

A Tracheal Sound Monitor Works During the Downtime of Capnography: A Case Report

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Introduction

Capnography and tracheal sound auscultation are recommended by clinical guidelines [1, 2] to monitor respiration in the patient under sedation. However, the accuracy of capnography might be compromised in some situations, such as airway obstruction. The effectiveness of tracheal sound monitoring during the downtime of capnography has not been investigated.

Case report

In this study, we simultaneously used the capnography and a real-time tracheal sound monitor to monitor the respiration of five sedation patients during surgical procedures. Two of the patients underwent a vacuum aspiration procedure, and two of them received a urethroscopic procedure. The aforesaid four patients received sedation with propofol and fentanyl during the whole procedures. The last patient received knee replacement surgery under regional spinal anesthesia combined with propofol sedation.

The tracheal sound was monitored with an electronic stethoscope. In one of the patients with urethroscopic procedure, we did identify that the capnography failed to provide end-tidal carbon dioxide (EtCO₂) and respiratory rate (RR) (Fig 1a-b) because of partial upper airway obstruction for about one minute. However, the tracheal sound monitor can detect inhalation events and give a correct RR estimation (Fig 1a-b). After the anesthesiologist opened the airway, both inhaling and exhaling pattern and sounds were detected by the tracheal sound monitor. The waveform of EtCO₂ and the reading of EtCO₂ and RR returned to normal on capnography about one minute later than the tracheal sound monitor (Fig 1c).

Discussion

Capnography and tracheal sound auscultation are the only two methods recommend by clinical guidelines to directly monitor respiration. This case report shows the potential of using a tracheal sound monitor to detect the airway condition earlier than the capnography. A more comprehensive study is needed to compare the coverage

time of respiratory monitoring between the capnography and the tracheal sound monitor in intensive care unit, procedure sedation, or operating room.

References

- [1] A. D. Association, "Guidelines for the use of sedation and general anesthesia by dentists," *Adopted by the ADA House of Delegates*, 2016.
- [2] S. S. S. Lives, "WHO guidelines for safe surgery 2009," *Geneva: World Health Organization*, 2009.

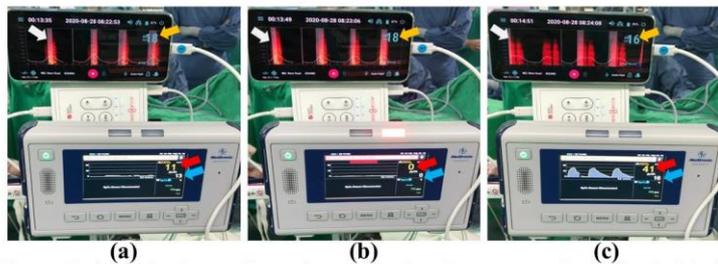


Figure 1. A tracheal sound monitor (above) and capnography (below). (a) the capnography stopped to update the readings of EtCO₂ and RR, which read 11 and 13 respectively, because of poor sampling caused by partial upper airway obstruction. However, the tracheal sound monitor still detected inhalation sound and gave an estimated RR of 18, (b) the EtCO₂ and RR were displayed as 0 after capnography failed to sample a valid signal for a while, and (c) after proper airway maneuvers to mitigate the partial upper airway obstruction, both inhalation and exhalation patterns were shown on the spectrogram and the function of capnography return to normal. Both monitors gave the same RR estimation of 16. Red arrows and blue arrows indicate the EtCO₂ and RR readings on the capnography respectively. White arrows and yellow arrows indicate the latest detected inhalation events and RR readings on the tracheal sound monitor.