



Jefferson® High Inspired CO₂ Capnograph Reading Due to Misplaced End-Tidal CO₂ Sampling Port

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Case: A 22 year old, 50kg female presented for left submandibular gland sialoendoscopy. The patient had an eleven month history of left neck swelling which occurred after ingestion of food. CT scan revealed sialolithiasis and sialadenitis. Past medical history includes exercise induced asthma and irritable bowel syndrome. Medications include fexofenadine and levalbuterol.

Prior to start of case, the FDA approved 15 item pre-anesthesia checkout was performed. There were no signs of CO₂ absorbent exhaustion or incompetent unidirectional valves. Expandable breathing circuit without gas sampling port at Y-piece was used.

General anesthesia was induced smoothly with propofol, fentanyl, lidocaine and rocuronium. Endotracheal tube was visualized passing through vocal cords. Capnography revealed a high inspired CO₂ tracing (Fig 1). Breath sounds were equal bilaterally. There was equal chest rise. Next, the end tidal carbon dioxide (ETCO₂) sampling line was inspected. It was noted that it was placed accidentally at the distal end of the expiratory limb (Fig 2). ETCO₂ sampling line was repositioned to the distal Y-piece (Fig 4). The capnograph returned to a normal tracing (Fig 3). The case proceeded uneventfully.

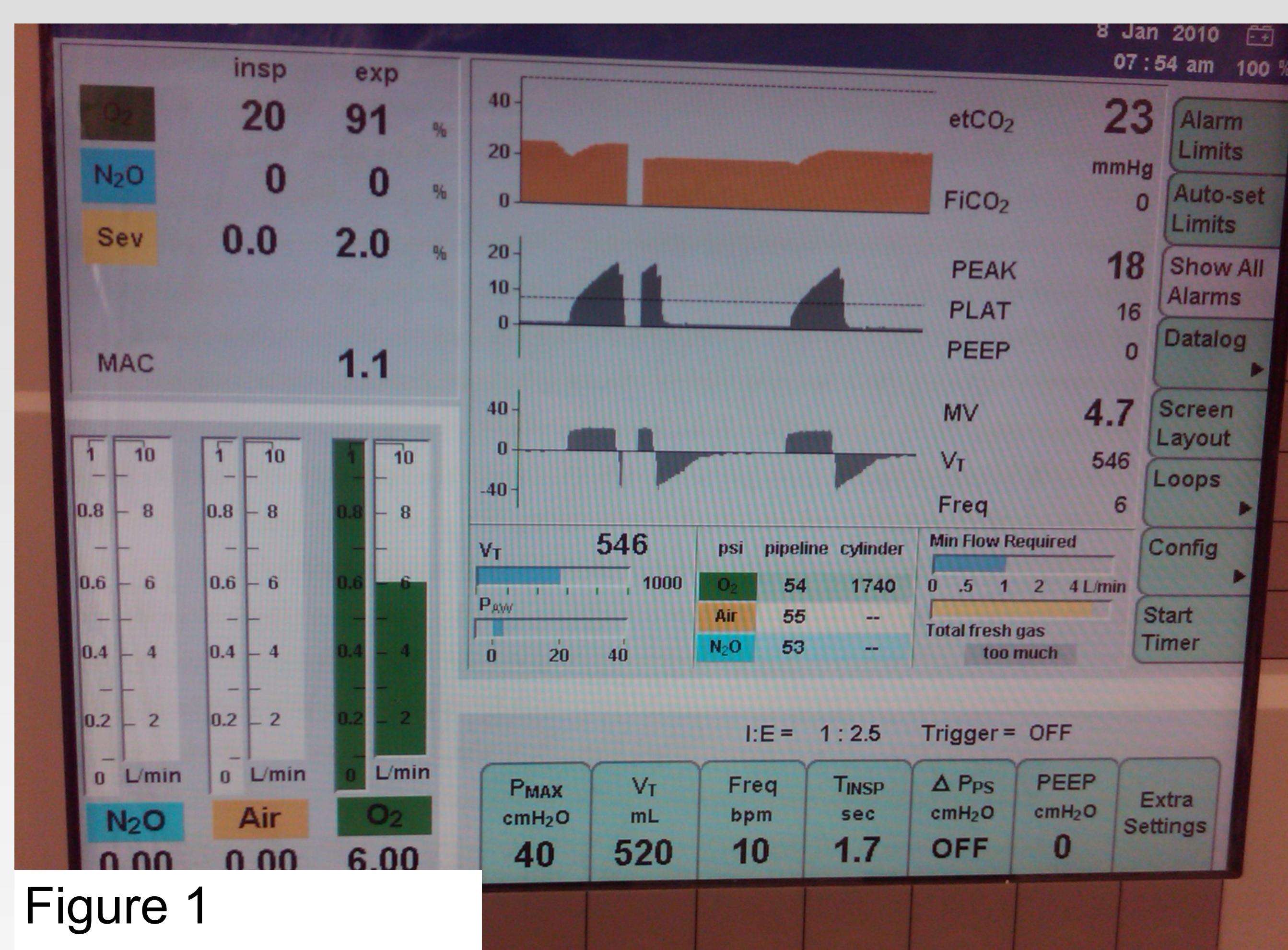


Figure 1



Figure 2

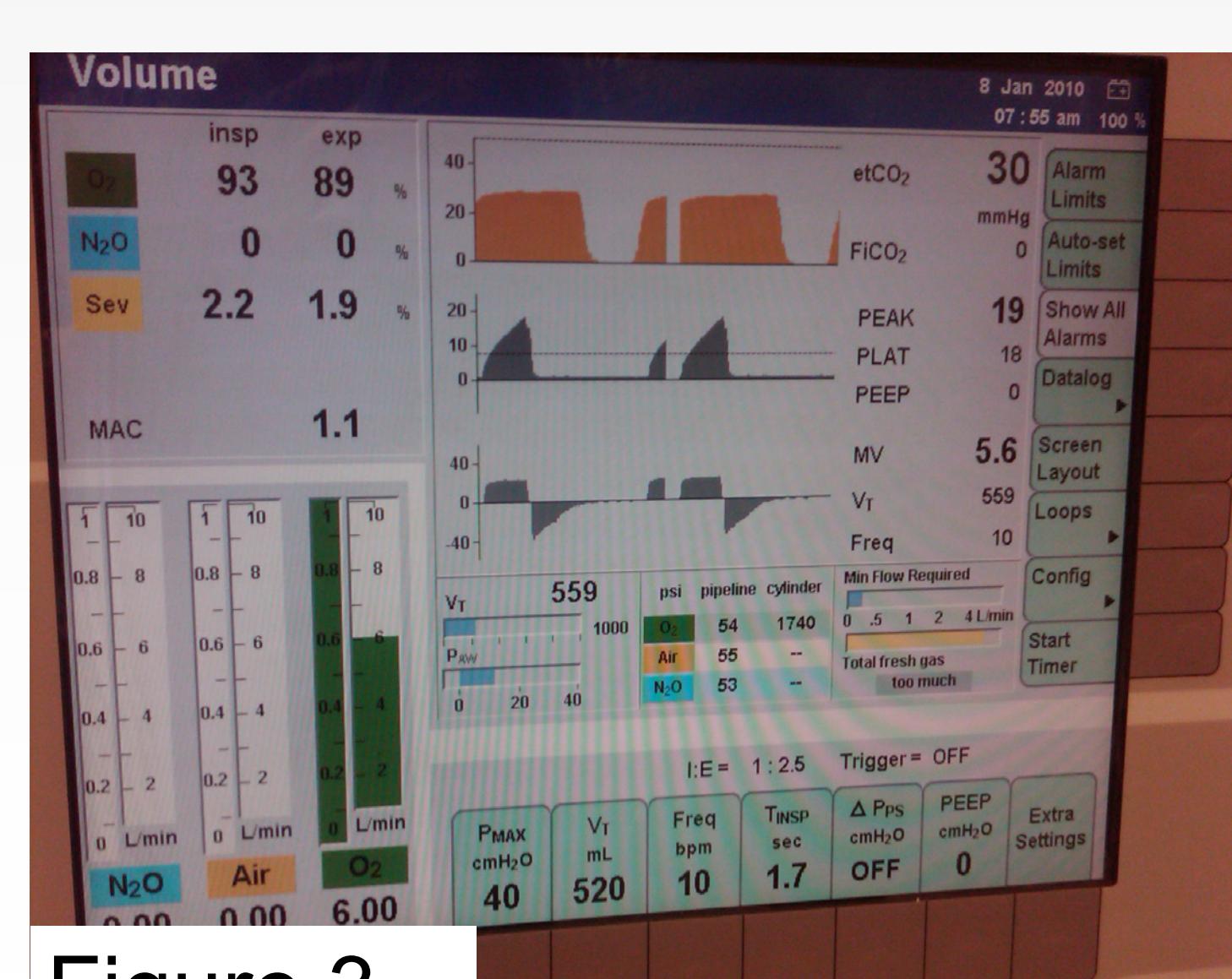


Figure 3



Figure 4

Discussion: Capnography monitors ventilation in anesthetized patients. Physiologic changes such as cardiac output, distribution of pulmonary blood flow or metabolic activity alter CO₂ production and hence capnography³. An abnormal capnography tracing where inspiratory downstroke does not return to baseline usually indicates malfunction of inspiratory or expiratory valves or exhaustion of CO₂ absorbent⁴.

In a circle system, gas flow is unidirectional in controlled ventilation with the placement of inspiratory, expiratory valves and CO₂ absorbent¹. If either of unidirectional valves becomes incompetent, exhaled gas enters inspiratory limb. During the next inspiratory cycle, inspired gas will have a higher concentration of CO₂, hence producing a higher baseline inspiratory CO₂. Rebreathing CO₂ also occurs when CO₂ absorbent is depleted. In the case described, neither of these explained the abnormal capnograph.

When the ETCO₂ sampling port is misplaced at the distal end of the expiratory limb, it will sample diluted CO₂ resulting in artificially lower ETCO₂. During the inspiratory phase, inspired ETCO₂ will be high since the sampled gas still contains CO₂. Hence, peaks and troughs of capnograph will not be observed during respiratory cycles. Therefore, ETCO₂ sampling port should be placed immediately distal to the Y-piece for a true measurement during exhalation and inspiration. (Fig 5)

In conclusion, if abnormal capnography is seen where the baseline inspiratory CO₂ is higher than usual, inspect the circuit for rebreathing and consider examining the position of ETCO₂ sampling port. We recommend confirming ETCO₂ sampling port is connected immediately distal to Y-piece before starting a case for accurate CO₂ measurement.

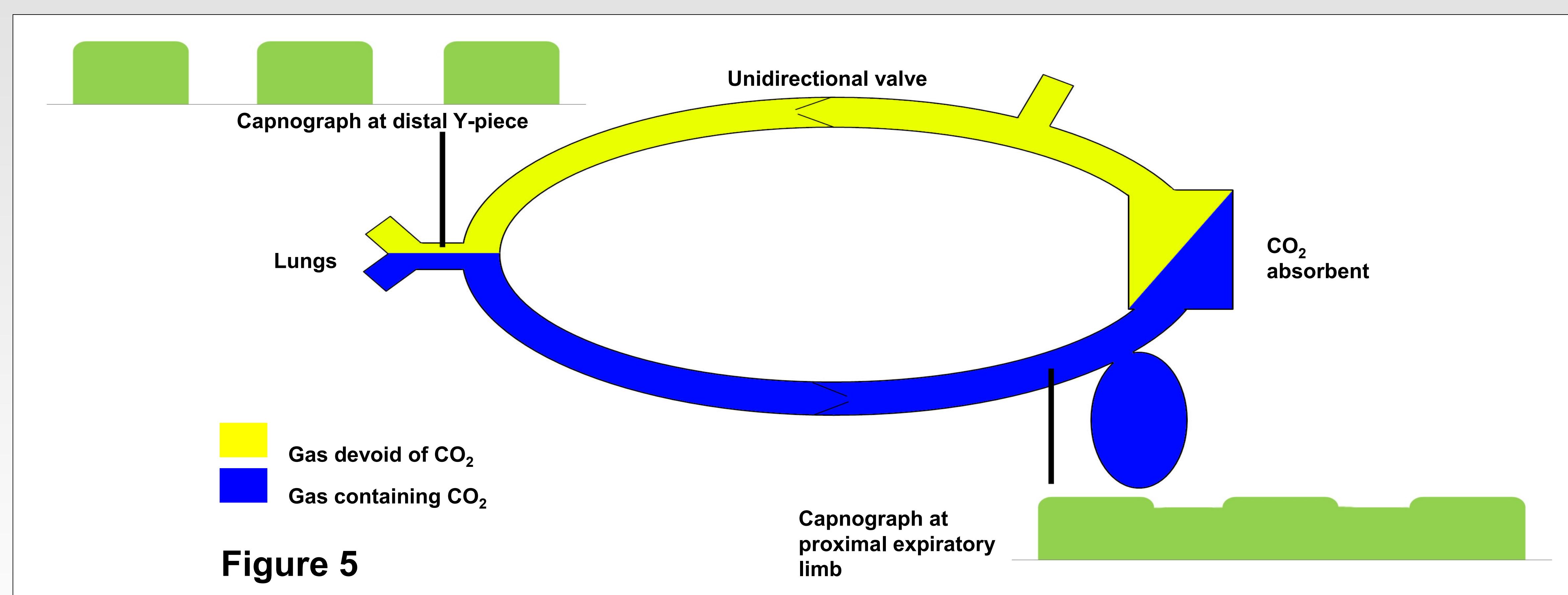


Figure 5

References:

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2. Yasodananda Kumar A, Bhavani Shankar K, Moseley HSL et al. Inspiratory valve malfunction in a circle system: pitfalls in capnography. *Can J Anaesth* 1992;39:997-9
3. Barash, Cullen, Stoelting. *Clinical Anesthesia* 5th edition. Lippincott Williams & Wilkins 2006
4. Pond, Jaffe et al. Failure to Detect CO₂ Absorbent Exhaustion: Seeing and Believing. *Anesthesiology* 2000;92:1196-1197