

Defect in the water trap of the end-tidal carbon dioxide analyzer as unusual cause for an abnormal capnography signal

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To the Editor,

Tunnel vision is a prevalent issue in our profession, potentially leading to continuous risks during clinical decision-making. A systematic approach, emphasizing vigilance in monitoring and troubleshooting, is essential to mitigate these risks. Through the following case scenario, we aim to highlight the importance of adopting a methodical strategy with differential diagnoses when addressing unexpected problems.

An 8-year-old male, weighing 20 kg, presented to the emergency department with a one-day history of headache and drowsiness. Non-contrast computed tomography of the head revealed right-sided parieto-occipital bleeding. The patient was scheduled for emergency diagnostic digital subtraction angiography in the neuro-cathlab.

During the pre-anesthesia evaluation, the patient was drowsy but responsive, with a Glasgow Coma Scale of Eye 4, Verbal 5, and Motor 6. A systolic murmur was audible at the pulmonary and mitral regions, although other clinical assessments and blood investigations were normal. Due to the urgency, a cardiac consultation and echocardiography could not be conducted.

The anesthesia workstation was checked, American Society of Anesthesiologists standard monitors were applied, and an intravenous cannula was secured. General anesthesia was induced with fentanyl, etomidate, and rocuronium after preoxygenation. The airway was secured using a size 5.5 mm endotracheal tube, fixed at 15 cm depth. The cuff pressure was maintained at 25 cmH₂O, with no evidence of a cuff leak.

Post-intubation, the end-tidal carbon dioxide (EtCO₂) was unusually low at 20-22 mmHg, despite adequate tidal volumes, a respiratory rate of 10 breaths per minute, and stable vital signs. Initial troubleshooting involved reducing ventilation and re-checking the workstation and circuits, which revealed no visible issues. Given the preoperative murmur, we suspected a right-to-left cardiac shunt as the cause of decreased EtCO₂¹. Consequently, an invasive arterial line was placed for arterial blood gas analysis. However, arterial blood gas revealed a partial pressure of carbon dioxide of 42 mmHg, indicating a discrepancy with the EtCO₂.

Further investigation showed a minimal alveolar concentration of 0.3, despite a sevoflurane dial setting of 2.5% and 6 liters of air-oxygen flow. A bizarre waveform pattern, with a dip in phase III (plateau phase) of the capnogram, heightened suspicion (Figure 1). Upon examining the EtCO₂ side stream line, we noticed an unusually loose connection at the water trap's tip. Replacing the water trap rectified the issue, normalizing both EtCO₂ and end-tidal agent concentrations. Closer inspection revealed a broken projection at the water trap's connector tip (Figure 2), causing a leaky and unstable connection.

This case underscores the importance of considering equipment-related issues before attributing anomalies to patient pathology. While previous reports have documented sampling line defects causing aberrant waveforms²⁻⁶, our case introduces a novel observation of a broken water trap connector tip. This defect caused external air dilution, leading to an initial rise and subsequent fall in phase III of the capnogram—a pattern we term the “reverse double hump.”

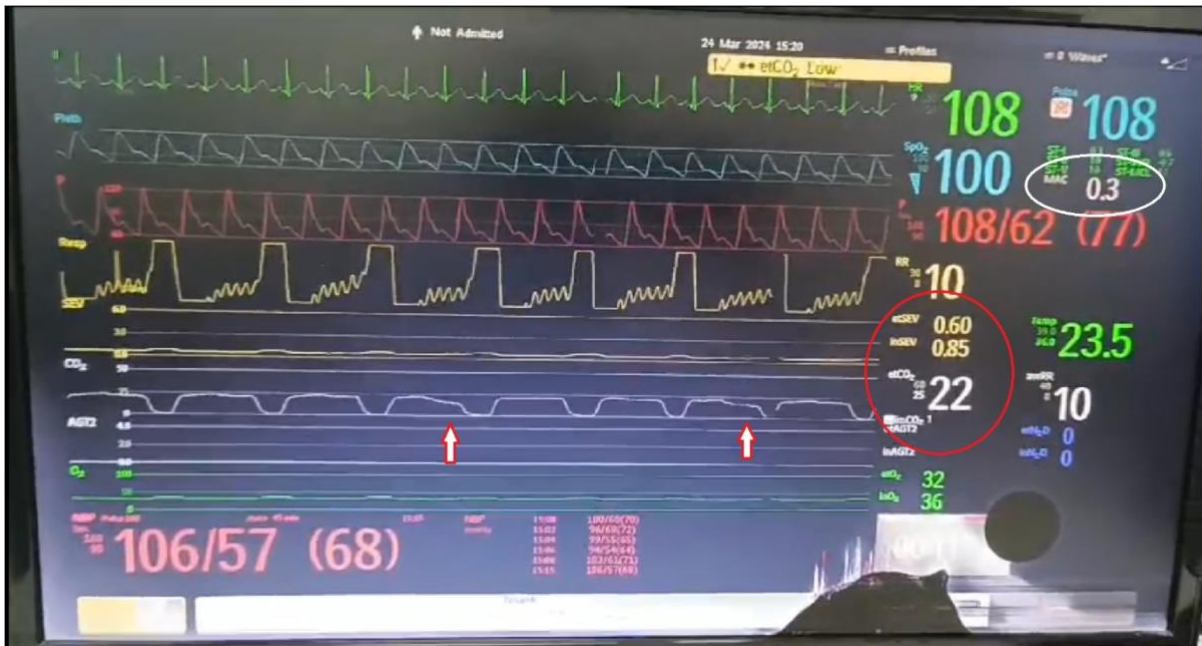


Fig. 1 — Monitor showing decreased EtCO₂ and agent concentration (circled in red), decreased Minimal Alveolar Concentration (circled in white), and bizarre EtCO₂ waveform (upward arrow mark).

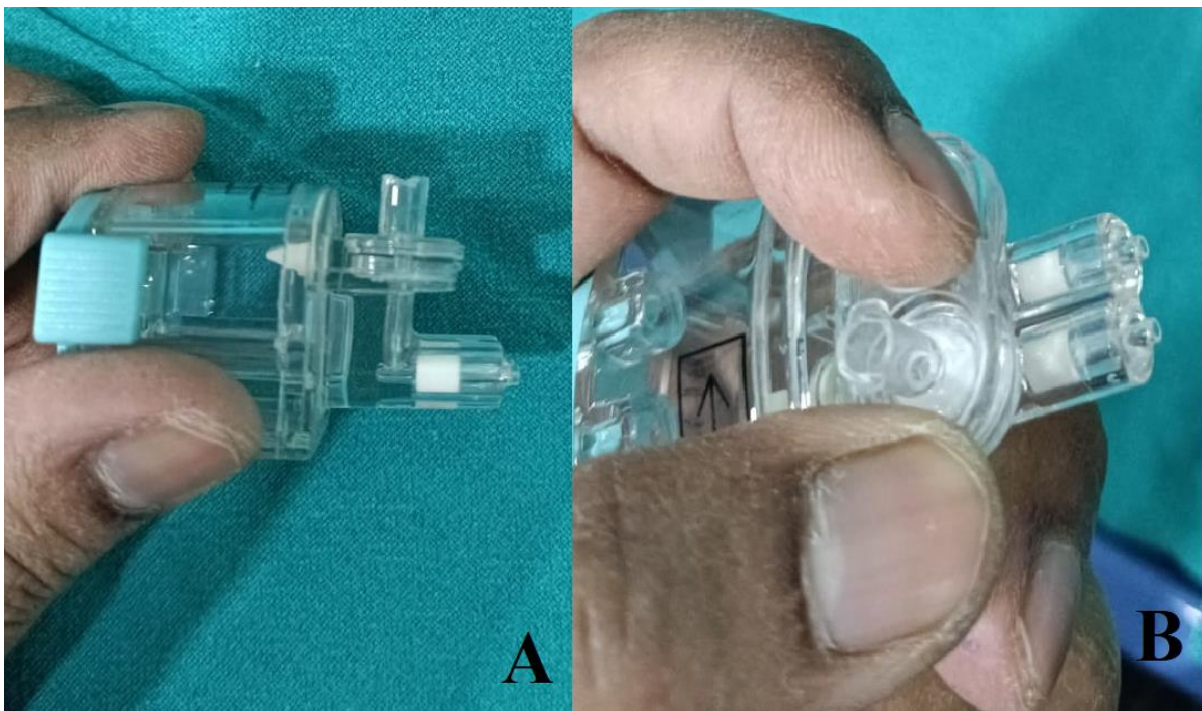


Fig. 2 — EtCO₂ water trap device- A- broken connector side tip, B- new connector with intact side tip.

Prompt identification of this defect was critical to avoiding mismanagement, such as excessive anesthetic administration or hypoventilation based on erroneous EtCO₂ values. In conclusion, anesthesiologists should familiarize themselves with capnogram waveform anomalies associated with equipment malfunction and include water trap connectors in routine machine checks.

Keywords: Water trap defect, capnogram abnormality, double hump, tailed up.

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