EMS Subspecialty Certification Review Course

1.1.2 Airway Compromise / Respiratory Failure

- 1.1.2.1 Devices for securing airway
- 1.1.2.2 Portable ventilator management
- 1.1.2.3 Pros and cons of drug-assisted intubation
- 1.1.2.4 Tracheotomy complications

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Learning Objectives

Upon the completion of this program participants will be able to:

- Describe basic categories of device to secure airway
- Provide initial ventilator settings for the uncomplicated patient
- Highlight pros and cons of drug-assisted intubation
- List 3 major tracheotomy complications

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Learning Objectives

Upon the completion of this program participants will be able to:

- Describe the airway methods used in EMS
- Describe the pros and cons of different airway methods
- Define the role of drug facilitated intubations
- Speak to the use of non-invasive ventilation
- Summarize the controversies in airway methods

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Portable ventilator settings for a patient with normal lung mechanics should target the following:

A. PaO2 > 100 mmHg
B. Peak inspiratory pressure < 35 cm H20
C. FiO2 100%
D. PaCO2 ≤ 35 mmHg

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In a patient with tracheostomy site bleeding:

A. Massive bleeding should be first managed by cuff hyperinflation
B. 10% of patients with tracheoinnominate artery fistula present with sentinel hemoptysis
C. Peak incidence is within the first 3 days postop
D. Patients s/p laryngectomy can be orally intubated

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Airway Compromise / Respiratory Failure

- Goals:
  - Recognize severity of disease
  - Provisional diagnosis to guide course of treatment

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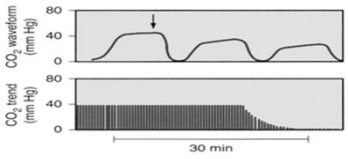
Assessment

- History
- General: Appearance, mental status, agitation/somnolence, diaphoresis, vital signs
- Dyspnea: Position, ability to speak, respiratory rate and depth, breath sounds, [heart rate], SpO2, ETCO2



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Differential Diagnosis

- Which organ system is causing dyspnea?
  - Pulmonary
  - Cardiac
  - Psychogenic
  - Infectious
- Management options
  - Target: adequate ventilation / gas exchange
  - Do no harm

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Specifics of 1.1.2.1. airway procedures and adjuncts are addressed in 1.4 Procedures

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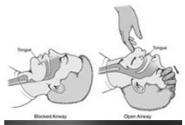
Establishing the Airway

- The most fundamental EMS skill
- Basic airway methods
  - Opening with head tilt/chin lift
  - Opening with jaw thrust method
- Basic adjuncts
  - Insertion of OPA and NPA
  - EMS personnel should use one of these devices during BVM ventilation



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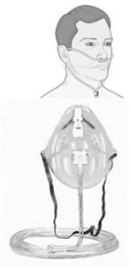
Oxygenation

- Devices: Nasal cannulae and masks
- Appropriate uses
  - Spontaneously breathing patients
  - Open airway
  - Intact protective reflexes
- NC: low flow 2-5 L/min = Fi02 20-40%
- Simple mask: 6-10 L/min = FiO2 40-60%
- NRB: 10-15 L/min = FiO2 >90%



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Oxygen: Indication

- Standard practice
  - Provide O_2 to all patients with actual or potential hypoxia
- Best to base O_2 supplementation on clinical findings
  - Beware of "treating the machine", i.e. SpO_2
- Tachypnea may precede hypoxia, hypercapnia and apnea

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Ventilation

- Bag Valve Mask (BVM)
  - Primary method for providing ventilation without invasive device
  - Key components
    - Self inflating bag
    - Oxygen reservoir
    - Conforming face mask
    - +/- PEEP valve
  - Primary indications
    - Hypoventilation
    - Apnea

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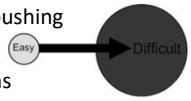
Bag-Valve-Mask (BVM) Ventilation

- Difficult to perform
- Two hands/"thumbs down"/two operators
- Lift the mandible into the mask vs pushing mask onto mandible



- Even more difficult in EMS situations
  - Moving ambulance
  - Prolonged resuscitation
  - Difficulty is a driver for invasive airway techniques
- Complications
  - Gastric insufflation/regurgitation/aspiration

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Demand Valve Ventilation
<u>Not widely used</u>

- Oxygen-powered
- Delivers high flow O2 through a mask via a trigger valve
- Rescuer can use both hands on mask and trigger ventilation with one finger
- Limitations
  - Potential barotrauma
  - No ability to gauge lung compliance

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Invasive Airway Management

- Placement of airway tube (either in trachea or obturating esophagus) to facilitate oxygen delivery and ventilation
- Indications
  - Hypoventilation or apnea
  - Potential for airway compromise

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1.1.2.1 Devices for securing airway

- Supraglottic airways
- Endotracheal intubation
- Cricothyrotomy

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Supraglottic Airway / Extraglottic Airway

aka "Alternate Airway"

- Invasive airway device to facilitate ventilation without endotracheal intubation
- Used as either a primary or backup airway
- Numerous options with varying level of evidence to support efficacy

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Supraglottic Airway / Extraglottic Airway

aka "Alternate Airway"

- Characteristics:
  - Blind insertion
  - Goal is NOT to place in trachea (some can function in this position also)
  - Skill acquisition and retention generally easier than endotracheal intubation
  - Broader range of providers may use – many are within scope for EMT and advanced

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Supraglottic Airway / Extraglottic Airway

aka "Alternate Airway"

- Some types of supraglottic airway
  - King
  - iGel
  - LMA
  - SALT
  - Combitube
- Some have inflatable component(s) to seat the device and seal off esophagus to limit aspiration

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Esophageal Tracheal Combitube

- Double lumen tube
  - Distal and proximal balloons
- Blind insertion
- Usual placement is esophageal
  - Longer blue tube delivers air to trachea via perforations in the tube
- If tracheal placement:
  - Ventilate through shorter white tube

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King Laryngeal Tube (LT)

- Resembles an ETC but has only one lumen
- Single port inflates both balloons simultaneously
- Strengths
  - Simple
  - More consistent esophageal placement
  - More compact

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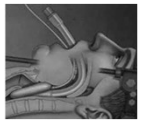
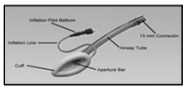
Laryngeal Mask Airway (LMA)

- Blind insertion
- Surrounds laryngeal structures and seals with a surrounding cuff
- Widely used in the operating room
- Slow (but increasing) prehospital adoption due to concerns about airway protection and concerns about dislodgement





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Endotracheal Intubation

- Oral ETI most common method

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Nasotracheal Intubation

- Requires intact respiratory drive
  - Option for awake intubation
  - Can be used with intact gag reflex
  - Potential when patient access limited or patient cannot lie down (e.g. crash victim still in vehicle)
- Blind technique, can be difficult
- Adverse events:
  - Nasal hemorrhage, cribriform plate injury, sinusitis
- Adjuncts:
  - Endotrol tube
  - Beck airflow monitor

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Other Intubation Techniques

- Gum elastic bougie (aka Eschmann stylet)
- Video laryngoscopy
- Digital Intubation
- Lighted stylet
- Retrograde intubation

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Other techniques

- Nasotracheal intubation is significantly less prevalent in EMS in recent years
- Apneic oxygenation – use of continuous high flow nasal oxygen during intubation
- Use of magills for foreign body removal

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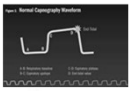
Confirmation of Airway Placement

- Confirmation and re-confirmation is crucial in EMS
- Waveform EtCO2 now considered standard of care
- Previously recommended using multiple methods
  - Auscultation
  - EDD (bulb)/Syringe
- Recheck with every patient movement and prior to handoff at hospital



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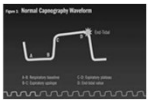
End-Tidal CO_2 and ETI

- Colorimetric
- Digital
- ***Waveform***
  - Most accurate and best device for prehospital use
  - Allows for continuous verification
  - Graphically displayed
- **Effectively, continuous waveform capnography has become standard for verification and monitoring of endotracheal tube placement**



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Securing the Airway

- High risk of tube dislodgement in field
- Methods
  - Adhesive tape wrapped around neck (Lillehei method)
  - Umbilical twill tape
  - IV or O2 tubing
  - Commercial tube holders
- Supraglottic airways must be secured using tape or commercial holder (Carlson and Wang PEC 2009)
- Manually holding tube strongly discouraged
- Consider C-Collar

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Special Considerations
Trauma Intubation

- Must perform ETI with manual inline cervical stabilization
  - Limits head extension and glottic exposure
- Some experts question value of manual stabilization
- Some studies have shown increased mortality in intubation in penetrating trauma patients

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Special Considerations
Pediatric Intubation

- Larynx more <u>superior</u> and <u>anterior</u>
  - More difficult laryngoscopic technique
- ET Tube Size
  - 4 + [Age (years) ÷ 4]
- ET Tube Depth (cm)
  - [Age ÷ 2] + 12

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Drug Facilitated Intubation (DFI)/DAAM

- "Use of IV sedative and/or neuromuscular blocking agents to facilitate ETI in patients with intact protective airway reflexes"
- Includes:
  - RSI (rapid sequence intubation/induction)
  - DSI, RSA, SAI

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NAEMSP Airway Compendium

- Position Statements on:
  - Mechanical Ventilation
  - Trauma Airways
  - Cardiac Arrest
  - Novel Techniques
  - Optimizing Physiology
  - Training & Education
  - Pediatric Respiratory Distress
  - DAAM
  - SGA
  - Manual Ventilation (BVM)
  - QI
  - Surgical Airways

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Rapid Sequence Intubation (RSI)

- Indication: Need for emergency airway and ventilatory control in patient with intact protective airway reflexes
- Goals
  - Rapid ETI with optimal exposure
  - Minimal disruption of physiology
    - HR, BP, ICP
- Basic drugs: sedative + paralytic agent

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RSI Technique

- IV/IO Access
- Position Patient
- Pre-oxygenate
- Rapid administration of pharmacological agents
- Laryngoscopy and intubation
- Verification and re-verification of placement
- Provision of ongoing sedation and paralysis

- Pediatric protocols may be different
  - Succinylcholine more controversial
  - Use of atropine

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RSI Drugs

- Sedatives
  - Etomidate 0.3 mg/kg IV
  - Midazolam 0.1 mg/kg IV
- Neuromuscular Blockade (Paralytics)
  - Succinylcholine 1-2 mg/kg IV
  - Rocuronium 0.6 mg/kg IV
  - Vecuronium 0.1 mg/mg IV

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RSI Drugs

- Pediatric protocols may differ
  - Less use of succinylcholine
  - Use of atropine to prevent bradycardia

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RSI Additional Considerations

- Complete abolition of airway reflexes and ventilatory drive
- Airway skills must be superior
- Alternate/rescue airway must be readily available
- May require enhanced airway training

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Sedation Assisted ETI
Controversial Practice

- Sedation-only without paralytic
  - Ketamine or Etomidate
- "Traditionally" felt to be safer BUT
- Controversial
  - Less optimal intubating conditions
  - Same physiologic risk as RSI
  - Same training requirements as RSI

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NIPPV: See Resp Module 1.3

- CPAP and BiPAP
- Used for acute respiratory distress WITH
  - Intact ventilatory drive
  - Protective reflexes
  - Intact mental status
- Indications:
  - Pulmonary edema and CHF
  - Other – Asthma, COPD, pneumonia

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Noninvasive Ventilation (NIPPV)
CPAP & BIPAP

- High-pressure ventilatory pressure support through tight face mask
- CPAP: continuous positive pressure through both inspiration and exhalation
- BiPAP: separate pressures for both inspiration and expiration
- Many portable and disposable CPAP systems available now for a reasonable cost

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Noninvasive Ventilation (NIPPV)
CPAP & BIPAP

- Physiologic effects
- Reduces work of breathing
- Increases intrathoracic pressure
- Reduces preload and afterload
- Does not “blow water out of lungs”

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1.1.2.2 Portable ventilator management

- Guide by using waveform capnography
- Pressure-cycle
  - Pressure support
- Volume-cycle
  - Continuous mechanical
  - Assist-control
  - Synchronized intermittent mandatory ventilation (SIMV)

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1.1.2.2 Portable ventilator management

Parameters	Initial settings
Mode	Assist control
FiO2	100%
Tidal volume	10 ml/kg
Respiratory rate	12 / min
Inspiratory flow	60 L/min
Inspiratory:Expiratory ratio	1 : 2
PEEP	5 cm H2O

Ventilation goals	
PaO2	60-90 mm Hg
PaCO2	40 mm Hg
pH	7.35-7.45
FiO2	40-60%
Peak insp pressure	< 35 cm H2O

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1.1.2.2 Portable ventilator management

- Pros
  - Frees provider for other tasks
  - Consistency in rate, volume, pressure
- Cons
  - Cost
  - Complexity
  - No ability to rapidly assess changes in compliance

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Airway Controversies

- Does prehospital intubation improve survival?
  - Prehospital ETI has not been shown to provide a survival benefit
  - Gauche RCT: BVM vs. [ETI or BVM], no improvement in survival or neuro outcome in children
  - Davis: Worse outcome with RSI of TBI
  - (Other data in TBI lecture)

  -PART, AIRWAYS-2, CAAM

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Airway Controversies

- Adverse events associated with EMS ETI
  - ~44% peri-intubation hypoxia
  - ~10% peri-intubation hypotension
  - ~2% peri-intubation cardiac arrest
  - Inadvertent hyperventilation is common
  - Unrecognized Failed Airways with ETI & SGA

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Airway Controversies

- Difficult to acquire and retain ETI skill
  - ETI complex and difficult
  - National shortage in operating room training opportunities for EMT ETI training
  - Decreasing opportunities for ETI in field
  - Skill dilution

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Airway Controversies

- BLS ETI?
  - Optional module in national EMT-Basic curriculum
  - Ability of EMT-Basic to attain and maintain ETI skill unclear
  - 2 Studies: Suboptimal ETI success (<50%) make it unlikely to see broad application.
- "Alternate airways" as primary airway device?
  - Strategy to improve CPR continuity

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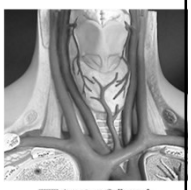
1.1.2.4 Tracheotomy complications

- Tube obstruction
- Stenosis
- Tracheocutaneous fistula
- Bleeding: thyroid vessels, tracheoinnominate artery, granulation tissue
- Post-Tracheostomy bleeding may be controllable by hyperinflation of cuff



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Portable ventilator settings for a patient with normal lung mechanics should target the following:

a. $PaO_2 > 100$ mmHg
b. Peak inspiratory pressure < 35 cm H20
c. FiO_2 100%
d. $PaCO_2 \leq 35$ mmHg

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In a patient with tracheostomy site bleeding:

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b. 10% of patients with tracheoinnominate artery fistula present with sentinel hemoptysis
c. Peak incidence is within the first 3 days postop
d. Patients s/p laryngectomy can be orally intubated

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Take-Home Points

- Airway management is an essential EMS skill
- Many techniques, approaches and considerations for quality EMS airway management
- Must use multiple methods for tube confirmation
- Drug-facilitated intubation presents unique requirements and challenges
- Alternate airways provide additional airway options with less skill retention issues
- Airway skill attainment and maintenance are challenges
- Many unanswered questions in airway management

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