CSE Tip of the Day

Mechanical Ventilation

### Spontaneous Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal</th>
<th>Unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_T$</td>
<td>5-8 ml/kg</td>
<td>&lt; 5 ml/kg</td>
</tr>
<tr>
<td>VC</td>
<td>65-75 ml/kg</td>
<td>&lt; 10 ml/kg</td>
</tr>
<tr>
<td>Rate</td>
<td>8-12 bpm</td>
<td>&lt; 8 or &gt; 20 bpm</td>
</tr>
<tr>
<td>Minute Ventilation</td>
<td>5-6 L/min</td>
<td>&gt; 10 L/min</td>
</tr>
<tr>
<td>MIP</td>
<td>-80 cmH$_2$O</td>
<td>&lt; -20 cmH$_2$O</td>
</tr>
</tbody>
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### Initial Ventilator Parameters

- Two most important settings are $V_T$ and rate
  - $V_T$ - set at about 10 ml/kg (8-12 ml/kg ideal body weight)
    - Example: pt weight 175 lbs = 79.5 (80) kg
      - $80 \times 8 = 640$ ml; $80 \times 12 = 960$ ml
    - Rate - set at about 8-12 bpm

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### Initial Ventilator Parameters

- Ventilation Mode
  - Do not rule out an answer because of mode - any mode is OK as long as $V_T$ and rate are correct
    - SIMV, A/C pr control
    - Normally SIMV or A/C is preferred
Initial Ventilator Parameters

• $F_iO_2$ and PEEP
  – No info about prior $O_2$ or ABGs - .40-.60
  – Patient was on $O_2$ and/or PEEP/CPAP before - same $F_iO_2$ and/or PEEP

Initial Ventilator Parameters

• Bottom Line:
  – Don’t worry about mode
  – Find a $V_t$ within the range for your patient’s weight
  – Find a rate of 8-12
  – Set $F_iO_2$ at .40-.60 unless you have a prior $F_iO_2$ or ABGs; set PEEP at same level as prior to ventilation

CSE Tip of the Day

Neuromuscular Disease
Myasthenia Gravis or Guillain-Barré Syndrome?

Myasthenia Gravis or Guillain-Barré

• Both exhibit progressive paralysis
  – MG has a descending pattern
  – GB has an ascending pattern
• In both, monitor VC and MIP
• In most simulations, both will progress to include mechanical ventilation
Myasthenia Gravis

- Chronic autoimmune neuromuscular disease characterized by varying degrees of weakness of the skeletal (voluntary) muscles
- Hallmark is muscle weakness that increases during periods of activity and improves after periods of rest
- Caused by a defect in the transmission of nerve impulses to muscles

The first noticeable symptoms of myasthenia gravis may be weakness of the eye muscles, difficulty in swallowing, or slurred speech.

Myasthenia gravis is not directly inherited nor is it contagious.

Diagnosis
- Edrophonium (Tensilon test)
- Serum antibodies to
  - muscle-specific receptor tyrosine kinase (MuSK)
  - the acetylcholine receptor (AChR)
- Electromyography
  - Repetitive Nerve Stimulation (RNS)
- Single Fiber EMG (SFEMG)
  - SFEMG is the most sensitive clinical test of neuromuscular transmission and shows increased jitter in some muscles in almost all patients with myasthenia gravis

NBRC will most likely still use the Tensilon test because RTs are present for this procedure.

Weakness caused by abnormal neuromuscular transmission characteristically improves after intravenous administration of edrophonium chloride (Tensilon).

Increased strength following an injection of Tensilon strongly suggests a diagnosis of MG.
Myasthenia Gravis

- 10 mg Tensilon is injected IV; if no adverse effects are noted, an additional 10 mg is injected and muscle strength is tested
- In a patient without MG, the Tensilon test will not produce an obvious increase in a previously weak muscle
- An obvious increase in strength in weakened muscles strongly suggests the diagnosis of myasthenia gravis - the effect comes on very rapidly, and fades within minutes

- Your role would be to monitor the patient and prepare for intubation
- In myasthenic crisis (worsening of the disease that requires anticholinesterase therapy), there is a brief improvement in the muscle strength
- In cholinergic crisis (overdose of anticholinesterase), Tensilon will exaggerate the muscle weakness; patient may become apneic - intubate and manually ventilate

Myasthenia Gravis

- Treatments
  - Cholinesterase inhibitors - Pyridostigmine bromide (Mestinon) and neostigmine bromide (Prostigmin) are the most commonly used
  - Thymectomy - recommended by many physicians for most patients with myasthenia gravis
  - Corticosteroids
  - Immunosuppressant drugs
  - Plasmapheresis
  - Intravenous immune globulin

Guillain-Barré Syndrome

- Auto-immune disorder in which the body's immune system attacks part of the peripheral nervous system
- First symptoms include varying degrees of weakness or tingling sensations in the legs (ascending paralysis)
- Can strike at any age and both sexes are equally prone to the disorder
- Rare - afflicts only about one person in 100,000
Guillain-Barré Syndrome

• Occurs a few days or weeks after the patient has had symptoms of a respiratory or gastrointestinal viral infection - occasionally surgery or vaccinations will trigger the syndrome
• After the first clinical manifestations of the disease, the symptoms can progress over the course of hours, days, or weeks - most people reach the stage of greatest weakness within the first 2 weeks

Guillain-Barré Syndrome

• Diagnosis
  – Made from symptoms: ascending paralysis, bilateral symptoms; rapid progression; testing CSF for high levels of protein

Guillain-Barré Syndrome

• Treatment
  – Plasmapheresis
  – High-dose immunoglobulin therapy
  – Corticosteroids
  – Mechanical ventilation (tracheostomy)
  – Passive range of motion exercises then physical therapy

CSE Tip of the Day

Patient Management
Patient Management

- Ask the Life Function questions
  - Is the patient ventilating? (PaCO$_2$, RR, VT, BS) - if not, treat it
  - Is the patient oxygenating? (PaO$_2$, SpO$_2$, PtcO$_2$, color, sensorium, HR) - if not, know the rules:
    - Increase F$_1$O$_2$ to .6, then add PEEP/CPAP
    - If patient is already above .6 F$_1$O$_2$, then increase PEEP/CPAP

Patient Management

- Ask the Life Function questions
  - Does the patient have circulation? (HR and strength, CO) - if not, treat it
  - Is the patient perfusing? (BP, sensorium, urine output, hemodynamics) - if not, treat it

Drug Overdose

- Patient assessment
  - Sensorium - sleepy, hard to arouse, nonresponsive
  - Slow, shallow or absent respirations
  - Medical history - previous admissions for OD?
  - Present illness history - found by ?, current meds?
  - ABGs - may show ventilatory failure

Drug Overdose

- Treatment
  - Placement of artificial airway is first priority
  - Mechanical ventilation if in ventilatory failure (pending??)
  - Nalaxone (Narcan) to reverse narcotics
Non-invasive Positive Pressure Ventilation

• Indications
  – Avoid intubation
  – Facilitate long-term ventilation at home
  – Assist patients in early resp. failure/COPD
  – Provide periodic support for patients with
    • Neuromuscular disease
    • Restrictive chest wall disease
    • Central/obstructive sleep apnea

• Potential hazards
  – Poorly fitting mask
  – Irritation or ulcerations from mask
  – Leaks around mask or in tubing
  – Gastric distention from high pressures

Non-invasive Positive Pressure Ventilation

• Support modes
  – EPAP
    • Same as CPAP; used to prevent airway closure in obstructive sleep apnea, improve oxygenation, improve alveolar recruitment or decrease shunting
  – IPAP
    • Positive pressure during inspiration; set at a higher pressure than EPAP; simulates pressure support - an inspiratory assist modality

• Support modes
  – Spontaneous/timed
    • Allows patient to breathe at a spontaneous rate with timed breaths in between
  – Timed
    • Provides only time controlled breaths; patient cannot trigger intermittent breaths
Non-invasive Positive Pressure Ventilation

- Initial pressures
  - Patients with uncomplicated obstructive sleep apnea will generally find relief with EPAP pressures of 5-10 cm H$_2$O
  - Patients placed on EPAP to treat hypoxemia should be started at 6-8 cm H$_2$O

- Changing BiPAP settings
  - $F_iO_2$ is hard to determine; oxygen flow is determined by patient assessment
  - Inspiratory and expiratory levels are changed according to patient status

Non-invasive Positive Pressure Ventilation

- Initial pressures
  - Patients with chronic but stable ventilatory insufficiency should be started with an IPAP of 5-10 cm H$_2$O; maximum IPAP should probably be 15-22 cm H$_2$O
  - Initial EPAP is normally 3-4 cm H$_2$O
  - Initial IPAP is generally 6-8 cm H$_2$O above expiratory level

CSE Tip of the Day

Croup or Epiglottitis?
Croup or Epiglottitis?

**Diagnosis**

- **Croup**
  - Acute viral infection
  - 6 months to 3 years old
  - History = recent cold that developed into a barking cough over 2-3 days
  - Vital signs:
    - Pulse - normal to slightly tachycardic
    - Respiration - some tachypnea
    - Temperature - low grade fever
  - Lat. neck x-ray - haziness in the subglottic region; *steeple sign*

- **Epiglottitis**
  - Immediate Emergency
  - Severe bacterial infection (H. influenzae)
  - 3-11 years old
  - History - sudden onset within last 6-8 hours
  - General appearance:
    - Lifeless, drooling, hoarseness, muffled cough, resp. Stridor
    - Dysphagia (difficult swallowing)
  - Vital signs:
    - Pulse - normal to slightly tachycardic
    - Respiration - tachypneic
    - Temperature - high fever
  - Lat. neck x-ray - only after artificial airway is in place - will show supraglottic swelling; *thumbprint sign* (thumb; little finger)

**Treatment**

- **Croup**
  - O₂ therapy at 30-40% (First)
  - SVN with racemic epinephrine
  - High humidity therapy (mist tent)
  - Criteria for intubation:
    - Lethargic
    - Severe stridor at rest
    - Diminished breath sounds
    - Extreme accessory muscle use
  - **Epiglottitis**
    - ESTABLISH AN AIRWAY
    - ETT
    - Tracheostomy if unable to intubate
    - O₂ therapy at 30-40%
    - Antibiotics (ceftriaxone [Rocephin], cefotaxime [Claforan], and cefuroxime [Ceftin])
    - Extubation after 3-4 days, once swelling is gone
Pre/Post Heart Surgery

• Assessment
  – Bedside
    • Perform overall assessment including
      – Vital signs
      – History - present illness, family, social
      – Breath sounds
      – General appearance
      – LOC

• Secondary
  • Pre-op ABGs
  • Pre-op PF - basic spirometric tests (FEV₁, VC)

• Treatment
  – Post-op care
    • Conscious patients - IS q1h
    • Unconscious patients - IPPB or CPAP by mask
    • IF CPR IS REQUIRED - DO NOT HESITATE

CSE Tip of the Day

Shock
A reduction in blood flow to the tissues that is inadequate to sustain life
**Shock**

- **Assessment**
  - **Bedside**
    - History of present illness
    - General appearance - clammy, pale, cyanotic
    - Sensorium - lethargic, unresponsive
    - Vital signs
      - Pulse - tachycardia
      - Respiration - tachypnea
      - Temperature - hypothermic
      - Blood pressure - hypotensive

- **Secondary**
  - Decreased urine output
  - ABGs - hypoxemia
  - Hemodynamic measurements - decreased 
    CVP, PAP, PWP, CO

- **Treatment**
  - Start O₂ therapy immediately (FIO₂ > .4)
  - Monitor vital signs frequently
  - Treat underlying cause
  - Watch for ventilatory failure

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**CSE Tip of the Day**

Neonatal Simulation Topics
Meconium Aspiration

- Patient Assessment
  - Bedside
    - Age - more common in post term infants (>37 wks)
    - Appearance - stained with meconium, grunting, retractions, cyanosis, nasal flaring & asphyxia
    - Low APGAR scores
  - Vital signs
    - Pulse = tachycardia
    - Respirations = tachypnea with gasping

- Secondary assessment
  - ABG - hypoxemia with mixed acidosis
  - CXR - patchy densities bilaterally with atelectasis

Meconium Aspiration

- Treatment/Management
  - First priority is to suction the airway - suction oropharynx before the nose
  - Repeat suctioning until adequately cleared
  - Intubate and resuscitate if APGAR indicates
  - Mechanical ventilation - by ABGs
  - Aggressive CPT
**IRDS**

**Patient Assessment**
- Bedside assessment
  - Premature - gestational age <36 wks
  - Low APGAR scores
  - Onset of symptoms - at birth or within a few hrs
  - Appearance - nasal flaring, grunting, retractions, cyanosis
  - Respirations - tachypnea

- Secondary assessment
  - CXR - reticulogranular infiltrates or honeycomb appearance or ground glass appearance
  - ABGs - hypoxemia
  - L/S ratio - <2:1

**Treatment/Management**
- Maintain PaO$_2$ levels >60 mmHg
- Treat hypoxemia with O$_2$ and CPAP
- Watch for respiratory failure - intubate, ventilate with PEEP
- SIMV
- Inverse I:E ratios
Bronchopulmonary Dysplasia

Signs & Symptoms
- Tachypnea
- Retractions
- Cough
- See-saw breathing
- Wheezing
- "Craning" the neck/use of accessory muscles
- Poor posture of the upper body
- Cyanosis

BPD typically occurs in very low birth weight (VLBW) infants who sustain lung damage as a result of oxygen toxicity and barotrauma from mechanical ventilation early in life.

The classic diagnosis of BPD may be assigned at 28 days of life if the following criteria are met:
- Positive pressure ventilation during the first 2 weeks of life for a minimum of 3 days
- Clinical signs of abnormal respiratory function
- Requirements for supplemental oxygen for longer than 28 days of age to maintain $\text{PaO}_2$ above 50 mmHg
- Chest radiograph with diffuse abnormal findings characteristic of BPD
Bronchopulmonary Dysplasia

• Treatment
  – Nasal CPAP
  – O2 therapy/monitoring
  – Bronchodilators
  – CPT
  – Fluid restriction/diuretics
  – Corticosteroids
  – Antibiotics

CSE Tip of the Day

ARDS

An illness or injury acutely affecting the lung compliance including a variety of contributing factors.

ARDS

• History
  – Most cases of ARDS can be traced to a pulmonary injury or insult
    • Direct lung injury
      – Severe pneumonia
      – Aspiration of vomitus
      – Inhalation of fumes or smoke
      – A severe blow to the chest or other accident that bruises the lungs

• History
  – Most cases of ARDS can be traced to a pulmonary injury or insult
    • Indirect lung injury
      – Severe and widespread bacterial infection in the body
      – Severe injury with shock
      – Severe bleeding requiring blood transfusions
      – Drug overdose
      – Inflamed pancreas
ARDS

- Patient Assessment
  - Bedside assessment
    - Tachypnea
    - Cyanosis
    - Shortness of breath

ARDS

- Patient Assessment
  - Secondary assessment
    - CXR - diffuse alveolar infiltrates in a honeycomb pattern or ground glass appearance
    - ABGs - refractory hypoxemia
    - Decreased FRC
    - Closely monitor hemodynamics via Swan-Ganz

ARDS

- Treatment/Management
  - Treat underlying cause
  - Increase $F_1O_2$ to .60, then add PEEP/CPAP
  - Titrate $F_1O_2$ to below .60, then reduce PEEP/CPAP
  - Inverse I:E ratio & pressure control ventilation if ventilating pressures become too high (>50 cmH$_2$O)

ARDS

- Modes of Ventilation
  - Most situations will be treated by regular modes of ventilation in the beginning
  - At some point, the patient's compliance will decrease and ventilation pressures will increase
  - At that time, you will probably be given the option to use Pressure Control Ventilation (PCV)
ARDS

- Modes of Ventilation
  - Another option might be Pressure Control - Inverse Ration Ventilation (PC-IRV)
  - These patients will require heavy sedation and paralysis with neuromuscular blocking agents
  - As patient continues to deteriorate, options will include Airway Pressure Relief Ventilation (APRV)

ARDS

- Modes of Ventilation
  - APRV is preferable because it
    - Does not require sedation or paralysis
    - Reduces the work of breathing
    - Reduces shunting
    - Preserves respiratory muscle reserve
    - Allows for earlier weaning

ARDS

- As patient improves, consider going back to SIMV and weaning the patient from ventilatory support and supplemental oxygen

CSE Tip of the Day

Bronchiolitis
Bronchiolitis

• Patient Assessment
  – Bedside assessment
    • Age - 3 months to 3 years (maybe younger)
    • General appearance - dyspnea with retractions, nasal discharge, cough, lethargy
    • Temperature - low grade fever
    • Breath sounds - audible wheezing, rhonchi and rales

Bronchiolitis

• Patient Assessment
  – Secondary assessment
    • CXR - hyperlucency with scattered infiltrates
    • Nasal lavage for RSV (most common cause)

Bronchiolitis

• Treatment/Management
  – Ribavirin aerosol - administer via SPAG for RSV
  – Isolation
  – May require ventilation
    • In this age group, use pressure ventilation
    • Start pressure in 20-25 range

CSE Tip of the Day

Pulmonary Tuberculosis
Pulmonary Tuberculosis

- What to look for
  - History of alcohol or drug abuse
  - HIV+
  - Malnourished
  - Upper lobe consolidation
  - Night sweats

Pulmonary Tuberculosis

- What to do
  - History
  - $SpO_2$
  - Sputum C & S; gram stain; AFB
  - Mantoux
  - CBC
  - CXR
  - And the usual - BS, VS, general appearance, age, weight, height

Pulmonary Tuberculosis

- Then
  - AFB isolation

- Treatment
  - As a general rule: 6-9 months INH and rifampin along with pyrazinamide and ethambutol

- Prophylaxis
  - 12 months daily INH