MEDAVIE HealthEd ÉduSanté

Advanced Airway Control

Advanced Care Paramedicine

Module: 12

Section: 01a

MEDAVIE HealthEd ÉduSanté

Advanced Airway Care (RSI)

Introduction

- Advanced airway control
- Facilitate intubations
- For conscious clenching patients and patients with an intact gag reflex
- No mechanical ventilation necessary
- Decrease vomiting
- Maintain patent airway

Indications

- Patients requiring sedation for procedure
- Patients unable to maintain airway
- Patients unable to oxygenate to sufficient levels
- Patient in danger of losing airway
- Predicted obtainable airway

Contraindications

- Lack of indications
- Cardiac arrest
- Indications for immediate airway control
- Predicted difficult airway
  - Tracheal Edema
  - Obstruction
  - Epiglottitis
  - Poor Mallampati

6 P's to RSI

- Preparation
- Pre-oxygenate
- Pretreatment
- Paralysis (sedation)
- Placement
- Post intubation management

Preparation

- Suction
- Laryngoscope
  - Blades
- Oxygen (BVM)
- Pillow
- Endotracheal Tube
- Stylet
- Spare endotracheal tubes
- Securing tape/twill
- Syringe

- End-tidal CO_2 Detector
- Toomey Syringe

- Rescue Airways
  - Bougie
  - Surgical

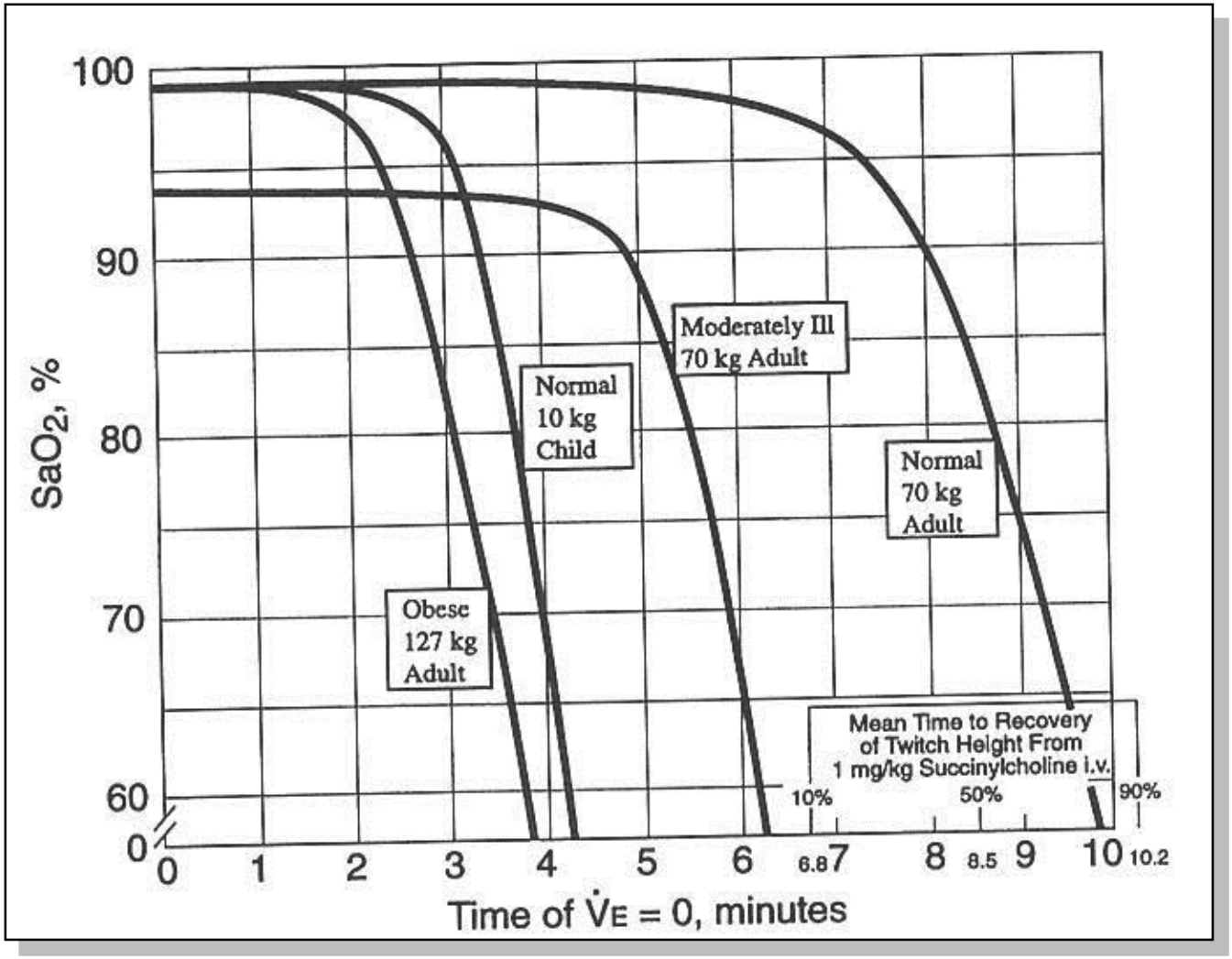
Pre-oxygenate

- Pre-oxygenate (nitrogen washout)
  - 100% NRB
  - Monitor O_2 saturations
  - Do not Ventilate via BVM
    - Minimizes gastric distention

How much time do I have?

- 70 kg adult maintains O_2 Sat >90% for 8 min
  - From 90% - 0% = < 120 seconds
- Obese adult (>120 kg) desaturate to 0% in less than 3 min
- 10 kg child desaturate < 90 in 4 min
  - From 90% to 0% in 45 seconds

Walls Graph


100
90
80
70
60
0
SaO2, %
Moderately Ill
70 kg Adult
Normal
10 kg
Child
Normal
70 kg
Adult
Obese
127 kg
Adult
Mean Time to Recovery
of Twitch Height From
1 mg/kg Succinylcholine i.v.
10%
50%
90%
0 1 2 3 4 5 6 6.8 7 8 8.5 9 10 10.2
Time of V̇E = 0, minutes

Pretreatment

- "LOAD" the patient
  - **L**idocaine
  - **O**pioid
  - **A**tropine
  - **D**efasiculating Dose of NMB

Lidocaine

- Class 1B anti-arrhythmic
  - Has been used as an adjunct since the early 1960's

- Premise
  - Laryngoscopy and Intubation
    - Afferent stimulation in post pharynx/ larynx
    - Increased central stimulation
    - Increased ICP
    - Stimulation of autonomic system
    - Increased HR / BP
    - Upper and lower respiratory tract leading to increased airway resistance

Lidocaine

- Literature (controversial)
  - Suppresses cough reflex
  - Attenuates increase in airway resistance (from ET tube irritation)
  - Prevents increased ICP
  - Prevents increased IOP
  - Decreases dysrhythmias by 30 - 40%
  - Use to attenuate **sympathetic** response to laryngoscopy (not supported by literature)

Lidocaine

- Dose: 1.5 mg/kg

- Topical 4% Lidocaine and ICP ????

Opiod

- Used to blunt systemic response
  - Morphine
    - Dose: 5 – 10 mg IVP
  - Fentanyl
    - Dose: 2 – 3 µg/kg (50 – 100 µg)

- Possible SE's of opiod administration
  - Potential rise in ICP (6 – 10 mmHg)
    - Associated with a decrease in MAP and CPP
  - May cause muscle rigidity (wooden chest syndrome)
    - Mechanism is unclear
    - Usually cleared with administration of NMB's

Beta Blockers

- Beta-blockers
  - Will decrease sympathetic response
    - Esmolol (β-1 cardioselectivity)
      - 2 mg/kg bolus
      - Effective at limiting rises in HR, systolic BP, and MAP, but it has little effect on diastolic pressure.
      - Problems:
        - » Negative inotrope
        - » Bronchioconstriction (especially in patients with underlying reactive airway disease)
    - Children are more prone to a bradycardic response to intubation, beta-blockers should generally be avoided in younger patients.

Atropine

- Acts as antimuscarinc to minimize vagal effects
  - Infants and Children are more susceptible to vagal nerve stimulation
  - Can be worsened with hypoxia
- Dries oral secretions

- Use with Succinylcholine in children under the age of 8 and when giving repeat doses
  - Repeat doses may cause Sinus Bradycardia, Junctional or Sinus Arrest since Succinylcholine mimics action of Ach at the cardiac muscarinic receptors

- Dose 0.02 mg/kg (no less than 0.1mg – max 1.0 mg), 3 min prior to induction

Defasiculation

- Prior to Succinylcholine administration to minimize
  - Injuries from fasiculations
  - Rise in ICP from Succinylcholine induced fasciculation (animal data, limited human)
    - Does not attenuate the sympathetic response to intubation
    - Does not attenuate the increase in airway resistance with intubation
- $1/10^{th}$ intubating dose of non-depolarizing NMB
  - Rocuronium
  - Pancuronium
  - Vecuronium

Paralysis (sedation)

- Induction phase is to performed to produce sedation and anaesthesia
  - Benzodiazepines
  - Barbiturates
  - Etomidate
  - Ketamine
  - Propofol
  - Neuromuscular Blockers

Benzodiazepines

- Sedative-hypnotic agent
  - Act as gamma-aminobutyric acid (GABA) agonists
  - Effective anxiolytic and amnestic agents
  - Midazolam
    - 2.0 – 5.0 mg IVP
  - Valium
    - 2.0 – 5.0 mg IVP

Barbiturates

- Also act at the GABA receptor to produce anaesthesia and sedation

- Sodium thiopental
  - Lipid soluble and cross the blood-brain barrier rapidly
  - 3 - 5 mg/kg IVP
  - Beneficial effects
    - Blunting the hemodynamic response to intubation
    - Decreasing CNS metabolism
  - Detrimental effects
    - Potent negative inotropes and vasodilators causing significant hypotension
    - Histamine release
    - Bronchospasm

Etomidate

- Similar to thiopental, but is non-barbiturate
- Rapid onset and brief duration of action
  - Has the added benefit of remarkable hemodynamic stability
  - Decreases cerebral metabolism and blood flow without affecting CPP
- 0.1 - 0.4 mg/kg IVP
- Myoclonus (jerky muscular contractions) may be seen after administration

Ketamine

- Dissociative anesthetic derived from phencyclidine (PCP)
- Usually seen with the sedation of children
- 1- 2 mg/kg IVP

- Does not produce a true unconscious state because reflexes, including spontaneous respirations, may be preserved
- As a dissociative agent can produce unpleasant emergence reactions, such as disturbing dreams and hallucinations, as it wears off
  - Generally a concern when used for conscious sedation; rarely an issue with long-term sedation is used following successful intubation

- Sympathomimetic activity can produce significant tachycardia and hypertension
- Increases cerebral metabolism, ICP, and cerebral blood flow

- Beneficial when intubating patients with status asthmaticus
  - Direct bronchodilatory properties

Propofol

- Short-acting hypnotic agent
  - Reduces cerebral metabolism and blood flow
  - May offer bronchodilatory properties
  - Significantly decreases MAP
  - Cardiac depressant
- 2 - 3 mg/kg IVP

Succinlycholine

- Depolarizing NMB
  - Adult: 0.5 – 1.5 mg/kg
  - Ped: 1.5 – 2.0 mg/kg
- Rapid onset, short duration
- May cause malignant hyperthermia

Non-depolarizing NMB's

- Pancuronium
  - 0.04 – 0.1 mg/kg
- Vecuronium
  - 0.08 – 0.1 mg/kg
- Rocuronium
  - 0.6 – 0.8 mg/kg

Placement

- Use of BURP or Sellick's Maneuver
- Perform direct laryngoscopic intubation
  - Confirm placement

Post Intubation Management

- Secure tube
- Ventilate
- Monitor patients status
- Maintain sedation/paralysis

Pitfalls

- Failure to adequately preoxygenate to achieve nitrogen washout
- Failure to allow adequate time between pretreatment and intubation
- Failure to recognize the patient with hemodynamic instability

Capnography

Capnography

- Capnography is the vital sign of ventilation
- Tracking the CO_2 in a patient's exhaled breath, capnography enables paramedics to objectively evaluate a patient's ventilatory status (and indirectly circulatory and metabolic status)
- A capnograph measures how much carbon dioxide is present in the patients breath

Definitions

- Capnography
  - Measurement of CO_2 in exhaled breath
- Capnometry
  - Measurement of partial pressure of expired CO_2
- Capnometer
  - Numeric measurement of CO_2
- Capnogram
  - "Real-time" visual waveform of $ETCO_2$
- End Tidal CO_2 ($ETCO_2$ or $P_{ET}CO_2$)
  - Level of (partial pressure of) carbon dioxide released at end of expiration
  - Normal value: 35 – 45 mmHg

Capnography

Colormetric Devices

- Disposable
- Detect exhaled CO_2 with litmus paper
  - H^+ ions in CO_2 cause change in color
  - of paper
    - Color change present between each breath
  - Manufactured in protective plastic housing
  - Placed between vent circuit and endotracheal tube
- Not useful in detecting hyper/hypocarbia

Electronic Devices

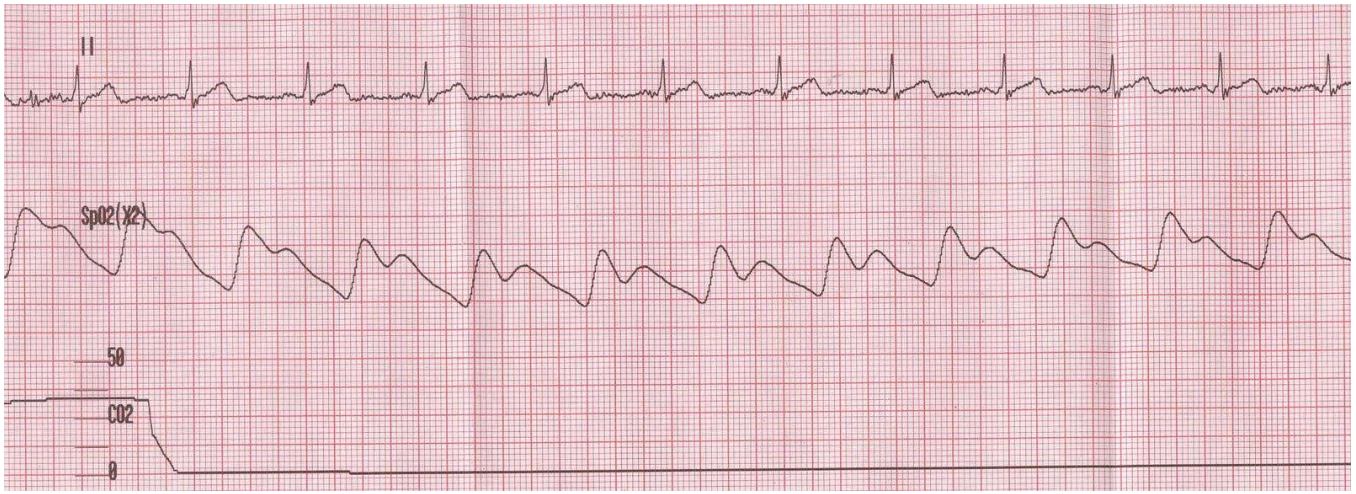
- CO_2 absorbs light at specific wavelength
  - Allows for measurement
- Can be qualitative or quantitative
  - Qualitative
    - Detect presence of CO_2
  - Quantitative
    - Determine how much CO_2 is present

Oxygenation versus Ventilation

- Oxygenation
  - Oxygen is inhaled into the lungs where gas exchange occurs at the capillary-alveolar membrane
  - Oxygen is transported to the tissues through the blood stream
  - Pulse oximetry measures oxygenation
- Ventilation
  - CO_2 is carried back through the blood and exhaled by the lungs through the alveoli
  - Capnography measures ventilation

Capnography versus Pulse Oximetry

- Capnography provides an immediate picture of patient condition.
- Pulse oximetry is delayed.
- Capnography will show immediate apnea, while pulse oximetry will show a high saturation for several minutes.



Circulation and Metabolism

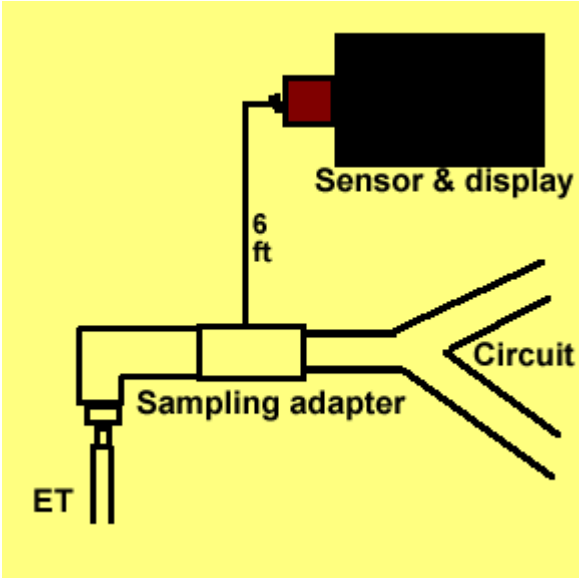
- Capnography is a direct measurement of ventilation in the lungs, it also indirectly measures metabolism and circulation
  - Increased metabolism will increase the production of carbon dioxide increasing the $ETCO_2$
  - Decrease in cardiac output will lower the delivery of carbon dioxide to the lungs decreasing the $ETCO_2$
  - $ETCO_2$ reflects changes in cardiac output and pulmonary blood, not ventilation

P_aCO_2 versus $P_{ET}CO_2$

- Normal $ETCO_2$ 1–2 mmHg $< CO_2$
- P_aCO_2
  - Partial Pressure of Carbon Dioxide in arterial blood gases
  - Measured by drawing the ABGs
- If ventilation and perfusion are stable P_aCO_2 should correlate to $P_{ET}CO_2$
- If ventilation or perfusion are unstable, a Ventilation/Perfusion (V/Q) mismatch can occur. This will alter the correlation between P_aCO_2 and $P_{ET}CO_2$

Main-stream Capnograph

- CO_2 sensor located between endotracheal tube and breathing circuit



Main-stream Capnograph

Advantages

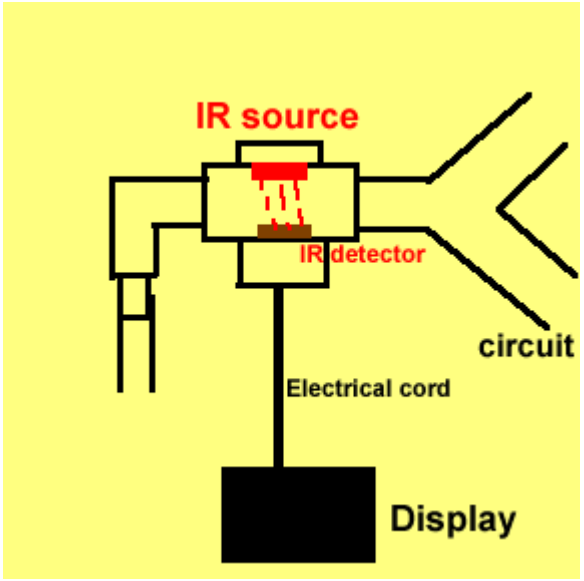
- No sampling tube No obstruction
- No affect due to pressure drop
- No affect due to changes in water vapor pressure
- No pollution
- No deformity of capnogram due to non dispersion of gases
- No delay in recording
- Suitable for neonates and children

Disadvantages

- Sensors are light weight minimizing traction on the endotracheal tube
- Sensor windows may clog with secretions.
- Difficult to use in unusual patient positioning such as in prone positions.
- The newer versions use disposable sensor windows thereby eliminating sterilization problem

Side-Stream Capnographs

- Sensor is located in the main unit and CO_2 is aspirated via a sampling tube connected to a T-piece adapter located between endotracheal tube and breathing circuit.



Side-Stream Capnographs

Advantages

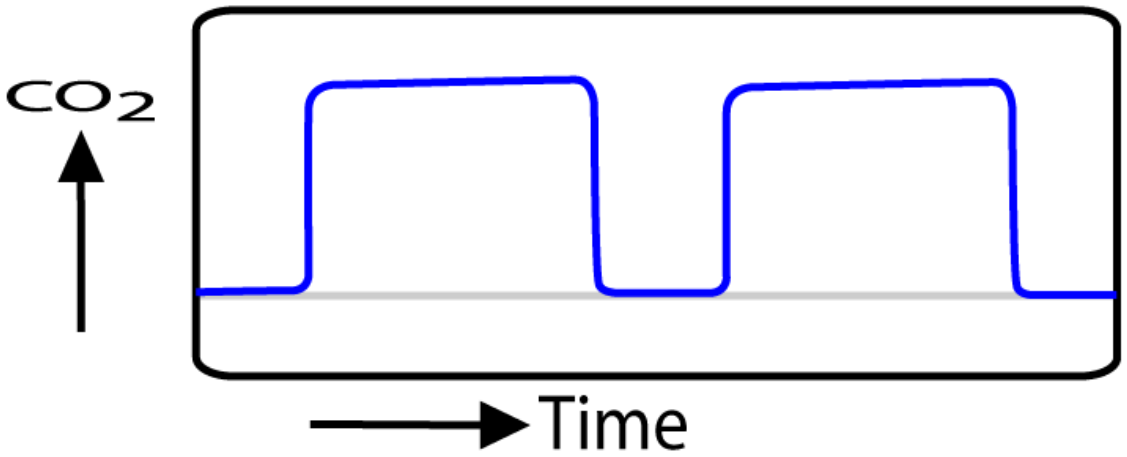
- Easy to connect
- No problems with sterilization
- Can be used in awake patients
- Easy to use when patient is in unusual positions such as in prone position
- Can be used in collaboration with simultaneous oxygen administration via a nasal prong

Disadvantages

- Delay in recording due to movement of gases from the ET to the unit Sampling tube obstruction
- Water vapor pressure changes affect CO_2 concentrations
- Pressure drop along the sampling tube affects CO_2 measurements

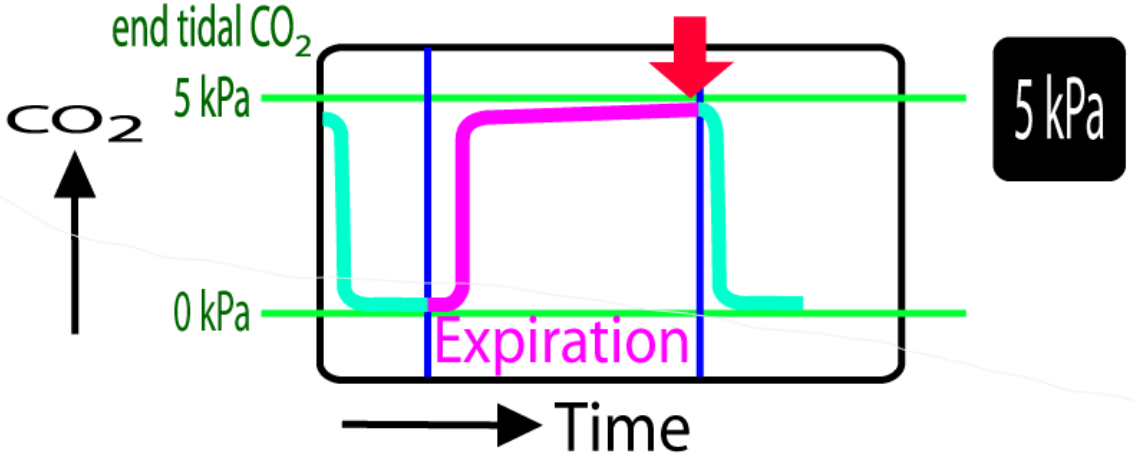
Waveform

- The capnograph is a trace of CO_2 levels over time.
- As the CO_2 levels at the sampling point fall and rise over time due to inspiration and expiration, you get a capnograph trace.



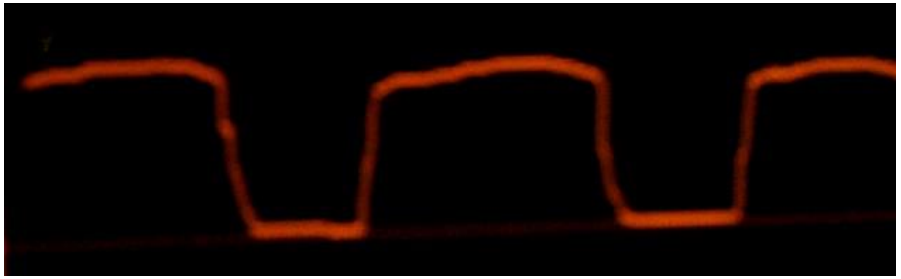
Monitor

- Monitor will show a capnograph waveform as well as $ETCO_2$
  - Waveform shows the amount of CO_2 in the patients breath
  - $ETCO_2$ is the measurement of CO_2 in the breath at the end of expiration

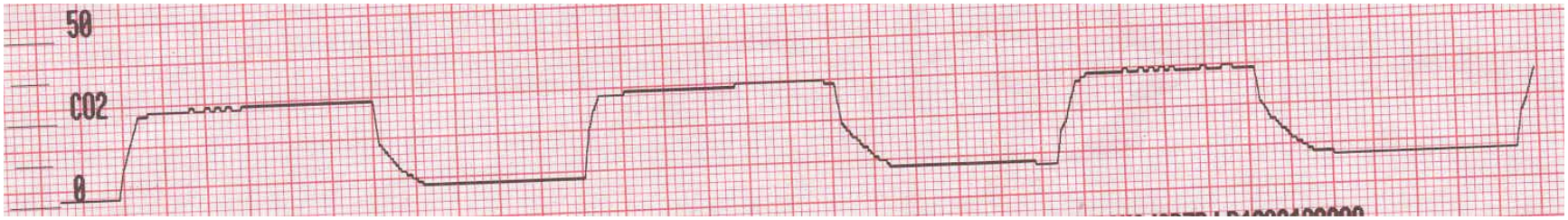


Waveform

- Monitor Screen
  - Compressed time

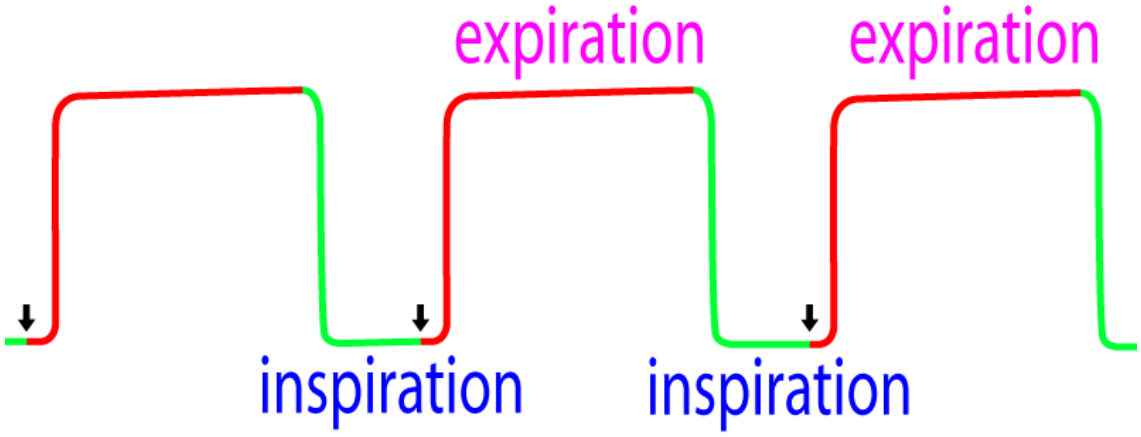


- Print
  - Waveform appears more drawn out, is in real time



Waveform

- The lines near the baseline represent inspiration and the higher lines represent expiration.
- In reality, expiration begins slightly at a different place to what has been shown to you before



Capnogram

- Phase I
  - Respiratory baseline
  - Flat
    - No CO_2 present
    - Corresponds with late inspiratory/early expiratory part of respiratory cycle
- Phase II
  - Respiratory upstroke
  - Mixture of dead space and alveolar gases
- Phase III
  - Respiratory plateau
  - Represents air from ventilated alveoli
  - Nearly constant CO_2 level
  - Highest point = $ETCO_2$
    - Recorded by capnometer
- Phase IV
  - Inspiratory phase
  - Sudden down stroke to baseline as atmospheric air is inspired

Abnormal Values

- Normal $ETCO_2$ = 35 – 45 mmHg
- $ETCO_2$ < 35 mmHg = Hyperventilation/Hypocapnia
- $ETCO_2$ > 45 mmHg = Hypoventilation/Hypercapnia

Caution: "An $ETCO_2$ reading without a waveform is like a heart rate without an ECG recording." – Bob Page "Riding the Waves"

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Clinical Uses of Capnography

Clinical Applications

- Confirmation of endotracheal tube placement
- Continuous monitoring of endotracheal tube placement
- Trend monitoring in nonintubated patients
- Evaluating effectiveness of CPR

Monitoring Ventilation

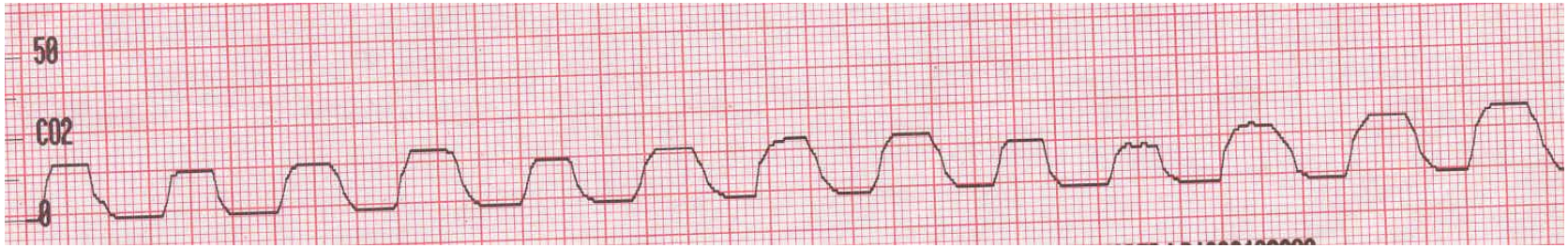
- Capnography monitors patient ventilation, providing a breath by breath trend of respirations and an early warning system of impending respiratory crisis
  - Hypoventilation
  - Hyperventilation

Monitoring Ventilation

- Hypoventilation
  - When a person hypoventilates, their CO_2 goes up.
  - Can be caused by altered mental status (OD, sedation, intoxication, postictal states, head trauma, or stroke, or by a tiring CHF patient)
  - Other reasons CO_2 may be high include Increased cardiac output with increased breathing, fever, sepsis, pain, severe difficulty breathing, depressed respirations, chronic hypercapnia

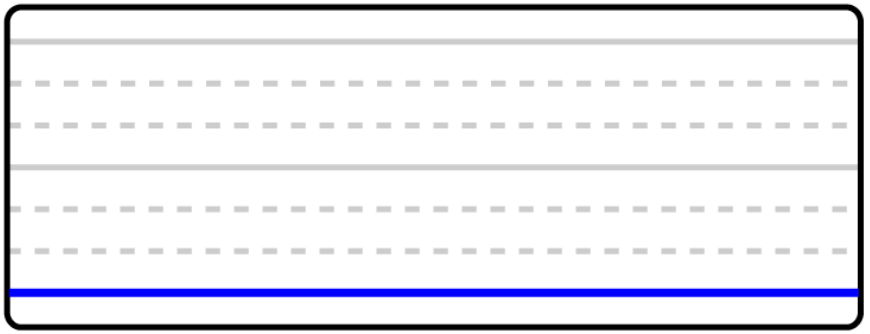
Monitoring Ventilation

- Hyperventilation
  - When a person hyperventilates, their CO_2 goes down.
  - Can be caused by many factors (Anxiety, bronchospasm, PE).
  - Other reasons $C0_2$ may be low include cardiac arrest, decreased cardiac output, hypotension, cold, severe pulmonary edema



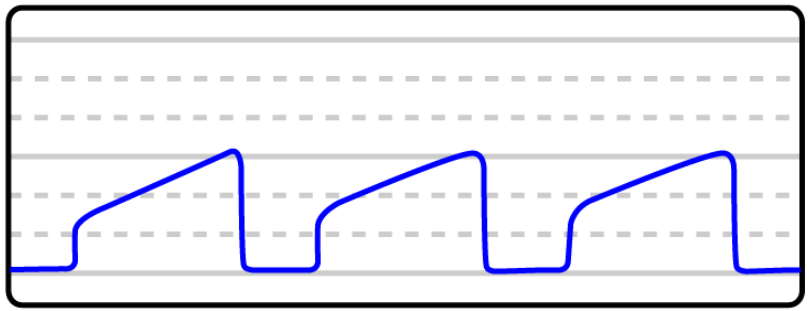
Straight Line

- Some possible reasons:
  - Capnograph is not connected
  - Esophageal intubation
  - Complete obstruction of:
    - Lungs (e.g. very severe bronchospasm leading to complete obstruction)
    - Airway (e.g. tracheal tube obstruction)
    - Capnograph sampling tubing
  - Respiratory arrest
  - Cardiac arrest



Sloping Expiratory Tracing

- "Shark Fin"
- Some possible reasons:
  - Partial obstruction of lungs (bronchospasm, COPD)
  - Partial obstruction of airway (e.g. tracheal tube secretions, kinking)



Deep Suction

Deep Suction

- Any suction performed past the oropharynx typically via ETT

Indications

Removal of endotracheal foreign bodies as demonstrated by fluid/obstruction visualized or increasing PiP

Equipment

- Suction Catheter (2 X ETT = size in Fr)
- Normal Saline
- Suction Unit (80-100mmHg)
- PPE

Procedure

- Pre-oxygenate
- Prepare equipment in sterile field
- NS (approx 5ml) can be instilled down ETT if thick secretions are present
- Insert catheter until pt. coughes, or resistance is met
- Apply suction and withdraw
- Procedure should last no more than 15 secs.

Complications

- Hypoxia
- Vagal Stimulation
- Infection
- Soft Tissue Injury (Carina, Main-stem Bronchus)

Summary

- Have proper equipment prepared
- Pre-oxygenate when possible
- Assess for side affects
- Keep procedure as sterile as possible