SUBJECT: END TIDAL CARBON DIOXIDE MONITORING (CAPNOGRAPHY)

PURPOSE: Capnography monitoring will be used to obtain a noninvasive measure of the end tidal carbon dioxide (etCO₂) on select patients. The purpose of this policy is to provide guidelines for the usage of capnography monitors to monitor patient’s ventilation.

AREAS AFFECTED/STAKEHOLDERS:
Patient care areas

PERFORMED BY:
Respiratory Therapists (RT)
Respiratory Therapy Assistants/Students under supervision of RT
Registered Nurse

DEFINITIONS:
etCO₂ = measurement of exhaled end tidal carbon dioxide

POLICY:

SUPPORTIVE DATA

1. During moderate or deep sedation the adequacy of ventilation shall be evaluated by continual observation of qualitative clinical signs and monitoring for the presence of exhaled carbon dioxide unless precluded or invalidated by the nature of the patient, procedure, or equipment.

2. Quantitative waveform capnography is suggested in intubated patients to monitor CPR quality, optimize chest compressions, and detect return of spontaneous circulation during chest compressions or when rhythm check reveals an organized rhythm.

3. Continuous waveform capnography is recommended in addition to clinical assessment as the most reliable method of confirming and monitoring correct placement of an ET tube.

4. Normal etCO₂ values range from 35-45 however the patient's baseline value is relative. What is normal for that patient at that time may not be within normal range. The focus
should be placed on trends and changes. Integrated pulmonary index (IPI) is a value which calculates and quantifies etCO₂, respirations, SpO₂ and pulse rate.

Trending IPI may be useful in early recognition of changes in ventilatory status. This feature is available on the Coviden capnography machines.

CLINICAL APPLICATIONS

1. Patients receiving sedation.
2. Patients receiving high doses or high frequencies of narcotics.
3. Patients receiving epidural or intrathecal pain management.
4. Patients who are difficult to arouse.
5. Patients with a history of respiratory distress or sleep apnea.
6. Patients who easily desaturate.
7. Patients undergoing resuscitative efforts and/or endotracheal intubation.

I. Capnography with PCA / Epidural application (Polices #1202 & #2948)

A. Capnography will be used as a standard of care for post op / post procedural monitoring of patients with PCA or PCEA because it is the most rapid indicator of hypoventilation and apnea.

B. Per PCA and PCEA protocols (#1202 & #2948), capnography and oximetry will be set up by Respiratory Therapy for patients that fall under these protocols.

C. Capnography may be paused or removed for patients ambulating, eating, or performing therapies and activities that stimulate respiratory effort.

Guidelines for PCA / PCEA Application

<table>
<thead>
<tr>
<th>EtCO₂</th>
<th>IPI (if available)</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 – 55</td>
<td>7 – 10</td>
<td>Monitor</td>
</tr>
<tr>
<td>55 - 60</td>
<td>4 – 6</td>
<td>Requires attention / attempt to stimulate and arouse patient.</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>1 - 3</td>
<td>Requires immediate intervention, consider recommending decreasing narcotic dosage, notify MD.</td>
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Capnography may be discontinued when:
- PCA pump is discontinued
- Six (6) hours after epidural infusion is discontinued
- 48 hours after one time epidural/intrathecal narcotic injection
- IV narcotics are discontinued
- Physician order
II. Capnography in Mechanical Ventilation

A. Capnography may be used to guide and optimize ventilator management.

B. Capnography trending is ideally used to determine that proper ventilation is occurring. It is recommended to routinely compare and contrast capnography readings with the PCO₂ obtained with an Arterial Blood Gas.

III. Capnography During Sedation

A. During moderate or deep sedation the adequacy of ventilation shall be evaluated by continual observation of qualitative clinical signs and monitoring for the presence of exhaled carbon dioxide via capnography monitor unless precluded or invalidated by the nature of the patient, procedure, or equipment.

B. Capnography detects changes in ventilation prior to pulse oximetry’s detection of oxygenation.

C. Capnography monitor may be discontinued when aldrete score meets discharge criteria.

D. Report changes in end tidal CO₂ of 10 above/below baseline, change in waveform indicating apnea, hypoventilation or airway obstruction to physician.

IV. Waveforms

A. Capnography waveforms are preferred in conjunction with numerical reading if possible in the clinical setting.

B. Waveforms help to identify the problem so that appropriate interventions may be taken to reduce the risk of respiratory compromise. See attached waveforms for additional information.

REFERENCES:


Oridion Implementation manual – capnography for pain management.

Covidien Education for Capnography during procedural sedation.

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Normal Waveform¹

A-B: Baseline period of no CO₂ end of inhalation
B-C: Rapid rise in CO₂ early exhalation
D: Alveolar plateau, end of expiration, end tidal CO₂ (etCO₂)
D-E: Inhalation

Abnormal Waveforms

FOR INTUBATED AND NON-INTUBATED* PATIENTS
Always check function of equipment and follow your institutional protocols.

Partial airway obstruction (partial loss of waveform)
Possible Causes (Non-intubated):
Airway collapse/blockage, secretions in the airway.

Possible Causes (Intubated):
Secretions in the airway, ETT misplaced in hypopharynx, partially kinked ETT, air leak from uncuffed ETT.

Hypoventilation with shallow breathing
Possible Causes (Non-intubated):
Ineffective tidal volume due to sedation, opioids, or other respiratory depressive medications.

Possible Causes (Intubated):
Ineffective tidal volume.

Apnea (loss of waveform)
Possible Causes (Non-intubated):
Sedation, opioids, or other respiratory depressive medications, kinked or displaced sampling line.

Possible Causes (Intubated):
Dislodged ETT, ETT misplaced in hypopharynx, complete airway obstruction.

Rebreathing of CO₂
Possible Causes (Non-intubated):
Insufficient oxygen flow, shallow breathing, not clearing dead space, or drape over face.

Possible Causes (Intubated):
Faulty exhalation valve, dead space in ventilator circuit.

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*Apnea-Sat Alert feature not indicated for use on intubated patients.