

## B03: Asthma and Bronchospasm

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### Introduction

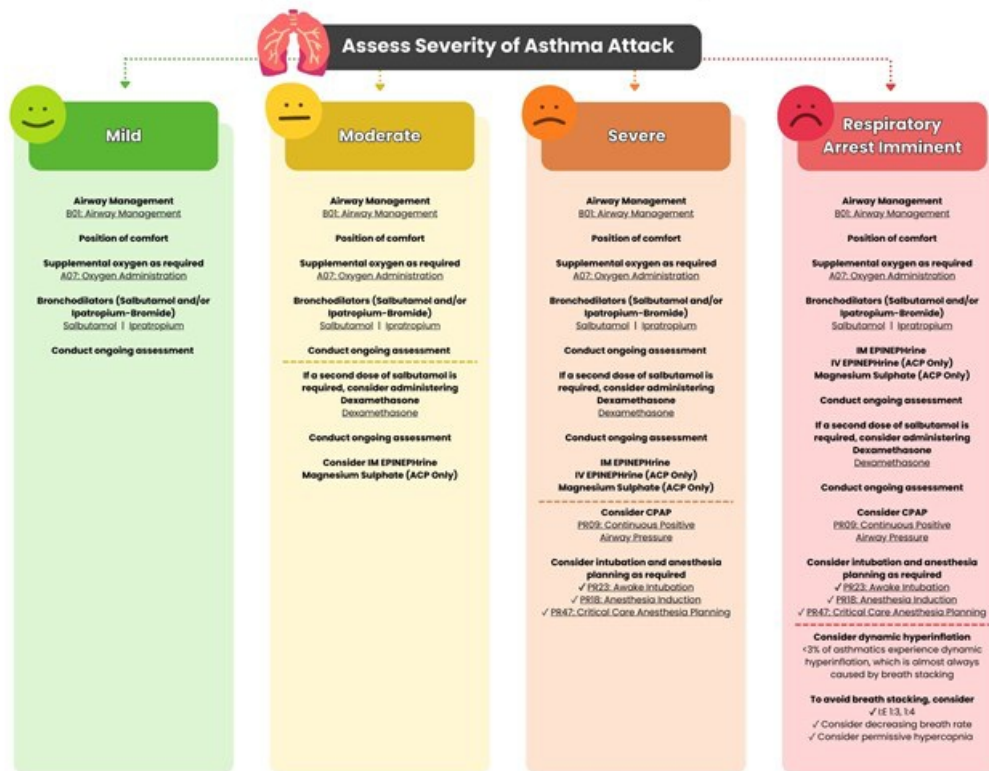
- Bronchospasm causes constriction of the bronchi's smooth muscles, leading to narrowed airways and is characterized by airway inflammation, coughing and generalized wheezing.
- In severe cases, air movement, especially during exhalation, may be significantly reduced, resulting in limited wheezing, air trapping, and increased respiratory secretions, causing mucus plugging.
- More time spent in the exhalation phase increases the inspiration-to-expiration ratio (I:E) and is a sign of bronchospasm
- Bronchospasm impairs ventilation, leading to potential oxygenation issues not solely due to oxygen exchange failure but often due to inadequate alveolar ventilation.
- In severe asthma cases, there's a risk of critically high carbon dioxide (CO<sub>2</sub>) levels due to reduced ventilation. Key signs of worsening respiratory function include diminished breath sounds, reduced effort, fatigue, altered consciousness, and a dropping respiratory rate, indicating imminent respiratory failure
- Breath stacking in severe asthma refers to a dangerous situation where a patient is unable to fully exhale before taking another breath. This leads to increased lung volume with each successive breath, as air gets trapped in the lungs due to severe airway obstruction.

**Not all wheezing is asthma, and not all asthma wheezes. Beware the silent chest.**

### Essentials

	Appearance	Wheezing	I: E Ratio	Accessory Muscle Use	Respiratory Rate	SPO2 %
MILD	Alert, Speaks in full sentences.	Expiratory wheezing only	2:1	Minimal	Slight tachypnea [20-30 RPM]	>95
MODERATE	May be agitated.  Speaks in partial sentences.	Wheezing throughout expiration  With/or without inspiratory wheezing	1:2	Significant and or decreased tidal volume	Increased tachypnea [30-50 RPM]	93-95
SEVERE	Agitated or speaking in 1-2 word sentences	Inspiratory and Expiratory wheezing	>1:2	Significant and or minimal tidal volume	Extreme tachypnea [>50]	90-92
RESPIRATORY ARREST IMMINENT	Drowsy or confused and/or cyanosis	Silent chest.	>1:2	Inability to maintain respiratory effort	Extreme tachypnea [>50] or paradoxical hypoventilation.	<90

## Algorithm | B03 | Asthma and Bronchospasm



- Bronchodilator therapy, including salbutamol and ipratropium-bromide, improves clinical outcomes for bronchospasm. Salbutamol and ipratropium can be co-administered in the same nebulizer. Deliver bronchodilator therapy via the most appropriate method, MDI or nebulizer.
- Administer intramuscular epinephrine in cases of severe bronchospasm or if respiratory arrest is imminent to open the airways and provide relief quickly. Intravenous epinephrine is for ACP use and should be used in severe bronchospasm or if respiratory arrest is imminent. Epinephrine, as an adrenergic agonist, can produce dramatic bronchodilation in critically ill patients.
- Glucocorticoids (i.e., dexamethasone) can be given in cases of acute asthma exacerbations where a patient does not show sustained improvement or worsens after one bronchodilator, or has a history of severe or recurrent exacerbations. If the first round of salbutamol and ipratropium do not provide sustained improvement and repeat salbutamol is required, dexamethasone should be included in the treatment plan.
- Magnesium sulfate is for ACP use and, given intravenously, can produce bronchodilation through the relaxation of smooth muscle.
- Continuous Positive Airway Pressure (CPAP) is an option for optimizing oxygenation in patients who have already received bronchodilator therapy.

**Cardiac arrest considerations:** For all asthmatic patients in cardiac arrest, and especially for patients in which ventilation is complex, the possible diagnosis of tension pneumothorax should be carefully considered and treated with extreme caution. In addition, MDI delivery of salbutamol can be considered during ventilation after cardiac arrest procedures are well-established (i.e., high-quality CPR, defibrillation).

## Additional Treatment Information

- Consider the risk of infectious disease exposure when performing interventions that produce aerosols. Nebulized medications should be given with caution to patients with a fever and a history of a respiratory illness. Use appropriate PPE as necessary. Applying a surgical mask over a nebulizer is not an effective reverse isolation technique.

- Bronchospasm is a disease of ventilation. Although the oxygen saturation may be low, this is a result of alveolar hypoventilation and does not necessarily represent a fundamental failure of oxygen uptake or delivery. Do not over-focus on oxygenation to the exclusion of ventilation. Recall that the elimination of carbon dioxide from the body depends on minute ventilation (which is in turn based on tidal volume and respiratory rate). Critical hypercarbia can develop in acute severe asthma; the patient's level of consciousness and respiratory effort must be monitored closely and aggressive action taken to support ventilation if deterioration becomes evident.
- Signs of impending respiratory failure include decreased air entry and respiratory effort, fatigue, decreasing level of consciousness, and declining respiratory rate.
- Salbutamol often provokes coughing and may temporarily worsen audible bronchospasm. Allow the nebulized medication to run its course before making additional treatment decisions unless the patient is deteriorating rapidly. In some cases, continuous nebulizer therapy can be beneficial in optimizing drug delivery to the tissues of the bronchi and should be considered if the patient continues to be significantly short of breath, but able to ventilate effectively, following the initial dose of salbutamol.
- Ipratropium is an anticholinergic agent that reduces airway secretions and acts synergistically with salbutamol as a bronchodilator. Its activity is limited to the lung parenchyma and there is little risk of systemic toxicity.

## Referral Information

Refusal of care instructions and guidelines must be followed for patients who decline to be taken to hospital.

## General Information

- Signs of acute severe asthma include tachypnea (> 30 breaths/minute), tachycardia, accessory muscle use during inspiration, diaphoresis, the inability to speak in full sentences, and the inability to lie supine. Note that not all patients with severe bronchospasm will exhibit these signs.
- Patients with bronchospasm typically have a prolonged expiratory phase, often 2-3 times longer than their inspiratory phase; this is the result of the effort required to exhale against the constricted airways. In the absence of audible wheezes in a patient who is visibly short of breath, consider the inspiratory-expiratory ratio as an additional piece of information.
- Obtaining a medical history from an acutely short of breath patient can be difficult. It is critical to ask concise, targeted questions to maximize the information return, and to minimize exertion for the patient. Investigations should be tailored towards developing an understanding of the potential for deterioration as opposed to solely establishing the severity of the disease. Severity directs the intensity of intervention, whereas a history helps predict the likely course or potential for exacerbations.
  - WHIPS is a mnemonic to help direct a clinical history for bronchospasm:
    - **W**orst you've ever had?
    - **H**ospital visits?
    - **I**CU stays?
    - **P**uffer requirements?
    - **S**teroid requirements?
- Questions should be formulated so that the patient can answer with single words or head movements.
  - Past medical history considerations
    - Hospital visits or admissions for asthma: number of previous visits or admissions; frequency of visits or admissions.
  - Current prescription drug use
    - Use of corticosteroids
    - Use of bronchodilators
    - Changes to medication doses or frequency
- A history of repeated hospital visits for asthma, with or without a concurrent history of increasing bronchodilator use, is predictive for severe disease and places the patient at risk for heightened mortality.

## Interventions

### First Responder

- Place the patient in a position of comfort, as permitted by clinical condition; in general, this will be a seated position with the patient leaning forward; limit patient movement
- Provide supplemental oxygen as required
  - → [A07: Oxygen Administration](#)
- Conduct ongoing assessment and gather collateral information, such as medications and identification documents
- May retrieve (but not administer) patient MDIs upon request
- Establish ingress and egress routes from the patient's location
- Communicate patient deterioration to follow-on responders

#### Emergency Medical Responder – All FR interventions, plus:

- Supplemental oxygen to maintain SpO<sub>2</sub> ≥ 94% (caution: may not be achievable)
  - → [A07: Oxygen Administration](#)
- ☐ **Requires completion of EMR scope expansion education:**
  - [Salbutamol](#)
  - In patients without influenza-like illness (ILI), nebulas are preferred. In patients with ILI or other infectious respiratory conditions, MDI and spacer use is strongly recommended.
- Convey early
- Consider intercept with additional resources

#### Primary Care Paramedic – All FR and EMR interventions, plus:

- [Salbutamol](#)
  - In patients without influenza-like illness (ILI), nebulas are preferred. In patients with ILI or other infectious respiratory conditions, MDI and spacer use is strongly recommended.
- ☐ **Requires completion of PCP scope expansion education or BCEHS Respiratory Assessment course:**
  - Salbutamol with [ipratropium](#) (Both salbutamol and ipratropium can be combined in the same nebulizer for co-administration purposes. Note: ipratropium is a single dose administration, while salbutamol may be repeated).
  - For severe disease or imminent respiratory failure: administer intramuscular [EPINEPHrine](#)
    - Epinephrine via intramuscular injection should be considered for a patient with SpO<sub>2</sub> < 90% and/or moderate to severe symptoms of bronchospasm that are unresolved with the use of salbutamol administered by MDIs or nebulizer treatment
  - ☐ [CliniCall consultation recommended](#) to discuss care planning options.
  - Consider [dexamethasone](#) (☐ [Clinical consultation required](#) prior to administration of dexamethasone)
- Consider CPAP
  - → [PR09: Continuous Positive Airway Pressure](#)

#### Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- [Salbutamol](#) and [ipratropium](#)
  - Consider repeated salbutamol therapy if limited/no improvement in bronchospasm symptoms
- Consider vascular access
  - → [D03: Vascular Access](#)
- Consider intravenous [magnesium sulfate](#)
- Consider intravenous or intramuscular [EPINEPHrine](#) for impending respiratory arrest; epinephrine via intramuscular injection should be considered for a patient with SpO<sub>2</sub> < 90% and moderate to severe symptoms of asthma that are unresolved with the use of salbutamol
- Consider intubation as required; ☐ [CliniCall consultation required](#) prior to attempting intubation for patients with perfusing rhythms who are breathing spontaneously.
  - → [PR18: Anesthesia Induction](#)
  - → [PR23: Awake Intubation](#)

#### Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Consider use of mechanical ventilation.
  - → [PR29: Mechanical ventilation](#)
    - Consider use of non-invasive ventilation
    - Consider invasive ventilation
    - Consider dynamic hyperinflation
      - < 3% of asthmatics develop dynamic hyperinflation. It is almost always due to breath stacking.
      - Consider decreasing breath rate to avoid breath stacking
      - Set PEEP 50-80% of the auto-PEEP
    - Consider I:E 1:3, 1:4
    - Consider reduced driving pressure < 15 cmH<sub>2</sub>O
    - Consider permissive hypercapnia
    - Volume ventilation is generally preferred to maintain V<sub>E</sub> typically 6-8 ml/kg
    - Consider ABG/VBG sampling to guide therapy
    - Consider [radial arterial line](#) placement
    - Consider [femoral arterial line](#) placement
- Consider a reduced cabin altitude if conveying by air. (Boyle's law)
- Anesthesia planning
  - Avoid morphine if possible (histamine release)
  - Consider [Ketamine](#)
  - Consider [Propofol](#)
  - Avoid [Etomidate](#) (increased airway resistance and adrenal dysfunction)
  - Consider paralytics
    - [Succinylcholine](#)
    - [Rocuronium](#)
    - [Cisatracurium](#)
- Glucocorticoids
  - [Prednisone](#) 40 mg
  - [Methylprednisolone](#) 60 mg or (0.5-1 mg/kg q6 hrs to a max of 60 mg/day pediatric)
  - [Dexamethasone](#)
- Consider use of empiric antimicrobials (azithromycin).
- [Magnesium](#) 2-4g or (25-75 mg/kg to a max of 2g pediatric)
- ☒ Call ETP prior to anesthetic gases. Consider anesthetic gas if unable to transport due to severe refractory bronchospasm. This is a temporizing measure until safe transport is possible. Must have an anesthetist capable of using the equipment and medication.
  - Consider sevoflurane or isoflurane. Avoid use of desflurane.
- Consider transport to ECMO center if not already planned.

## Algorithm

## Evidence Based Practice

Asthma

### Supportive

- [Anticholinergic](#)
- [Beta Agonist-MDI](#)
- [Beta Agonist-Nebulized](#)

- [Beta Agonist-Parenteral](#)
- [Epinephrine-Nebulized](#)
- [Hypertonic Saline-Nebulized](#)
- [Magnesium Sulfate-IV](#)
- [NiPPV](#)
- [Steroids-Inhaled](#)
- [Steroids-Oral](#)
- [Steroids-Parenteral](#)
- [Epinephrine- SQ](#)
- [Oxymetry Monitoring](#)

#### Neutral

- [Magnesium Sulfate-nebulized](#)
- [Steroids-IV](#)
- [High flow nasal canula](#)
- [Oxygen](#)
- [Epinephrine-IV](#)
- [Humidified oxygen](#)
- [Intubation](#)

#### Against

Respiratory Distress NYD

#### Supportive

- [NiPPV](#)
- [Intubation](#)
- [Oxymetry Monitoring](#)
- [Transfer of ECMO patients](#)

#### Neutral

- [High flow nasal canula](#)
- [Temperature Monitoring](#)

#### Against

## References

1. Fanta CH, et al. Acute exacerbations of asthma in adults: Home and office management. UpToDate. 2021.
2. Wenzel S. et al. Treatment of severe asthma in adolescents and adults. UpToDate. 2021.

## Practice Updates

- 2023-09-29: updated EMR and PCP interventions to add salbutamol (EMR) and ipratropium, dexamethasone (PCP)
- 2023-12-18: removed COVID-related restrictions, added information about BCEHS Respiratory Assessment Course

