oxygen to the patient.

Table 1. Range of Pressures Measured at the Breathing Circle Pressure Meter (in cmH₂O)

L/m	A	B	C
2	14-15	21-25	
4	32-38	41-≥50	7-12
6	>40		13-22
10			31-≥40
15			>40

A = Airlife™ Nasal Oxygen Cannula no. 001325 (Baxter Healthcare, Valencia, CA); B = Adult Oxygen Delivery CO₂ Sampling Nasal Cannula no. 4707F* (Salter, Arvin, CA); C = Adult Medium Concentration Comfort Mask no. 1102 (Salter Labs, Arvin, CA).

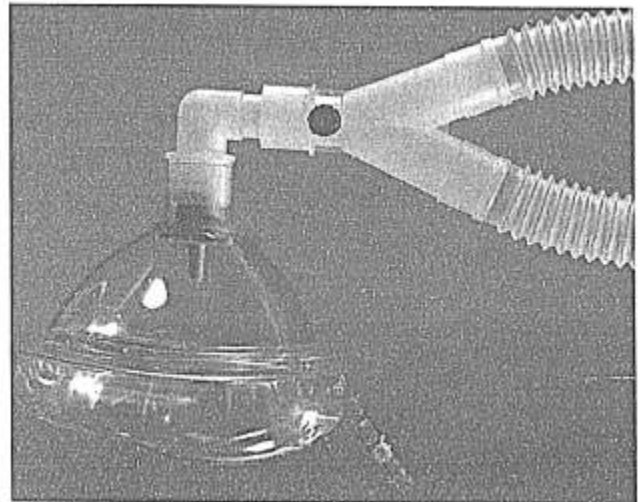


Fig. 1. An endotracheal tube connector inadvertently left inside a face mask. Difficulty in ventilating may be attributed to airway obstruction if mask ventilation *via* the circle system becomes necessary.

If supplementary oxygen is obtained from the patient Y-connector of the circle system, gas monitors can be used and problems associated with dismantling the circle system are avoided, although additional problems can arise. Oxygen delivery can be inadequate if the circle system leaks or vents through the automatic pressure limiter (APL) valve. Face masks or nasal cannulae offer significant resistance to flow, and considerable back pressure can build up in the circle system (table 1). Back pressure can exceed 40 cmH₂O, and most anesthesia machines have continuous pressure alarms that trigger at 15 cmH₂O. If the APL valve is opened to silence the alarm, a lower than intended flow may be delivered to the patient because the gas also is being vented through the scavenger system.

If a 4- or 5-mm endotracheal tube connector is placed inside a face mask to connect to oxygen tubing, the connector may be inadvertently left in place as shown in figure 1. If mask ventilation *via* the circle system becomes necessary during this or subsequent cases, difficulty in ventilating may be attributed to airway obstruction and misdirected treatment may be given or inadequate ventilation may result.

Many modern anesthesia machines have separate flowmeters for supplementary oxygen, which makes it more difficult to deliver gases other than oxygen to the patient unless internal piping errors or cross-filled gas cylinders or bulk supply exist. The presence of oxygen

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from the supplementary oxygen flowmeter should always be verified when a machine is placed into service.

Our department developed a policy that states that operating room circulating nurses who apply supplemental oxygen must obtain their supply from separate flowmeters connected directly to wall-mounted oxygen fittings. Only anesthesiologists and certified registered nurse anesthetists may use the anesthesia machine for an oxygen source because of the potential problems described in this letter.

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Hypotension and Spinal Anesthesia

To the Editor:—The recent study by Carpenter *et al.*¹ imposes a few specifications concerning the definition and prevention of hypotension during spinal anesthesia.

First, as pointed out by the authors, the definition of hypotension during spinal anesthesia is controversial.¹ Nevertheless it seems to be unsafe to define hypotension as a systolic blood pressure of less than 90 mmHg. Rather than an arbitrary value, hypotension usually is defined as a decrease of systolic blood pressure of more than 30% from the baseline.²

Second, the authors have found many risk factors for hypotension during spinal anesthesia, but they omitted discussing the role of fluid loading in preventing hypotension. Venn *et al.*³ found a tendency toward a more stable systolic blood pressure after fluid loading in patients in whom the block extended to T5 or above, whereas others found it less effective.⁴ It seems that different volumes of fluid loading are the reason for these contradictory results.

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In Reply:—Szmuk *et al.* state that our definition of hypotension seems unsafe and then suggest that it would have been more appropriate to define hypotension as a 30% decrease from baseline. Szmuk *et al.* may be correct. However, it is not possible to define the lowest acceptable blood pressure for any individual patient using routine anesthetic monitoring techniques. Furthermore, the absence of data on this topic precludes a definitive conclusion and leaves our study open to criticism of what seems to be appropriate.

In defense of our definition, we do not agree that relative definitions of hypotension would have reduced the risk or improved our ability to interpret the data. For example, a recent epidemiologic publication utilized $\geq 20\%$ decline in blood pressure from baseline (measured

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immediately prior to induction of anesthesia) as a relative definition of hypotension.¹ Although this is a concise definition, the clinical relevance of a 20% (or even a 30%) decline is questionable for at least two reasons.

First, blood pressure normally decreases by an average of 20% with sleep each night,² yet the effect of sleep on blood pressure is not considered to place individuals at risk for morbidity or mortality. Second, selection of an accurate and representative baseline blood pressure is difficult (a critical factor that is often ignored). Blood pressure measurements made immediately prior to induction of anesthesia can be considerably higher or lower than those measured in the clinic or hospital and thus may not accurately represent the