CAPNOGRAPHY
In Emergency Care

EDUCATIONAL SERIES

Part 1: Overview
CAPNOGRAPHY
In Emergency Care

• Program Learning Objectives
  – Relate a normal capnogram to the phases of breathing
  – List five clinical applications for capnography
  – Identify the four most common abnormal capnograms
  – Describe how to incorporate capnogram to patient care according to local protocol
CAPNOGRAPHY
In Emergency Care

Program Parts

Part 1: Overview
Part 2: Introduction to Capnography
Part 3: Capnography in the Intubated Patient
Part 4: Capnography in the Non-intubated Patient
CAPNOGRAPHY
In Emergency Care

Part 1: Overview
Why use capnography?

(Corollary: Why should I learn capnography?)
Case Scenario

- 61 year old male
- C/O: “short-of-breath” and “exhausted”
- H/O: > 45 years of smoking 2 packs a day, 3 heart attacks, high blood pressure
- Meds: “too expensive to take every day”
- Exam: HR 92, RR 18, 160/100, 2+ pitting edema, wheezing, crackles

What other information would you want in making your assessment?
Capnography Overview

• A technology that:
  – Provides another measurement in assessing your patient
  – Gives an objective measure of your patient’s ventilatory status
  – Shows a graphic picture of your patient’s ventilatory status
  – Presents an early warning of changes in your patient's cardiopulmonary status
  – Supplies important documentation on your patient
Capnography Overview

- Capnography provides an objective measure of ventilation
- Capnography provides
  - Numeric value of “End-Tidal CO₂”
  - Waveform of respiration
Capnography Overview

• **End Tidal CO₂**—what is it?
  - Breathing is done in waves
  - EtCO₂ is the amount of CO₂ measured at the peak of the wave
  - EtCO₂ is measured at the nose, mouth, or hub of the ET tube
Capnography Overview

• “Capnos” is Greek for smoke
  – From the “fire of life”—metabolism
  – Metabolism produces carbon dioxide as a waste product
Capnography Overview

- Carbon Dioxide (CO₂)
  - Produced by all living cells
  - Diffused into the bloodstream
  - Transported to the lungs
  - Perfused into the alveoli
  - Exhaled through the airway
History of Capnography in EMS

- Initially used for monitoring anesthetized patients in the OR
- New technology now available for EMS in both intubated and non-intubated patients
History of Capnography in EMS

- Used by anesthesiologists since the 1970s
- Standard of care in the OR since 1991
- New JCAHO standard now expanding utilization

History of Capnography in EMS

- JCAHO January 2001 standard on procedural sedation
  - In any hospital or clinic setting
  - Monitoring vital signs, continuous monitoring of oxygenation and ventilation

Capnography provides the only continuous visual monitoring of ventilation

Source: Joint Commission Perspectives, Special Report. July/August 2000
History of Capnography in EMS

- Pulse oximetry preceded capnography
- Pulse oximetry measures oxygenation
- Capnography measures ventilation
  - New technologies now allow use in EMS
History of Capnography in EMS

Colorimetric

Capnometry

Capnography
History of Capnography in EMS

Colorimetric:

- Specially treated litmus paper
  - Color changes indicate qualitative amount of CO\textsubscript{2} detected
- For intubated patients only
- Disposable detector fits on ET tube hub
History of Capnography in EMS

Colorimetric:

- Single use
- Easily impaired by moisture or secretions
- False negatives during cardiac arrest
  - Presence
  - Strength/amount
History of Capnography in EMS

Colorimetric:

Colorimetric CO₂ Indicator

Breathing Circuit

ET Tube
History of Capnography in EMS

**Capnometry:**

- A numerical value of the EtCO₂
- For both non-intubated and intubated patients
- Continuous monitoring
History of Capnography in EMS

Capnometry:

• No waveform of the EtCO₂ in the airway
• Equates to monitoring heart rate in cardiac patient
  – Present
  – Amount or range
  – Changes over time
History of Capnography in EMS

Capnometer:

- EtCO₂: 32
- RR/MIN: 11
History of Capnography in EMS

Capnometry:

• Numeric reading: HR 100
• Waveform:
History of Capnography in EMS

Capnometry:

- Numeric reading: HR 100
- Waveform:
History of Capnography in EMS

Capnography:

• A numerical value of the EtCO₂ AND
• A waveform of the concentration of CO₂ present in the airway
History of Capnography in EMS

Capnography:

• For both non-intubated and intubated patients
• Continuous breath-to-breath monitoring
• Equates to ECG monitoring in cardiac patient
History of Capnography in EMS

Capnography:

HR
SpO₂
EtCO₂
ECG Waveform
Oximetry Waveform
Capnography Waveform
History of Capnography in EMS

- Capnography systems
  - Collector of the air sample
  - Analyzer detects and measures CO₂
  - Display shows waveform and number
History of Capnography in EMS

Capnography Technologies:

Conventional high-flow sidestream

1980’s

Mainstream

Early 1990’s

New low-flow sidestream technology
History of Capnography in EMS

- Conventional high-flow sidestream capnography
  - For both intubated and non-intubated patient
  - Analyzer located inside the device for protection
- No added weight on patient’s airway
History of Capnography in EMS

• Conventional high-flow sidestream capnography
  – Requires 150-200ml of air to measure a CO₂ level
  • Air aspirating system
  • Requires frequent calibration
  • Frequent occlusion of tubing by moisture and secretions
• Inaccurate in neonates, infants, and young children
History of Capnography in EMS

Conventional high-flow sidestream capnography system
History of Capnography

- Mainstream Capnography
  - Developed for intubated patient
  - Analyzer on the hub of ET tube
    - Not disposable
    - Weight on the ET tube
    - Adaptors attach to analyzer for non-intubated patients
History of Capnography

- New low-flow sidestream capnography
  - Newer technology requires 50ml of air for sampling
  - Occlusions uncommon
  - Accurate in all age groups
    - neonates to large adults
History of Capnography

• New low-flow sidestream capnography
  – For intubated and non-intubated patients
  – No calibration required between patients
  – Disposable tubing and cannulas
  – New in-line filters exclude contaminants
  – Durable for EMS environment
History of Capnography

• New low-flow sidestream technology
Using Capnography

• Immediate information via breath-to-breath monitoring

• Information on the ABCs
  – Airway
  – Breathing
  – Circulation

• Documentation
Using Capnography

- **Airway**
  - Verification of ET tube placement
  - Continuous monitoring of ET tube position

- **Circulation**
  - Check effectiveness of cardiac compressions
  - First indicator of ROSC
  - Monitor low perfusion states
Using Capnography

• Breathing
  – Hyperventilation
  – Hypoventilation
  – Asthma
  – COPD
Using Capnography

- Documentation
  - Waveforms
    - Initial assessment
    - Changes with treatment
  - EtCO₂ values
    - Trends over time
Part 1: Capnography Overview

Summary

- The only visual objective measure of ventilation
- Provides breath-to-breath readings
- For intubated and non-intubated patients
- Information and documentation of patient’s ABCs
- New technology for use in EMS
Part 1: Capnography Overview

Okay, let’s get started.