EXHAUSTION OR CHANGE IN MENTAL STATUS?

http://everclevermom.com/2016/05/evs-asthma-its-a-big-deal/
FROM THIS TO THIS…
THEN THIS
Making Asthma Scary Since 1977
Identifying Who is Bad
First Steps
Next Steps
Then What???
Current Asthma Prevalence: United States, 2001-2010

One in 12 people (about 26 million, or 8% of the U.S. population) had asthma in 2010, compared with 1 in 14 (about 20 million, or 7%) in 2001.

Asthma Prevalence in the United States, CDC website. June 2014
Asthma Attack Prevalence among Children with Current Asthma: United States, 2001-2010

From 2001 to 2010 children had fewer asthma attacks. For children, asthma attacks declined from at least one asthma attack in the previous 12 months for 61.7% of children with asthma in 2001 to 58.3% in 2010.
A flare-up or exacerbation is an acute or subacute worsening of symptoms and lung function compared with the patient's usual status.

Terminology:

- ‘Flare-up’ is the preferred term for discussion with patients
- ‘Exacerbation’ is a difficult term for patients
- ‘Attack’ has highly variable meanings for patients and clinicians
- ‘Episode’ does not convey clinical urgency

PATHOPHYSIOLOGY

- Inflammation
  - Edema
  - Bronchospasm
  - Mucous plugging
- VQ mismatch
  - Intrapulmonary shunting
  - Hypoxic pulmonary vasoconstriction
- Abnormally high airway resistance
- Dynamic hyperinflation
  - Auto-PEEP
- Cardiovascular effects
  - Pulsus paradoxus
FATAL AND NEAR-FATAL ASTHMA

TYPE 1 (80%)

- Slow onset, progressive airway obstruction
- On medications but not compliant
- Frequently using bronchodilators
- Usually undertreated with inhaled corticosteroids
- More inflammation + mucous plugging

TYPE 2 (20%)

- Sudden onset, sudden asphyxial asthma
- More epidemic or sporadic
- Death can follow in only a few hours after start of the clinical symptoms
- Higher incidence of AMS, respiratory arrest, acidemia
- Severe bronchospasm but little to no mucous plugging
- Rapid deterioration but rapid recovery with treatment

RISK FACTORS FOR POOR ASTHMA OUTCOMES
IDENTIFY PATIENTS AT RISK OF ASTHMA-RELATED DEATH

- Any history of near-fatal asthma requiring intubation and ventilation
- Hospitalization or emergency care for asthma in last 12 months
- Not currently using ICS, or poor adherence with ICS
- Currently using or recently stopped using OCS
- Over-use of SABAs, especially if more than 1 canister/month
- Lack of a written asthma action plan
- History of psychiatric disease or psychosocial problems
- Confirmed food allergy in a patient with asthma

## BUT WHO IS SICK?

### Classification of severity of an asthma exacerbation

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Imminent Respiratory Arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnoea</td>
<td>When walking</td>
<td>During speech (infant-softer or shorter crying; difficulty drinking)</td>
<td>At rest (infant; stops drinking)</td>
<td>Gasping</td>
</tr>
<tr>
<td>Tachypnea:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Occiput</td>
<td></td>
<td></td>
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<tr>
<td>Signs at physical examination</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Breathing frequency (awake patient)</td>
<td>Increased</td>
<td>Normal breathing frequency in children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 months</td>
<td></td>
<td></td>
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<tr>
<td>2–12 months</td>
<td></td>
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<tr>
<td>1–3 years</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>4–12 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of auxiliary muscles</td>
<td>Most often not</td>
<td>Often</td>
<td>Usually</td>
<td>Paradoxical thoracoabdominal movements</td>
</tr>
<tr>
<td>Normal retractions</td>
<td>Moderate, most often end-expiratory</td>
<td>Loud, whole expiration</td>
<td>Monthly loud in- and expiratory</td>
<td></td>
</tr>
<tr>
<td>Wherez</td>
<td>Normal pulse rate in children</td>
<td>Normal pulse:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>&lt; 100</td>
<td>80–180</td>
<td></td>
<td></td>
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<tr>
<td>2–12 months</td>
<td></td>
<td>75–150</td>
<td></td>
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<tr>
<td>1–3 years</td>
<td></td>
<td>60–120</td>
<td></td>
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<tr>
<td>4–12 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse paradoxus</td>
<td>Absent</td>
<td>Can be present</td>
<td>Often</td>
<td>Absence suggests exhaustion</td>
</tr>
<tr>
<td>Fluctuation of pulse pressure between in- and expiration</td>
<td>&lt; 10 mm Hg</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gas exchange</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SaO2 (room air)</td>
<td>&gt; 95%</td>
<td>91-95%</td>
<td>&lt; 91%</td>
<td></td>
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<tr>
<td>PaCO2</td>
<td>&lt; 5.6 kPa</td>
<td>&gt; 5.6 kPa</td>
<td>&gt; 5.6 kPa (child)</td>
<td></td>
</tr>
<tr>
<td>PaO2</td>
<td>Normal</td>
<td></td>
<td>&gt; 8 kPa (child)</td>
<td></td>
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</tbody>
</table>


The presence of several parameters, not necessarily all, gives an indication of the severity of status asthmaticus. Many of these parameters have not been studied systematically, they only serve as guidance.
SO WHY USE THEM?

- Reliably and rapidly identify severity level
- Identify changes in clinical status
- Research purposes
- Protocols, pathways
OTHER CLUES?
BLOOD GAS

7.08/64/62/18

7.39/33/85/22
• Most patients who have an asthma exacerbation do not require any initial laboratory studies.
  • CBC if fever
  • Electrolytes if on diuretics

• If laboratory studies are ordered, they must not delay initiation of asthma treatment
To Image? Or Not?
**WHAT ARE WE DOING?**

- **Medications:**
  - 90% use steroids
  - 90% use inhaled beta agonists
  - 44% used IV beta agonists
  - 40% use both inhaled and IV
  - 45% use magnesium
  - 14% use methylxanthines
  - 62% use antibiotics
  - 53% use neuromuscular blockade

- **Mechanical Support**
  - 27% use Heliox
  - 8% only use non-invasive
  - 62% were intubated in ED if intubated
  - 30% were intubated in PICU

- **Labs/Imaging**
  - 6% obtained a blood gas
  - 6% obtained an xray

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**Table 4. Therapies used to treat children receiving mechanical ventilatory support in a Collaborative Pediatric Critical Care Research Center**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Collaborative Pediatric Critical Care Research Network Sites</th>
<th>All Collaborative Pediatric Critical Care Research Network N = 303</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steroids</td>
<td></td>
<td></td>
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<tr>
<td>β-agonists</td>
<td></td>
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<tr>
<td>Inhaled albuterol</td>
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<td></td>
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<tr>
<td>Inhaled lev-albuterol</td>
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<tr>
<td>Inhaled salbuterol</td>
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<td></td>
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<tr>
<td>Inhaled ipratropium</td>
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<tr>
<td>Magnesium</td>
<td></td>
<td></td>
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<tr>
<td>Methyloxanthines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurmuscular blocking agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heliox</td>
<td></td>
<td></td>
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<tr>
<td>Noninvasive only</td>
<td></td>
<td></td>
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<tr>
<td>Intubated in emergency departm</td>
<td></td>
<td></td>
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<tr>
<td>Intubated in pediatric intensive care unit</td>
<td></td>
<td></td>
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<tr>
<td>Laboratory testing, median (interquartile range)</td>
<td></td>
<td></td>
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<tr>
<td>N, blood gases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N, x-rays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N, magnesium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*α p < .05 within groups; β includes those with a trial of noninvasive and then intubated in the pediatric intensive care unit; γ total tests during intensive care stay.

Alteration in Mental Status
Bradycardia
Inability to Speak
Silent Chest
Asthma Treatments
ASSESSING AND MANAGING EXACERBATIONS IN ACUTE CARE SETTINGS

INITIAL ASSESSMENT
A: airway  B: breathing  C: circulation

Are any of the following present?
- Drowsiness
- Confusion
- Silent chest

NO

Further TRIAGE BY CLINICAL STATUS according to worst feature

MILD or MODERATE
- Talks in phrases
- Prefers sitting to lying
- Not agitated
- Respiratory rate increased
- Accessory muscles not used
- Pulse rate 100–120 bpm
- O₂ saturation (on air) 90–95%
- PEF >50% predicted or best

SEVERE
- Talks in words
- Sits hunched forwards
- Agitated
- Respiratory rate >30/min
- Accessory muscles being used
- Pulse rate >120 bpm
- O₂ saturation (on air) < 90%
- PEF ≤50% predicted or best

YES

Consult ICU, start SABA and O₂, and prepare patient for intubation

If continuing deterioration, treat as severe and re-assess for ICU

Short-acting β₂-agonists
- Consider ipratropium bromide
- Controlled O₂ to maintain saturation 93–95% (children 94–98%)
- Oral corticosteroids

Short-acting β₂-agonists
- Ipratropium bromide
- Controlled O₂ to maintain saturation 93–95% (children 94–98%)
- Oral or IV corticosteroids
- Consider IV magnesium
- Consider high dose ICS

ASSESS CLINICAL PROGRESS FREQUENTLY
- MEASURE LUNG FUNCTION in all patients one hour after initial treatment

FEV₁ or PEF 60–80% of predicted or personal best and symptoms improved
- MODERATE
- Consider for discharge planning

FEV₁ or PEF <60% of predicted or personal best, or lack of clinical response
- SEVERE
- Continue treatment as above and reassess frequently

Assess patient. Obtain vital signs, weight, and height upon admission. Consider FEV1/peak flow if ≥ 5 y old. FEV1/peak flow may be difficult or impossible to measure due to significant dyspnea and cough. Further, FEV1/peak flow may not be appropriate in very severe cases of obvious airway compromise or cyanosis.

- Patient is breathless at rest. Dyspnea interferes with conversation (e.g. speaks in words). Patient is using accessory muscles, has suprasternal retractions, may or may not have loud wheezing (throughout inhalation and exhalation), and is tachypneic; and/or,
- FEV1/peak flow < 40% of predicted or personal best; and/or,
- O2 saturation < 90%.

Administer oxygen to keep saturation ≥ 90%. Administer moderate to high dose nebulized albuterol plus ipratropium q 1 - 3 hours or albuterol continuously. BAN (breath actuating nebulizer) is recommended to increase delivery of nebulized medications in severe exacerbations.

Corticosteroids (oral – prednisone or equivalent) 1 - 2 mg/kg up to a maximum of 60 mg in children, if not given prior to hospitalization. Consider IV steroids if patient cannot tolerate oral medication. Continue systemic steroids 0.5 - 1 mg/kg q 6 - 12 hours (usual maximum dose 60 mg/day in children < 12 y old, maximum dose 80 mg/day in adults).

Frequent vital sign monitoring, including pulse, respirations, and continuous pulse oximetry. Once improvement established, monitor FEV1/peak flow BID if ≥ 5 y old.

If the patient smokes or is in contact with a smoking environment, consider a urine cotinine level.

Consider chest x-ray, if unequal breath sounds, high fever, or sudden decline in status.

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**Good Response**
- FEV1 or PEF ≥ 70%
- Sustained response 60 minutes after treatment
- No dyspnea or oxygen requirement
- Improved physical exam

**Incomplete Response**
- FEV1 or PEF 40 - 69%
- Mild to moderate symptoms

**Poor Response**
- FEV1 or PEF < 40%
- pCO2 ≥ 45 mm Hg
- Severe symptoms
- Drowsy, confused

Arrange for hospitalization:
- Continue supplemental oxygen
- Continue nebulized albuterol and ipratropium q 1 - 3 hours (while in ED) or albuterol continuously at 0.15 - 0.5 mg/kg/hr (maximum of 10 - 15 mg/hr). Ipratropium may be useful q 4 - 6 hours during first 24 hours of hospitalization.
- Continue systemic corticosteroids 0.5 - 1 mg/kg q 6 - 12 hours for 3 - 10 days (usual maximum dose 60 mg/day in children < 12 y old; maximum dose 80 mg/day in adults). Consider tapering for patients requiring > 6 days of systemic corticosteroids.
- Consider other diagnoses
- Continue controller medications
- If not on inhaled corticosteroids, consider initiating treatment prior to discharge

**PICU Admission Criteria**
- Intubated or pending intubation
- pCO2 greater than 45
- Requiring more than 50% FiO2
- Requiring nebulized therapies more frequently than q 2 hours
- Altered mental status
- Acute pneumothorax
- Use of adjunctive therapies – heliox, terbutaline, magnesium

Admit to PICU - With orders for:
- Supplemental oxygen
- Nebulized albuterol and ipratropium q 1 - 2 hours (while in ED) or continuously at 0.15 - 0.5 mg/kg/hr (maximum of 10 - 15 mg/hr). Ipratropium may be useful q 4 - 6 hours during first 24 hours of hospitalization.
- Systemic corticosteroids 0.5 - 1 mg/kg q 6 - 12 hours
- Consider arterial line for serial ABGs
- Continue controller medications as appropriate
- Consider adjunctive therapies
PRINCIPAL GOALS AND EXPERT PANEL RECOMMENDATIONS

PRIMARY TREATMENTS
**OXYGEN**

- **Standard Therapy**
  - Results from V/Q mismatch, alveolar hypoventilation, and hypercarbia
  - Can produce pulmonary hypertension, worsen bronchoconstriction, and decrease oxygen delivery
  - Bronchodilators reduce hypoxic pulmonary vasoconstriction and can worsen the hypoxemia transiently
  - Caution with high flow cannulae that can “wash out” the benefit of nebulized beta-agonists

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STEROIDS

- 1st line agents
- Reduces the rate of hospital admission
- Improved pulmonary function testing
- Increases the number and sensitivity of Beta-adrenergic receptors
- Potent anti-inflammatory effects

- Start within first hour!

- Typical dose:
  - Methylpred 1-2 mg/kg/day divided BID
  - Prednisolone 1-2 mg/kg/day divided BID
  - Dexamethasone 0.3-1 mg/kg

WHAT STEROID?

- Data is too weak to draw any conclusions
- In kids with potential for discharge, either Decadron or prednisolone can be used
- In sick kids, DON'T USE ORAL MEDICATIONS
- Try Solumedrol at 1mg/kg q6h IV
ALBUTEROL

• Reverse bronchoconstriction to open airway and better allow gas exchange

MDI with spacer (6-12 breaths) is equally effective as nebulizer
  • Adult studies suggest no difference but lots of confounders
  • In kids, MDI associated with shorter ED LOS, maybe less admissions, less systemic effects
    • But NOT performed in critically ill kids

• Typical Dose:
  • 0.15–0.5 mg/kg/hr given usually as the total dose (5mg/hr, 10 mg/hr, 15 mg/hr, 20 mg/hr)
  • Limited by tachycardia

The sicker you are, the more improvement you see


CONTINUOUS OR INTERMITTENT?

• Can use either method

• Cochran Review 2003:
  • Less admissions with continuous
  • Improved peak flows with continuous
  • Asthma score and duration of time RT spent performing therapies lower with continuous

Typical dose:  
250–500 mcg inhaled every 20 min for up to three doses  
May continue every 4-6 hrs

FLUIDS

• Higher insensible losses with increased work of breathing
• Lots of variation

• Most would benefit from a fluid bolus
  • 20ml/kg normal saline or normosol/plasmalyte
EXHAUSTION OR CHANGE IN MENTAL STATUS?

http://everclevermom.com/2016/05/evas-asthma-its-a-big-deal/
SECONDARY TREATMENTS

- Magnesium
- Terbutaline
- Ketamine
- Theophylline
- Heliox
- BiPAP
MAGNESIUM

- Significant differences between adults and children
- Improved pulmonary function, reduced admission rates with IV magnesium
- Minimal improvements with nebulized magnesium except in sickest patients

- Typical dose:
  - 25-50 mg/kg over 20 min up to 2g

• IV/SQ beta agonist

• 2012 Cochrane Review
  • Limited evidence but possibly beneficial
  • Improvements in severity scores, duration of continuous nebs, and ICU stay but not statistically significant

TERBUTALINE

• Use when air movement is drastically decreased

• Limited by tachycardia

• Can cause troponin leak

• Typical dose:
  • SQ 0.01 mg/kg/dose (max of 0.3 mg)
  • IV Loading 10 mcg/kg IV over 10 min, followed by continuous infusion at 0.1–10 mcg/kg/min
THEOPHYLLINE

• Evidence does not support the routine use

• Lots of side effects
• Improve laminar flow
• Greater percentage of lung particle deposition potentially resulted in improved scores
• Limited by degree of hypoxemia

• Dose dependent preservation of airway tone/reflexes
• Bronchodilatory effects

• 2012 Cochrane Review
  • No significant difference in oxygen saturation, respiratory rate, hospital admission rate, and the need for endotracheal intubation

• Case reports show improvement in oxygenation, respiratory rate and decreased admissions

• Typical dose:
  • 1-2 mg/kg IV bolus
  • If using an infusion, consider 0.5mg/kg/hr – 2mg/kg/hr

CAN WE AVOID THIS…

http://everclevermom.com/2016/05/evas-asthma-its-a-big-deal/
http://savarassalvation.angelfire.com/savanass_first_days_at_st_francois_childrens_hospital/Picture_048.jpg
MECHANICAL VENTILATION

- Can aid in oxygenation
- Improves delivery of aerosolized medications
- Significantly reduces rate of intubation
- Some thought that earlier is better
BIPAP

• How:
  • Facilitates “stenting” open the airway to enable better ventilation and oxygenation
  • Improves V/Q mismatch
  • Decreases work needed by patient

• Who:
  • Extreme tachypnea
  • Impressive use of accessory muscles
  • Profound hypoxemia

• Initial Settings:
  • IPAP: 10-16 (based on age and severity of presentation)
  • EPAP: 5-10
  • Rate: low (aim for I:E ratio of 1:3 or greater)

Intubation of an asthmatic should be a last ditch effort or the therapy of last resort.
The decision to tracheally intubate should be based upon the clinical examination and not the results of an arterial blood gas.
Alteration in Mental Status
Bradycardia
Silent Chest
Children who present to a community hospital ED (as opposed to a pediatric ED) are more likely to be tracheally intubated.
INTUBATION

• Who:
  • The MOST experienced and skilled physician available

• How:
  • Induction with Ketamine (2mg/kg IV)
  • Neuromuscular blockade with sux (1.5mg/kg IV) or rocuronium (1mg/kg IV)
  • Consider fluid bolus
  • Slow, breaths allowing for complete exhalation

VENTILATOR MANAGEMENT

• Low Tidal Volume (6cc/kg)
• Short iTime
• Low respiratory rate
• Mode could be PRVC or volume mode if watching PIP’s
• Use of PEEP is controversial
• Use of muscle relaxant is controversial
ECMO
<table>
<thead>
<tr>
<th>Step</th>
<th>Therapy</th>
<th>Dosing/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oxygen</td>
<td>Maintain SaO2 &gt; 92%</td>
</tr>
<tr>
<td>2</td>
<td>Steroids</td>
<td>Methylprednisolone 1 mg/kg IV</td>
</tr>
<tr>
<td>3</td>
<td>Continuous Albuterol</td>
<td>0.15-0.5 mg/kg/hr&lt;br&gt;&lt;br&gt;0.15 mg/kg/hr if &lt; 10 kg; 0.3 mg/hr if 10-20 kg; 0.5 mg/hr if &gt; 20 kg</td>
</tr>
<tr>
<td>4</td>
<td>Ipratropium</td>
<td>If &lt; 20 kg: 250 mcg; If &gt; 20 kg: 500 mcg inhaled every 20 min up to 3 doses</td>
</tr>
<tr>
<td>5</td>
<td>IV Magnesium</td>
<td>25-50 mg/kg up to 2 g over 20 min</td>
</tr>
<tr>
<td>6</td>
<td>IV/SQ Terbutaline</td>
<td>SQ 0.01 mg/kg/dose (max of 0.3 mg) up to every 20 min&lt;br&gt;&lt;br&gt;IV loading 10-20 mcg/kg IV over 10 min, followed by continuous infusion at 0.1–10 mcg/kg/min</td>
</tr>
<tr>
<td>7</td>
<td>IM Epinephrine</td>
<td>0.01 mL/kg of 1:1,000 concentration up to every 20 min</td>
</tr>
<tr>
<td>8</td>
<td>Non-Invasive Ventilation</td>
<td>BiPAP IPAP 10-16&lt;br&gt;EPAP 5-10&lt;br&gt;Rate: Spontaneous</td>
</tr>
<tr>
<td>9</td>
<td>IV Ketamine</td>
<td>1-2 mg/kg IV&lt;br&gt;0.5 mg/kg/hr – 2 mg/kg/hr</td>
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<tr>
<td>10</td>
<td>Intubation</td>
<td>Ketamine 2 mg/kg IV, rocuronium 1 mg/kg</td>
</tr>
</tbody>
</table>


