Frequently used Pharmacological Agents in Ventilated Patients: Sedatives, Analgesics, and Paralytics

CRC 335
Cardiorespiratory Care
University of South Alabama
Discussion Points

- Patient-ventilator dyssynchrony
- Respiratory reserve and weaning
- Sedatives
- Analgesics
- Paralytics (NRBMs)
Patient-Ventilator Dyssynchrony

“Fighting or bucking the ventilator”

Inspiration and expiration “out-of-sync”
  – Patient may develop respiratory alkalosis
    (acute ventilatory insufficiency)

Common causes: hypoxia, inadequate ventilation (f, VT, inspiratory flow, pressure support), pain, neurological

Do not use drugs to “treat” dyssynchrony
Fig. 45. Waveforms from a normal subject ventilated with pressure-regulated volume control on a Servo 300A ventilator. The subject’s expiratory effort begins just prior to the end of the mechanical inspiratory time, which causes pressure spikes (arrows). Also note the small inspiratory zero flow plateau at the end of the inspiratory flow waveform, which indicates that flow into the lung has stopped just prior to mechanical expiration. In pressure-controlled modes the inspiratory time is set on the ventilator, and in this instance the ventilator inspiratory time setting needs to be reduced slightly.
- Insufficient flow at 30 L/min
- Ineffective triggering
- Increase flow to 90 L/min
- Increased expiratory time and improved triggering
Respiratory Reserve and Weaning

Patient-ventilator dyssynchrony
- Increased work of breathing
- Increased metabolism
- Increased respiratory muscle fatigue
- Deteriorating blood gases
- Reduced respiratory reserve
- Delayed healing and weaning
Pharmacological agents

Uses in respiratory care

- Apply uncomfortable procedures (e.g., intubation, inversed ratio PCV)
- Manage uncorrected patient-ventilator dyssynchrony
- Reduce work of breathing
- Reduce oxygenation & ventilation requirement
Pharmacological agents

These agents

- Affect respiratory mechanics
  - MIP, RSBI, VC, f, VT
  - Coordinate measurement of respiratory mechanics with drug administration

- Delay weaning attempts
Sedatives and analgesics

Indications
- Treat anxiety and agitation (anxiolytic)
- Prevent or minimize sleep deprivation
- Facilitate HFV, IRV, and permissive hypercapnia
Levels of sedation

- **Minimal:** responds to verbal commands, no ventilatory or cardiovascular effect
- **Moderate, or conscious sedation:** responds to verbal command, but may need tactile stimulus; No effect on spontaneous ventilation or cardiovascular function
- **Deep sedation:** patient responds to painful stimulus; spontaneous ventilation and airway patency may be inadequate; CV function unaffected
- **Anesthesia:** general anesthesia; patient cannot be aroused, ventilation usually required, CV function may be impaired
Monitoring the need for sedation and analgesia

Ramsay scale: 2-4 indicates adequate sedation; no guidance on selection of sedative and is subjective

- score 1: awake, agitated, anxious and restless
- score 2: awake, cooperative, oriented, tranquil
- score 3: semi-asleep, responds to verbal commands
- score 4: asleep, brisk response to light glabellar or loud noise
- score 5: asleep, sluggish response to light glabellar tap or loud noise
- score 6: asleep, no response to light glabellar tap or loud noise
Benzodiazepines

- Drugs of choice for anxiety; anxiolytic, hypnotic, muscle relaxation, anti-convulsant, anterograde amnesic
- CNS depressant
- Accomplished when the drug binds to the gamma-aminobutyric acid (GABA) receptor complex on neurons in the brain
- Minimal CV effect, do not adversely affect the respiratory system
- Reversed in overdose by flumazenil (Romazicon)
Benzodiazepines

- Diazepam (Valium): not for continuous infusion, given in boluses

- Lorazepam (Ativan): most potent for sedation of mechanically ventilated patients, recommended by SCCM
Midazolam (Versed)

- commonly used for conscious sedation, ($35 / 5-mg vial)
  - Reduces cerebral perfusion pressure
  - cardioversion
  - bronchoscopy
Neuroleptics

- Indicated for extreme agitation and delirium, ICU psychosis
- Haloperidol (Haldol)
  - CNS depression, cardiac dysrhythmias
  - given IV
Anesthetic

Propofol (Diprivan)
- IV general anesthetic; sedative, amnesic, and hypnotic
- bolus, f/b continuous infusion
- decreases SVR, BP, HR during induction
- decreases ICP and CBF; used following TBI
- rapid onset, short duration; patient awakens immediately
- Extubation can be facilitated
Opiates

- Relieve pain, sedation, anxiolytic
- Act on mu (analgesia) and kappa (sedative) receptors
- Side effects
  - nausea, vomiting, reduced GI motility
  - respiratory depression
  - bradycardia and hypotension
  - myoclonus, convulsions
  - histamine release, immunosuppression
  - physical dependence
Opiates

- Reversed in overdose with naloxone (Narcan)

- Morphine
  - preferred agent for intermittent therapy
  - decreased $V_E$, may cause periodic breathing and apnea, hypotension (due to vasodilation)
Fentanyl (Sublimaze)

- 100-150 times more potent than morphine
- loading dose, f/b infusion
- preferred for patients with hemodynamic instability
Paralytics (Neuromuscular Blocking Agents, NMBAs)

Indications

- Patient-ventilator dyssynchrony that cannot be corrected
- Facilitation of less-conventional modes of ventilation (IRV, HFO, permissive hypercapnia)
- Facilitation of intubation
- Dynamic hyperinflation that cannot be corrected
- Adjunctive in elevated ICP
- Reduction of oxygen consumption and carbon dioxide production
Monitoring Neuromuscular Blockade

Train of four monitoring electrodes are placed on the skin near a nerve path (close to the hand)

- 4 electrical impulses applied over 2 seconds
- 1-2 twitches in 5 sec = 80% to 90% blockade
- 3 or 4 twitches in 5 sec indicates that more NMBA is needed
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Depolarizing agent

Succinylcholine (Anectine)

- Causes paralysis by binding to acetylcholine receptors and prolonged depolarization of the motor end-plate
- Short-acting (5-10 minutes)
- IV for intubation
- Onset 30-60 sec.
Depolarizing agent

Succinylcholine (Anectine)
- Used in rapid sequence intubation (ER, ICU, floor)
- Must be used with a sedative
- Analgesic is optional for pain
Nondepolarizing agents

- Pancuronium, vecuronium, atracurium, cisatracurium, doxacurium
- Bind to acetylcholine receptors and cause paralysis by competitively inhibiting the action of acetylcholine at the neuromuscular junction
- Do not relieve anxiety or pain
- Must be used with a sedative (and analgesic if indicated)
Pancuronium bromide (Pavulon)

- IV bolus
- May cause prolonged paralysis in patients with liver or kidney disease
- Known for it’s CV side-effects and is not recommended for patients with unstable hemodynamics
- Onset of action 2-3 minutes
- Duration of action 60-90 minutes
Non ICU use of Pavulon
Vecuronium (Norcuron)

- Duration of action 25-40 minutes
- Onset of action 2-3 minutes
Doxacurium (Neuromax)

- Onset of action 6 minutes
- Duration of action 100 minutes