

CO₂ Monitoring

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What Is Capnography?

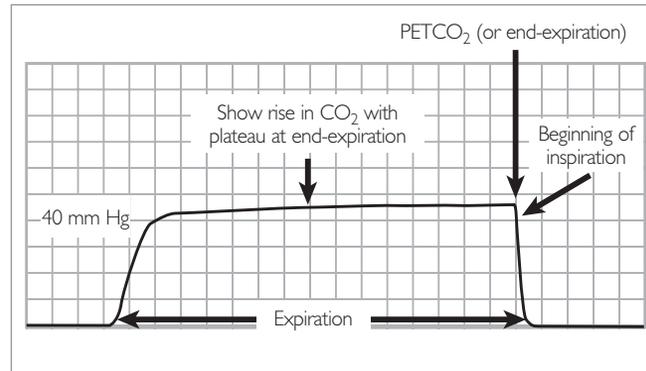
Capnography is the sensing of exhaled CO₂. Carbon dioxide is produced in the body as a by-product of metabolism and is eliminated by exhaling.

By measuring exhaled CO₂, many types of pulmonary assessments can be made.

Potential Applications of Capnography

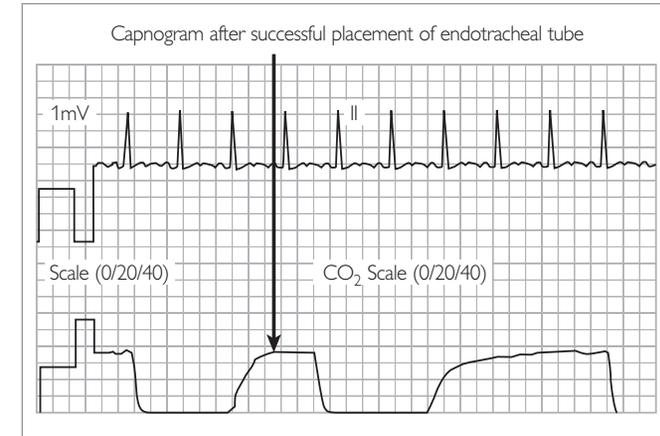
- Detecting esophageal placement of endotracheal tubes during intubation
- Detecting disconnection of the patient from mechanical ventilation
- Providing sedation protection
- Avoiding ABG analysis in selected clinical situations
- Detecting changes in cardiac output to identify heart failure and hypovolemia
- Detecting changes in dead space (e.g., pulmonary emboli)
- Recognizing alveolar emptying (e.g., effectiveness of bronchodilator therapy)
- Predicting survival in cardiopulmonary resuscitation

Characteristics of a Normal Capnogram

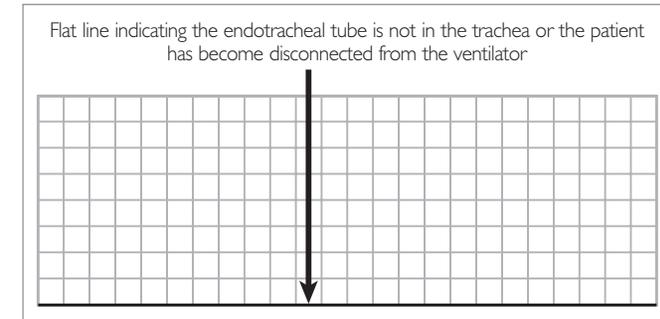


Use of Capnography During Intubation

Carbon dioxide is eliminated from the lungs but not from the stomach or esophagus (unless a carbonated beverage has been consumed). It is easy to determine when a tube, such as an endotracheal or nasogastric tube, has been placed in the trachea. When tracheal placement occurs, a capnogram shows exhaled CO₂.



If esophageal placement occurs, a flat line occurs or no CO₂ is detected.



Detecting Disconnection from Mechanical Ventilation

Capnography is one of the fastest ways to determine if a patient has become disconnected from the ventilator. Capnography, unlike ventilator alarms, monitors the patient. Immediately upon disconnection from the ventilator, the waveform on the capnogram disappears and goes flat.

Providing Sedation Protection

The main reason a PETCO₂ value increases is reduced alveolar ventilation. Obtaining a blood gas can confirm this possibility.

During sedation, weaning from ventilation or managing reactive airway patients, the PETCO₂ is the first indication of danger.

- If the PETCO₂ increases by 10mm Hg, airway protection should be implemented.
- If sedation or analgesia is being administered, stop the infusion until the PETCO₂ returns to near baseline or increase ventilation, if possible.
- Monitor the patient simultaneously for comfort and awareness.

Case Study*

A 56-year-old man is admitted to the outpatient procedure area for a follow-up colonoscopy. The patient had a colonoscopy three years earlier where a pre-cancerous polyp was removed. During this follow-up procedure, the physician elects to use Propofol (instead of Midazolam) due to its more rapid elimination and shorter recovery time. Twenty minutes into the procedure, you note the PETCO₂ listed below.

	P	RR	BP	SpO ₂	PETCO ₂
Admission	72	12	132/72	100	37
5 min into procedure	76	10	128/70	100	42
20 min into procedure	73	10	134/78	100	48

Action: Reduce sedation until the PETCO₂ decreases to less than 47.

* Results from case studies are not predictive of results in other cases.

Avoiding Unnecessary Arterial Blood Gas Testing

When the PaCO₂ – PETCO₂ gradient is normal, the PaCO₂ can be estimated from the PETCO₂. It is important to note the gradient when results of ABG analysis are obtained.

When using PETCO₂ to estimate PaCO₂, it is helpful to simultaneously measure expired ventilation (V_E). If the V_E and PETCO₂ remain constant, then the PaCO₂ – PETCO₂ gradient is unlikely to have changed.

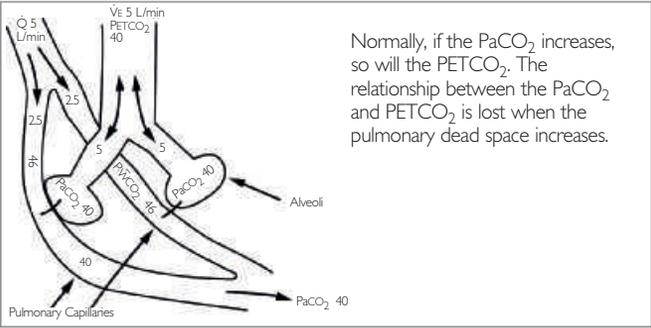
Detecting Changes in Cardiac Output to Identify Heart Failure and Hypovolemia

Passive leg raise with a subsequent increase in the PETCO₂ can indicate hypovolemia.

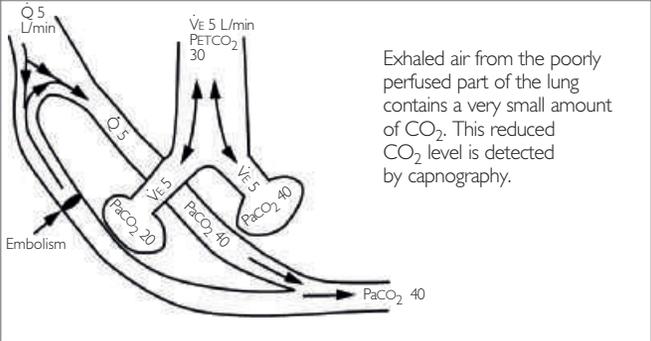
	P	RR	BP	SpO ₂	PETCO ₂
Prior to leg raise	102	21	110/70	100	27
1 minute after leg raise	98	19	114/72	100	38

Detecting Changes in Pulmonary Dead Space

Normally, the PETCO₂ level correlates closely with PaCO₂. The PETCO₂ is usually 1-5mm Hg lower than the PaCO₂. The difference between the PaCO₂ and PETCO₂ is called the PaCO₂ – PETCO₂ gradient.



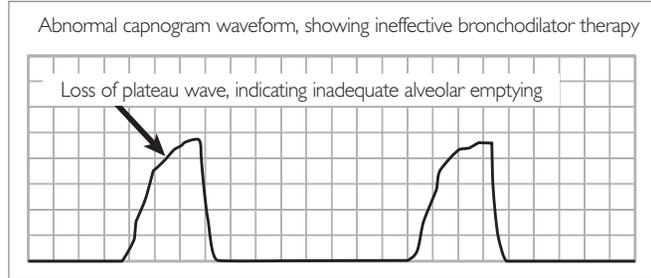
When a condition such as pulmonary embolism (PE) occurs, blood flow to a part of the lung is decreased.



Two patients with shortness of breath and a potential diagnosis of pulmonary emboli

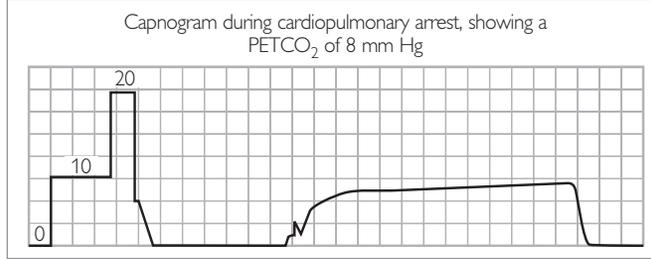
	Patient 1	Patient 2
PaCO ₂	36mm Hg	39mm Hg
PETCO ₂	32mm Hg	21mm Hg
Interpretation	<ul style="list-style-type: none"> • No significant PE. • Normal PaCO₂ – PETCO₂ gradient. 	<ul style="list-style-type: none"> • PE should be considered. • Widened PaCO₂ – PETCO₂ gradient.

Recognizing the Adequacy of Alveolar Emptying



Predicting Survival in Cardiopulmonary Resuscitation

Exhaled CO₂, specifically PETCO₂, is a noninvasive indicator of cardiac output. The lower the cardiac output, the lower the PETCO₂. If PETCO₂ is less than 10mm Hg after 20 minutes of cardiopulmonary resuscitation, the code is almost always unsuccessful.



The higher the PETCO₂, the more effective the resuscitation efforts

