**principles**

- **spontaneous ventilation:**
  - venous return and preload are augmented, pressure gradient between LV and aorta

- **Pos. pressure ventilation issues:**
  - decreased venous return, dec. Cardiac Output, less pressure gradient LV --> aorta
  - exacerbates hypotension

- **invasive mechanical ventilation:**
  - **control variable**
    - Pressure controlled
      - set amount of pressure applied to lungs
      - set inspiratory time
      - Useful to prevent barotrauma or high resp. reserve
        - Asthma, COPD
        - salicylate overdose
      - unable to control volume
    - volume controlled
      - peak insp. pressures vary based on Tidal volume
      - Risky when poor resp. system compliance
      - Useful in volume restricted diseases:
        - ALI
        - ARDS
        - obesity
  - **dual control ventilation**
    - PRVC
  - **Ventilator mode:**
    - Continuous mechanical ventilation (CMV)
      - Assist/control - P or V control.
        - fixed breaths per min, assists fixed vol. breaths with pts triggering breathing.
        - deeply sedated or paralysed pts. ***standard ED setting****
    - Intermittent mech. vent. (IMV)
      - SIMV
      - patients with weak, intermittent breaths
      - preset breaths, promotes patient comfort, avoids hypervent.
    - Continuous spont. vent. (CSV) ****(all patient determined)****
      - PSV: awake interactive patients
      - CPAP- set PEEP
        - PEEP: is the maintenance of pos. airway press. AFTER the completion of passive exhalation
          - increases FRC, oxygenation, dec. intrapulm shunt
      - BiPAP- set IPAP and EPAP

**non-invasive techniques**

- NIPPV
○ CPAP: constant pos, pressuring during the resp. cycle
○ BiPAP: alternates between iPAP and ePAP (alveolar recruitment)

MANAGEMENT:

NIPPV vs. Invasive:
● NIPPV can obviate intubation in many "DNR" situations or for reversible conditions

<table>
<thead>
<tr>
<th>Ideal pt. popultn.</th>
<th>Contraindications</th>
<th>notes</th>
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<tbody>
<tr>
<td>NIPPV</td>
<td>• COPD</td>
<td>• decreased LOC</td>
</tr>
<tr>
<td></td>
<td>• cardiogenic pulm edema w. fatigue</td>
<td>• no resp. drive</td>
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<td></td>
<td>• hypercapnic acidosis</td>
<td>• increased secretions</td>
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<td></td>
<td>• ?asthma</td>
<td>• Actively vomiting patient/or about to vomit</td>
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<td></td>
<td>• ?pneumonia</td>
<td>• hemodynamic instability</td>
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<td>• facial trauma/deformity</td>
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<td>• agitated or combative patient</td>
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<td>leads to afterload reduction: causes elevations of intrathoracic pressure; decreases LV ejection pressure; decreases RV preload</td>
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</tbody>
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approach to initial vent. settings:
● systematic questions to talk through:
1) could NIPPV help?
   ● CPAP:
     ○ IPAP at 10 cm H20
     ○ EPAP at 5 cm H20
     ○ increase each by 1 cm at a time.
     ○ max IPAP is 20 cm h20

2) Intubation needed?
   ● Mode: A/C
   ● tidal Vol: 6-8 ml/kg
   ● rate: 12-14 bpm
   ● pressure targets < 30 cm h20
   ● FiO2: @ 1.0, then titrated DOWN to maintain sp02 > 90%
   ● PEEP: at 5 cm h20

ongoing management:
● regular titration of settings based on blood gases
● **VBG’s good for pH and Pco2**
● PIP / peak airway pressures = the amount of airway pressure in the alveoli at end inspiration

● **Must also address analgesia and sedation!**
  ○ RASS score from -5 <= > +4; ideal emerg level is -2
  ○ Morphine - has active metabolites that accumulate in the system
Benzo's - when infused have tissue accumulating properties leading to prolonged delirium and sedation
  - boluses are much better if absolutely needed
Propofol - better given as an infusion: 0.1mg/kg/min
Dexmedetomidine - great drug for sedation and for ICU delirium
***Haldol - useful adjunct who are acutely agitated after large doses of other sedatives**
VAP prevention:
  - Suctioning
  - HOB >30 deg.
  - OG/NG to suction
  - Chlorhexidine mouthwashes

Complications of PPV:
  - Lung barotrauma and volutrauma
    - max end-inspiratory pressures at 30 cm H2O
    - risk of pneumothorax, pneumomediastinum
  - breath stacking in obstructive lung disease leading to hyperinflation
    - decrease resp rate and I:E ratio

***Troubleshooting the ventilator:***

  - first step: "Disconnect the Ventilator system and Bag with 100% 02"
  - Acute diagnoses not to miss:
    - physiologic things:
      - tension pneumothorax
      - acute PE
      - inadequate sedation
    - mechanical things:
      - dislodged tube or mucous plug
      - cuff leak or vent circuit problem

special clinical circumstances: any existing lung disease:
"treat them like BABY lungs"

<table>
<thead>
<tr>
<th>Disease</th>
<th>Acute exac. COPD</th>
<th>Status Asthmaticus</th>
<th>ALI / ARDS</th>
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</thead>
<tbody>
<tr>
<td>notes</td>
<td>minimize IPEEP:</td>
<td>similar to COPD</td>
<td>decreased tidal Vol.</td>
</tr>
<tr>
<td></td>
<td>- bronchodilators,</td>
<td>- low RR,</td>
<td>below 7 ml/kg</td>
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<td>- steroids</td>
<td>- long Exp. times</td>
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<tr>
<td></td>
<td>- long expiratory time,</td>
<td>- NO PEEP</td>
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<td>- low RR</td>
<td>- low PEEP</td>
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<td>- low TV</td>
<td>- low tidal Vol.</td>
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<td>- &quot;permissive hypercapnia&quot;</td>
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<td>- I:E of 1:4</td>
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<tr>
<td></td>
<td>- deep sedation!</td>
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