End-tidal Carbon Dioxide Monitoring during Transthoracic Echocardiography (TEE) with Procedural Sedation: A Pilot Study

Primary Author: Perene Patel

Co-Authors:

Background.

Carbon dioxide (CO2) monitoring is the standard of care for all patients receiving general anesthesia and is a routine part of anesthesia practice. Use of end-tidal carbon dioxide (ETCO2) monitoring is growing in emergency medicine, intensive care, and other non-anesthesia practices. In spontaneously breathing, nonintubated patients, capnography can be useful determining adequacy of ventilation in patients undergoing procedural sedation. It can rapidly detect the common adverse airway and respiratory events associated with procedural sedation, including: apnea, upper airway obstruction, laryngospasm, bronchospasm, and respiratory depression. Moreover, it is the only monitoring modality that is accurate and reliable in actively seizing patients because the capnogram is determined entirely by respiratory activity and is not confounded by muscle activity or movement artifact. The administration of supplemental oxygen can render pulse oximetry ineffective as an early warning device for respiratory depression during sedation. Thus, capnography is beneficial when supplemental oxygen is used because its readings are not affected by the presence or absence of additional oxygen. In multiple randomized trials, performed in the emergency department and endoscopy suites, patients monitored with capnography experienced significantly fewer episodes of hypoxia than those monitored without capnography.

Methods.

Sixty-one patients underwent procedural sedation for TEE with or without capnography/capnometry; eight additional patients were not included in data analysis because ETCO2 monitoring was discontinued during the procedure due to alarm sounds. Patients received supplemental oxygen (via nasal cannula) and intravenous versed, fentanyl, and/or morphine administered by a registered nurse (RN) under the supervision of a cardiologist. Forty-one patients were monitored with ETCO2 and twenty without ETCO2 monitoring. Sidestream CO2 devices measured respiratory gas via nasal cannula by aspirating a small sample from the exhaled breath through the cannula tubing to a sensor located inside the monitor.

RNs completed a questionnaire documenting number of respiratory events (bradypnea, apnea, desaturation, airway intervention), administration of reversal agents (naloxone and/or flumazenil), other adverse events, recovery time, and comments on the effect of capnography on patient management. Bradypnea was defined as RR<10 for >30 seconds, desaturation was defined as SpO2 <90% for >5 seconds. Airway intervention options were as chin lift, jaw thrust, increase oxygen flows, assisted ventilation, oral airway, nasal trumpet. Prior to initiation of pilot study, RNs were educated about CO2 monitoring, including how to use and interpret monitors.
Due to small lack of normality and sample size, data were analyzed using the Wilcoxon Rank Sum (or Mann Whitney U) test. To help control for multiple testing, p-values less than 0.01 are considered significant (as opposed to 0.05).

Results.

The only significant difference found between the two groups (with/without ETCO2) was recovery time (minutes) which was longer in the ETCO2 group (p < 0.01). In the ETCO2 group, one patient experienced bradypnea, three patients had apnea, one patient had a desaturation event, and no patients received reversal agents. In the group without ETCO2 monitoring, there were no documented bradypneas, apnea, desaturation, airway interventions, or reversal agent administration. Feedback from RNs was mixed overall; minority of RNs commented that it helped them obtain an accurate respiratory rate and allowed them to know when it was appropriate to give or withhold medication. Criticism included the fact that cardiologists asked RNs to turn off ETCO2 monitoring due to distracting alarm sounds. Nurses had some difficulty obtaining consistent measurements in mouth breathing patients.

Conclusion.

No significant conclusions can be drawn about the use of end-tidal CO2 monitoring during procedural sedation from this pilot study. The sample size was small and unequal between groups. In the group without ETCO2 monitoring, RNs relied on derivation of respiratory rate from ECG. The ability to detect respiratory rate may be inaccurate due to motion artifact, reducing the ability to detect respiratory depression; thus, underreporting of respiratory events may have occurred. Additionally, RNs had difficulty maintaining capnography in mouth breathing patients because sample line was connected to the nasal cannula. The mouth piece was not used to detect CO2 because TEE probe was in place. For future consideration, detection of CO2 via oral device (such as bite block) may improve CO2 measurement during TEE procedures.