Chapter 20
Pharmacology–Assisted Intubation

Learning Objectives

- Differentiate goals of rapid sequence induction from rapid sequence intubation
- List six questions to ask when preparing for rapid sequence intubation
- List three goals of rapid sequence intubation

Learning Objectives

- Discuss depolarizing paralytics used in rapid sequence intubation:
  - Succinylcholine (Anectine)
  - Atropine sulfate
Learning Objectives

- Discuss nondepolarizing paralytics used in rapid sequence intubation:
  - Vecuronium (Norcuron)
  - Rocuronium (Zemuron)
  - Atracurium (Tracrium)
  - Pancuronium (Pavulon)

- Discuss deep sedation medications used in rapid sequence intubation:
  - Midazolam (Versed)
  - Etomidate (Amidate)
  - Ketamine (Ketalar)
  - Flumazenil (Romazicon)

- List seven Ps of rapid sequence intubation technique

Introduction

- Endotracheal (ET) intubation is valuable tool
- Rapid sequence intubation (RSI)
  - Key components of technique
    - IV barbiturate
    - Muscular paralytic drugs
  - Goal: patient safely intubated
- Rapid sequence (RS) induction
  - Goal: patient is safely anesthetized
Introduction

- Poorer outcomes for patients with head injuries
  - Possible hyperventilation
    * Severely lowers CO₂ pressures, which constrict brain blood vessels and impair O₂ delivery
    * Prolonged hypoxia during intubation attempts
  - Can be minimized by:
    * Limiting duration of intubation attempts
    * Monitoring pulse oximetry during and after intubation
    * Using end-tidal CO₂ monitoring to guide ventilation rate and volume

RSI Goals

- When performed correctly, patient is:
  - Chemically paralyzed
  - Deeply sedated or anesthetized
  - Endotracheally intubated
RSI Goals

- Medications used allow paramedic to assume control of airway
  - Must ask:
    - If I administer these drugs, will I be able to intubate the patient if he stops breathing?
    - If I am unable to intubate, will I be able to ventilate him?
    - If I am unable to intubate, do I have other options?

RSI Goals

- Medications used allow paramedic to assume control of airway
  - Must ask:
    - Do I have the right equipment on hand? Is the equipment assembled?
    - Does the patient have any medical problems or conditions for which these drugs and techniques are contraindicated?
    - If I do not act, will this patient die or have permanent brain damage?

RSI Goals

- RSI goals:
  - To overcome barriers to intubation by establishing deep sedation and skeletal muscle relaxation while protecting against aspiration of stomach contents into the lungs
  - To provide protection against body’s normal response to intubation, reflexes that can potentially cause cardiac or neurologic deterioration in at-risk patients
  - To provide humane conditions for unpleasant procedure
RSI Goals

- Need for cervical immobilization imparts more limited laryngeal view compared with cases in which neck immobilization is not necessary
  - Sellick maneuver
  - Displace jaw anteriorly can improve visualization

- Sellick maneuver

- Displace jaw anteriorly can improve visualization

RSI Goals

- Look for anatomic problems that could interfere with ability to apply bag-mask device

- Must have rescue airway, such as dual-lumen device
  - Esophageal Combitube double-lumen airway tube is only specific device for difficult airways
  - Translaryngeal catheter ventilation can temporarily deliver O2 if unable to intubate

RSI Goals

- Before administration, ensure proper equipment:
  - Functional line
  - Functional laryngoscope
  - Appropriate sizes of ET tubes
  - Reliable pulse oximeter reading
  - Bag-mask with resuscitation bag attached to ample supply of O2
  - End-tidal CO2 monitor

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**RSI Goals**

- Before giving any medications, look for medical identification jewelry
- Consider whether benefits of proceeding outweigh risks of attempting it

**RSI Pharmacology**

- Chemical paralysis
  - For voluntary skeletal contracture, nerve impulse is generated to brain cells, transmitted to neuron in the spinal canal, then transmitted to nerve that directly communicates with the muscle
  - At each junction between neurons, "hand off" occurs by neurotransmitters being released on one side of the synapse
    - Diffuses across to other side
    - Initiates electrochemical impulse along the nerve

**RSI Pharmacology**

- Chemical paralysis
  - End of nerve fiber comes into close contact with muscle cell that has receptors for neurotransmitter sent by the nerve cell
    - Neuromuscular junction is between nerve and muscle cell
    - Nerve side is presynaptic membrane
    - Muscle side is postsynaptic membrane
    - Space in between is synaptic cleft
    - Acetylcholine is the chemical transmitter
RSI Pharmacology

- Chemical paralysis
  - Electrochemical signal reaches presynaptic membrane of neuromuscular junction
    - Acetylcholine is released from storage sites at end of nerve cell axon and crosses synaptic cleft to bind to receptors on postsynaptic side
    - Once acetylcholine binds to postsynaptic membrane at special receptors binding sites, specific acetylcholine receptors are unlocked and opened

- Muscle cells contracting in synchrony lead to coordinated muscle contraction
- After acetylcholine binds to its receptor site on postsynaptic membrane, ion flow continues until acetylcholine molecule disengages
- Atropine is used to treat nerve gas toxicity

RSI Pharmacology

- Paralytic drugs
  - Depolarizing paralytics
    - Succinylcholine (SUX) is the only one
      - Two molecules of acetylcholine attached head-to-head
      - Binds at same receptor as acetylcholine
      - Ion gates remain open
      - Muscle cell cannot reestablish its electrical potential and cannot generate further contractions
      - Acts to depolarize muscle cell membrane and prevent repolarization
      - Rapid onset of paralysis
      - Short effective duration of 5 min
RSI Pharmacology

♥ Paralytic drugs
  ➢ Depolarizing paralytics
    • Succinylcholine side effects:
      ➢ Release potassium in blood, can lead to sudden cardiac arrest from arrhythmia
      ➢ Susceptible patients include major burns, neuromuscular disease, myopathic disease, kidney dialysis or failure, crush injuries
      ➢ Malignant hyperthermia

♥ Paralytic drugs
  ➢ Depolarizing paralytics
    • Succinylcholine side effects:
      ➢ Intragastric pressure
      ➢ Increased ocular pressure
      ➢ Increased ICP
      ➢ Masseter spasm
      ➢ Severe bradycardia in children

♥ Paralytic drugs
  ➢ Nondepolarizing paralytics
    • Act to bind preferentially to acetylcholine receptor site
    • Prevents binding of acetylcholine and ion flow into the cell
    • Prevents muscle contraction
    • Mivacurium (Mivacron)
      ➢ Not available in the United States
    • Rocuronium (Zemuron)
      ➢ Rapid onset and short duration of 15 to 30 min
RSI Pharmacology

- Paralytic drugs
  - Nondepolarizing paralytics
    - Vecuronium (Norcuron)
      - Reliable combination of rapid onset, intermediate duration, and reasonable cost
      - Intermediate-acting
      - Induces muscle paralysis by blocking receptors for acetylcholine
      - Prevents muscle contraction
    - No negative effects on cardiovascular function
    - Does not lower BP or affect heart rate
    - Primarily metabolized by the liver; has increased duration in patients with liver disease
    - Onset of action is slower than SUX and duration of action is significantly longer
    - Typically used to maintain neuromuscular paralysis after patient has been intubated with SUX
  - Atracurium (Tracrium)
  - Pancuronium (Pavulon)
    - Long-acting agent
RSI Pharmacology

- Paralytic drugs
  - Must preoxygenate patient
    - Nonrebreather mask at 100% O₂ concentration for 5 min before RSI
    - If patient is able to cooperate, he or she can take four maximal tidal breaths while breathing 100% O₂
    - Can sustain up to 6 min of complete apnea without O₂ saturation dropping below 90%

RSI Pharmacology

- Paralytic drugs
  - Methods for decreasing onset time for vecuronium
    - Priming
      - Administering 1/10 of paralyzing dose 2 to 3 min before administration of full dose initiates blockade of some of the receptors
      - Shortens time of onset by 1 to 1.5 min

RSI Pharmacology

- Paralytic drugs
  - Methods for decreasing onset time for vecuronium
    - Increase paralyzing dose
      - Can extend effective paralysis 90+ min
      - Increases patient vulnerability if intubation was unsuccessful
RSI Pharmacology

- Paralytic drugs
  - Methods for decreasing onset time for vecuronium
    - Timing
      - Sedating agent is withheld until paralysis is about to take effect
      - Sedating agent takes effect as paralysis ensues
      - Maximal sedation is achieved at same time as maximal paralysis
      - Difficult to use in prehospital environment

RSI Pharmacology

- Deep sedation drugs
  - When used with paralytics, improves intubation success rate
  - Protects brain and heart from dangerous fluctuations in BP and heart rate
  - Prevents patient from being paralyzed while awake

RSI Pharmacology

- Deep sedation drugs
  - Midazolam (Versed)
    - Benzodiazepine
    - Anticonvulsant properties
    - Sedative properties
    - Ability to induce amnesia for events after administration
    - Causes slight decrease in ICP
    - Does not blunt increase in pressure that results from laryngoscopy or intubation
Deep sedation drugs

- **Midazolam (Versed)**
  - Causes decrease in vascular resistance from vascular smooth muscle relaxation
  - Should be used cautiously in patients with multiple trauma
  - Has no analgesic effects
  - Can cause respiratory depression
  - Advocated as a single agent to facilitate intubation in patients with barriers to intubation
  - Possible underdose due to concerns for hypotension

- **Flumazenil (Romazicon)**
  - Reverses effects of midazolam
  - Use with caution in people who regularly take benzodiazepines
    - Can produce withdrawal seizures and complicate airway

- **Etomidate**
  - Not related to benzodiazepines, narcotics, or barbiturates
  - Rapid onset of 30 sec
  - Short duration of 3 to 5 min
  - Minimal effects on the heart and blood vessels
  - Lowers ICP and preserves cerebral and heart perfusion
  - Does not cause hypotension or worsen shock states
Deep sedation drugs

- Etomidate
  - Agent of choice for multiple trauma
  - Be prepared to resectate or administer longer-acting sedation after successful intubation
  - Causes burning pain on injection
  - Dose-related suppression of adrenal function

- Ketamine
  - Dissociative anesthetic
  - Induces intense sedation, analgesia, and amnesia
  - Protective airway reflexes are preserved
  - No significant respiratory depression
  - Apnea is rare
  - Causes modest increase in BP and heart rate
  - Can increase myocardial O₂ demands
  - Should not be used in patients with acute coronary syndromes or MI
  - Offers protection against arrhythmias precipitated by epinephrine
  - Works well in patients with hypovolemia
  - Potent bronchodilator
  - Causes rise in ICP, should not be used if potential for increased ICP exists
  - Has excellent safety record
Deep sedation drugs

- Ketamine
  - Onset is less than 1 min
  - Duration is 15 to 20 min
  - Can be given IM
    - Onset delayed to 3 to 5 min
    - Duration is 1 hour

Adverse side effects:
- Laryngospasm
- Increased bronchial secretions
- Dysphoric emergence from sedation

Preparations (time greater than or equal to 5 min)

- Patient is attached to pulse oximeter, ECG monitor, and end-tidal CO₂ monitor
- Medications are chosen after considering patient condition and contraindications
- Intubation and suction equipment are readied
  - Combitube
  - Manual jet ventilator
- Ensure O₂ is connected and flowing at maximal rate
- PPE
RSI Procedure

- **Preoxygenation (time = t-5 min)**
  - Patient is placed on tight-fitting 100% nonrebreather face mask for 5 min
  - Attempt to wash out any excess nitrogen from pulmonary alveoli
    - Provides reservoir of O₂ to enable tolerance of apneic period
    - Avoid ventilating with positive pressure unless O₂ saturation less than 95%
    - If patient is alert, coach him to take eight maximal breaths

RSI Procedure

- **Pretreatment/priming (time = t-3 min)**
  - If using succinylcholine, administer 1/10 of paralyzing dose
  - Ensure equipment is ready in event of premature paralysis
  - Consider pretreatment with lidocaine
  - Manipulation of the larynx causes both reflex elevation of ICP and secretion of catecholamines
    - Can cause decreased blood flow to the brain and increased stress on cardiac O₂ consumption

RSI Procedure

- **Paralytic/sedation (time = t-1 min)**
  - Administer sedation agent followed immediately by paralytic agent
  - Allow for adequate relaxation before attempting to intubate
  - In some cases, you can administer sedation, maintain spontaneous breathing, assess ability to visualize laryngeal opening, then follow with full paralysis and intubation
RSI Procedure

- Protection (time = t-1 min)
  - From point of sedation and paralytic agent administration until ET position is confirmed, apply Sellick maneuver

RSI Procedure

- Pass the tube (time = 0)
- Prove it (time = t+)
  - Confirm tube position
  - End-tidal CO₂ detectors
  - Esophageal detector devices
  - Clinical assessment

Questions?