# BASICS OF WAVEFORM CAPNOGRAPHY

Waveform capnography assesses ventilation by monitoring exhaled carbon dioxide

Can use measurement and morphology during different phases of respiratory cycle to uncover pathophysiology

CHEST®



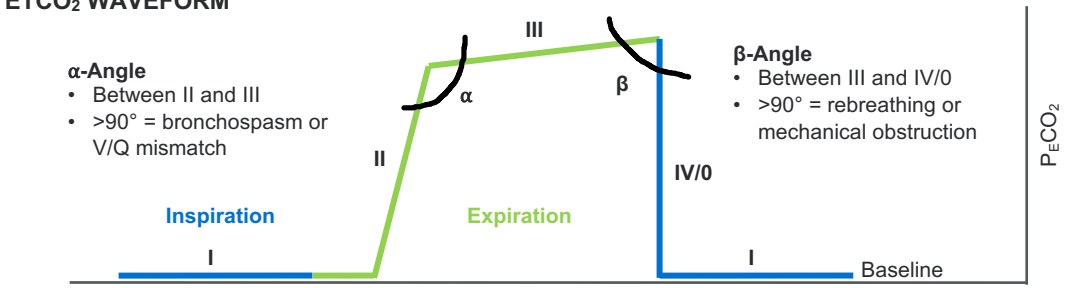
## OVERVIEW

- Capnography measures ventilation through exhaled $CO_2$ ($P_ECO_2$)
- Abnormal morphology can provide important data regarding pulmonary pathophysiology

## CLINICAL APPLICATIONS

- Confirmation of endotracheal intubation
- Monitoring airway integrity
- Monitoring cardiac output
- Monitoring spontaneous respiration
- Assessing for $CO_2$ retention
- Assessing ROSC during CPR by observing a sudden increase in waveform amplitude

## $ETCO_2$ WAVEFORM




**PHASE I**
- Inspiratory baseline
- $P_ECO_2$ = zero

**PHASE II**
- Beginning of expiration
- Transition as $CO_2$ rises when anatomical dead space, then alveolar gas, is exhaled

**PHASE III**
- Alveolar plateau
- **$ETCO_2$**
  - Peak $CO_2$ at end of phase III
  - Correlates with $PaCO_2$

**PHASE IV/0**
- Start of inspiration
- $P_ECO_2$ rapidly falls to zero

## BRONCHOSPASM AND REBREATHING/AIR TRAPPING

- Increase or loss of α-angle (aka "shark fin")
- Dead space has not finished emptying before next inspiration
- Increasing level of baseline $P_ECO_2$ due to air trapping

## MECHANICAL AIRWAY OBSTRUCTION

- Fixed mechanical obstruction affects both inspiration (phase IV/0) & expiration (phase II)
- α-angle and β-angle both >90°

## EMPHYSEMA

- Arterial $CO_2$ represented by early peak, not end-tidal, due to hypercompliance and poor gas exchange surface
- Pattern can also be seen with pneumothorax with air leak

## CARDIOGENIC OSCILLATIONS

- Pulsation transmitted from the heart to the lung parenchyma produces small volume changes that manifest as oscillations
- Sign of cardiomegaly

## SUDDEN LOSS OF WAVEFORM

- Critical event needing emergency intervention
- ET tube disconnected, dislodged, kinked, or obstructed

## DOWNTRENDING $ETCO_2$

- Decreasing waveform size can indicate:
  - Shock/low cardiac output state
  - Pulmonary embolism
  - Hyperventilation