Analgesia, Sedation, and Paralysis

Paralytics

Agent	Onset	Duration	Dose	Notes
Cisatracurium	1-3 min	25-44 min	IV: 0.2 mg/kg/dose or infusion	Undergoes nonenzymatic degradation in circulation, thus duration of action remains same in patients w/ liver/renal dysfxn
Succinylcholine	30-60 sec	5-10 min	IV: 1 mg/kg/dose	Depolarizing NMB (patient will fasciculate). Can cause bradycardia. Contraindicated in presence of hyperkalemia, major trauma/ burns, rhabdomyolysis

Ventilation

Non-invasive Positive Pressure Ventilation

Interface	Nasal mask, facemask, RAM nasal cannula depending on patient. Consult w/ RT at both BCH and BMC to evaluate patient early for best interface for NIPPV.
Continuous Positive Airway Pressure (CPAP)	• Provides continuous airway pressure (PEEP). No “breaths” delivered, patient MUST be spontaneously breathing • Indications include: hypoxic respiratory failure, obstructive sleep apnea, upper airway obstruction • Mechanism: Alveolar recruitment improved, which improves oxygenation through better V/Q matching • FiO2 can be adjusted to improve oxygenation as well
Bilevel Positive Airway Pressure (BiPAP)	• Provide inspiratory pressure (IPAP), compared to PIP, and expiratory pressure (EPAP), compared to PEEP • Indications include: hypoxic, hypercarbic or mixed respiratory failure • Mechanism: in addition to alveolar recruitment, delta pressure (IPAP - EPAP) influences tidal volume to improve ventilation (Minute Ventilation = Tidal Volume x Respiratory Rate); IPAP can also reduce work of breathing • In addition to adjusting IPAP and EPAP, you can adjust FiO2 to improve oxygenation • Although you can set a mandatory breath rate in certain BiPAP modes, machine breaths that are not aligned w/ patient efforts do not result in good tidal volumes due to the noninvasive interface - not a good choice for patients w/ inconsistent respiratory drive. Not a good choice for patients w/ altered mental status or who cannot protect their airway (ie. no cough or gag) from aspiration.

Mechanical Ventilation

MBR	Mandatory breath rate: number of breaths the ventilator will deliver to patient per minute (or ensure patient receives breath if patient not triggering the ventilator)
RR	MBR plus whatever spontaneous breaths the patient takes (breaths above MBR may or may not be supported depending on mode)
PIP	Peak inspiratory pressure: highest pressure the patient will see during the respiratory cycle
PEEP	Positive end expiratory pressure: pressure the lungs see during expiration (helps keep the alveoli open during expiration and prevent collapse)
TV	Tidal Volume: maximum volume delivered to the patient during inspiration
IT	Inspiratory time: time over which tidal volume is delivered

Ventilation continued on next page →

Ventilation

Mechanical Ventilation

ET	Expiratory time: time over which exhalation occurs, generally longer than IT (basically what is left over after you have a certain number of breaths per minute w/ a certain Ti)
MAP	Mean-airway pressure: (Ti x PIP) + (Te x PEEP) / (Ti + Te)

Modes of Ventilation

1. AC (assist-control)	• Every breath is machine supported and has the same parameters (PIP, PEEP, Ti), whether patient-triggered or machine-triggered • Breaths can be triggered by patient (assisted breaths) or elapsed time if patient not able to trigger (controlled breaths) • Risk of overventilation if patient's spontaneous respiratory rate is high for other reasons (fever, agitation) or if ventilator is inappropriately triggering • Can set to pressure control or volume control
2. SIMV (Synchronized Intermittent Mandatory Ventilation)	• Machine will synchronize breath delivery to align w/ patient's effort, but if patient is not triggering breaths frequently enough, machine provides mandatory breath rate to patient • Often paired w/ pressure support ventilation (SIMV + PSV) to support breaths above mandatory breath rate • Can set to pressure control or volume control • Pressure Control: set pressure, tidal volume changes based on compliance ($\Delta V/\Delta P$) • Volume Control: set volume, pressure changes
3. Pressure Regulated Volume Control (PRVC)	• Ventilator adjusts pressure depending on exhaled tidal volume every 3rd breath • Optimizes lowest pressure possible to achieve set tidal volume by constant adjustments
4. Pressure Support	• No mandatory breath rate, no inspiratory time set • When patient triggers a breath, machine delivers a set level of pressure above PEEP • Inspiratory time of breath determined by patient-driven inspiratory flow (flow cycling) - if patient is "satisfied" stops inhaling then the ventilator will stop inspiratory flow and cycle into exhalation

General Principle

- Improve oxygenation (increase pO2) by recruiting alveoli and optimizing V/Q matching - usually done by optimizing PEEP, MAP, FiO2, I:E ratio
- Both atelectasis and overdistension must be avoided
- Improve ventilation (decreased pCO2) by increasing alveolar ventilation - adjust variables that influence RR, TV
- Remember lungs need to empty in order for new air from outside (pCO2 = 0) to enter - particularly in patients w/ obstructive physiology (asthma), this may require longer expiratory times

Troubleshooting Desaturations on Ventilator (DOPE)

- **D**islodgement (of ETT)—mask ventilate, call staff assist
- **O**bstruction (mucus plug)—suction, call nursing & RT
- **P**neumothorax—obtain CXR, consider needle decompression if concern for tension physiology
- **E**quipment Failure—bag-ETT ventilate, call RT