

Assessing the Asthmatic Airway

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Asthma is a disease of great proportions world wide. It is estimated by the American Lung Association 17.7 million individuals are affected by asthma. Asthma is responsible for 12.9 million visits to Doctor's offices and 1.8 million visits to the Emergency Room in the United States each year.



Asthma is also a growing problem. In 1998 alone, 423,000 people were admitted into the hospital with a principal diagnosis of asthma that is a 25% increase from 1979. The death toll is also noted to be higher. In 1979, 2,598 patients died from asthma. In 1998, that number increased by 109% to 5,438 patients. Today it is estimated that two out of every 100,000 deaths are related to asthma. Asthma has a monetary impact as well costing Americans 6.2 billion dollars each year in lost wages and medical cost.

The increases are not fully understood. A greater understanding and more accurate diagnosis of asthma can affect the numbers. Misdiagnosis can affect the numbers even more. The definition of asthma varies from region to region and varies greatly from country to country. The factors that trigger asthma are also increasing. A link between asthma and environmental allergies is becoming

more apparent and as incidence of allergies increase incidence of asthma increases as well.

A link is also being found between asthma and other medical illness, many of which commonly affect children. Among the children who were diagnosed with asthma, 85% were also found to have a history of viral infection. These infections were most commonly Respiratory Syncytial Virus (RSV) or Mycoplasma Pneumoniae. The majority of these children could carry asthma into adulthood.

Asthma has also developed an occupational link. Many workers who inhale harmful agents may develop an asthma like condition call Reactive Airway Dysfunction Syndrome (RADS). The symptoms of RADS are identical to asthma but RADS does not need an allergic agent or medical condition to trigger an attack.

In this article our objective will be to

- Assess the triggers of an attack.
- We will review the anatomy of the airway and how it is affected by asthma.
- We will learn the different types of treatment options that are available and discuss their benefits as well as the downfalls.



What is Asthma?

Traditionally asthma has been a considered a disorder of the smooth muscle mediators in the airway and the anatomic elements that create mucus in the lungs. In recent years research has also found that allergic reactions to

agents in our environment can also cause asthma. Because of this, asthma is divided into two categories allergic and non-allergic. The treatment is the same for both types. The only difference is the agent that triggers the attack.

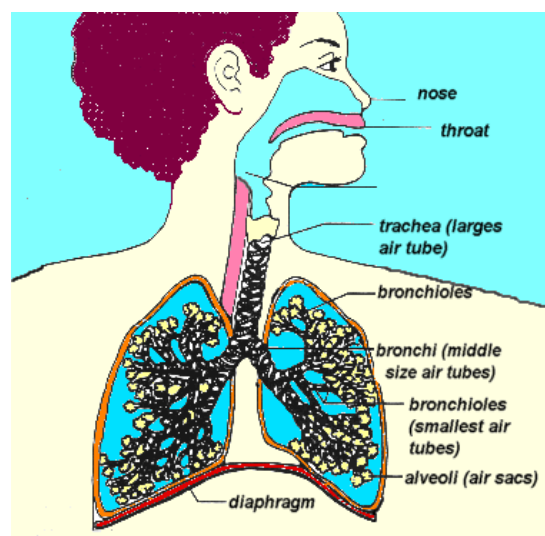
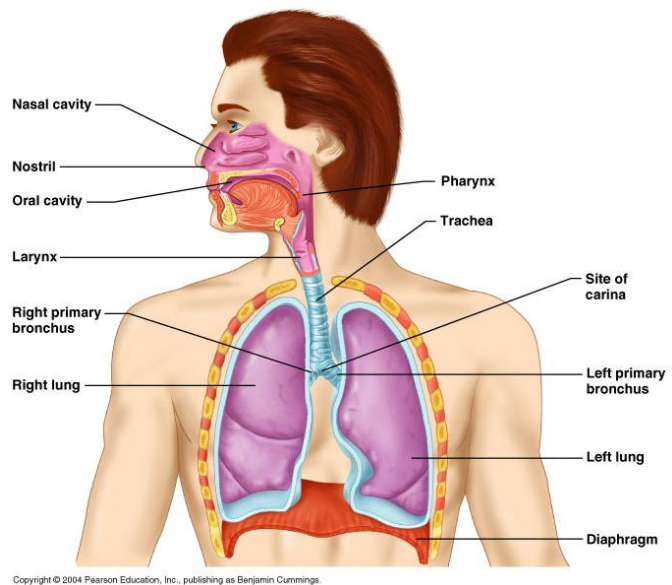
Asthma is also an inflammatory disorder that obstructs airflow. The inflammation is the result of interaction between various cells, cellular elements and cytokines that cause persistent broncospasm. Attacks can range from mild where the symptoms may go away with rest to the most severe form, Status Asthmaticus which may require tracheal intubation.

The airway is divided into two parts the upper airway and the lower airway. The upper airway is made up of four parts.

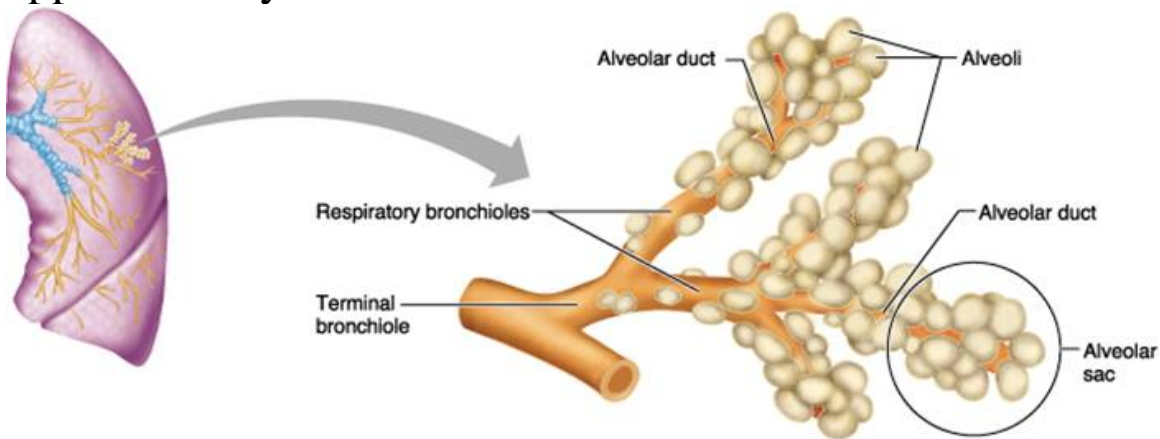
- Nasal cavity
- Oral cavity
- Pharynx
- Larynx

The lower airway consists of five parts.

- Trachea
- Bronchi
- Right and left bronchus
- Bronchioles
- Alveoli



During inspiration air is drawn into the lungs through the nose and mouth. As air travels through the nose it is filtered, warmed and moisture is added. The air continues down to the pharynx and through the glottis which is inside the larynx. Once past the larynx the air has entered the lower airway. The air travels through the trachea until it reaches the carina. At this point the air is divided into the right and left bronchus. The air will continue into the bronchioles. The bronchioles are the smallest of the non-gas exchanging structures. The terminal bronchiole is approximately 5mm



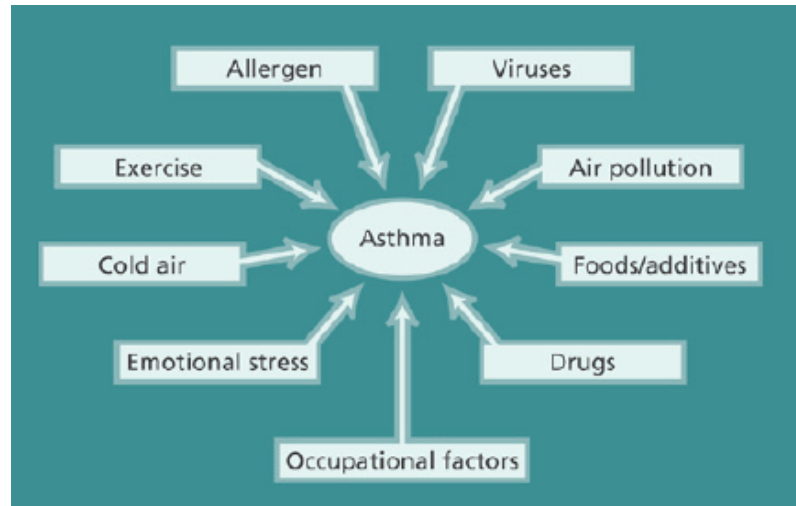
in diameter. The respiratory bronchiole and the alveoli connect to complete the airway. The point where they come together may be as small as 1 mm. Oxygen is transferred into the blood stream in the alveoli by crossing a very thin membrane.

The airway is made from cartilage and smooth muscle. Along the inside of the airway are glands which produce specialized mucus. In some cases, there are more mucous glands than normal. This leads to excessive mucus production that can obstruct the tiny airways. Smooth muscles can also respond more than normal causing constriction in the airways.

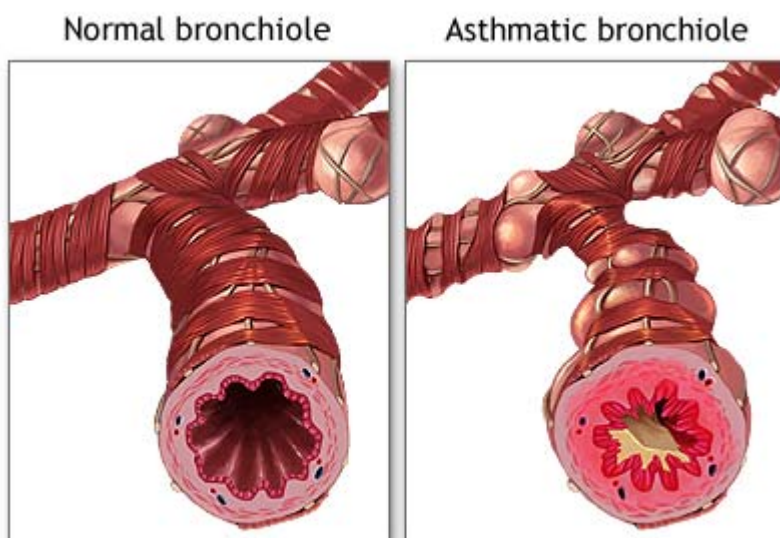
Anatomy of an Attack

Asthma attacks can be triggered by several different agents.

- Upper respiratory track infections (URTI)
- Allergens
- Airway irritants such as tobacco smoke or perfume.
- Weather changes
- Exercise
- Emotional factors (crying or anxiety)
- Gastroesophageal reflux (GERD)



As an asthma attack begins the airway becomes narrow as



the smooth muscles contract more than normal functioning lungs. This is in response to a release of histamine and

other mediators that are reacting to the trigger. Mucus glands release mucus into the airway. In some cases, this mucus may be thick and produced excessively. This mucus coats the bronchial tubes making them even narrower and creating an increased resistance to airflow that leads to a decreased expiratory flow rate and hyperinflation of the lungs. The resulting overdistention helps to keep the airway patent but also alters the pulmonary mechanics and damages the smallest part of the respiratory system, the alveoli. As the attack continues mucus begins to “plug” the terminal bronchi keeping oxygen from entering the blood stream. This is the leading cause of death of patients with asthma.

The longer that an attack goes on without intervention the slower it will respond to treatment. At times, the response will be so slow that it may appear that there is no response at all. This is when the patient is considered to be suffering from status asthmaticus. A strong rapid response to a trigger may also lead to status asthmaticus in only a few minutes.

Assessment

Patients with asthma are normally asymptomatic unless they are exposed to elements that may trigger attack. The patient or their family may know what triggers their asthma allowing you to assess the scene for the presence of a possible trigger. Learning the events leading up to the attack can help you assess the



cause of the problem.

During the physical assessment the primary symptom will be shortness of breath, other symptoms may include

- Anxiety
- Cough
- Chest tightness
- Diaphoresis.

You may also find signs such as

- Barrel chest
- Diffuse or local wheezes
- Pallor
- Pulse paradoxus (pulse becomes weaker with inspiration and stronger with expiration)
- Accessory muscle use.

In mild cases of asthma wheezing may only be heard at the end of expiration. In more severe cases, wheezing will be present throughout expiration. As the attack worsens, wheezing will be present during both inspiration and expiration. During the most severe attacks wheezing may be absent. This indicates that the smaller airways have become obstructed by mucus or that the patient is so fatigued that they are not moving enough air to make the sound.



Wheezing is not sign that is exclusive to asthma. It is important to gather a good history and consider other possibilities prior to deciding to treat the patient for asthma.

In many cases of status asthmaticus, it was found later that



the reason the patients asthma was not responding to treatment was because the patient did not have asthma. Laryngeal abnormalities, growths and foreign body obstructions can all cause wheezing.

Asthma attacks can be placed into three severity categories mild, moderate and severe.

- In a mild attack, the patient will be able to speak in sentences and will be willing to lie down. They may be anxious but are easily calmed. The patient's respiratory rate will be increased and accessory muscles will not be used. End expiratory wheezes may be present. Oxygen saturations will be above 95% on room air.
- During a moderate attack the patient will be breathless while talking and may only use short sentences. Respiratory rates will be increased and accessory muscles will be used. The heart rate will be increased and a pulse paradox may be present. The patient will have loud expiratory wheezes. In infants, trouble feeding and a short soft cry will be noted. Oxygen saturations will be between 91% and 95% on room air.
- In severe attacks the patient will be breathless even while resting. They will be very anxious, sitting upright and will be unwilling to lie down. They will only be able to speak in single words. Respiratory rate will be 30 bpm or higher. Accessory muscles will be used. The patients

pulse rate will be as high as 120 bpm and the patient may have a low blood pressure as the hyperinflated lungs are affecting the pre-load of the heart. Both inspiratory and expiratory wheezes can be heard. Pulse paradox is often present. The patients Oxygen saturations will be below 90%.

While assessing an asthma patient consideration should be given to the amount of respiratory effort being made. A patient who fits the description of one having a moderate attack but is working hard to breath will soon become tired and quickly progress into respiratory arrest.

Many patients with severe asthma may also have a history of severe attacks. While gathering the patients history, you should be sure to ask if they have ever had to be intubated or if they have been admitted into the ICU because of there asthma. You should also ask about the number of breathing treatments or puffs on an inhaler that the patient may have had as this may affect your treatment plan.

Treatment

Patients suffering from asthma should be treated quickly and aggressively with bronchodilating medications and oxygen. You should ask the patient or the patient's family what medications the patient has been taken so that the patient is not over medicated or given a medication that his asthma is resisting.



If the patient is moving an adequate volume of air then they may be started on a hand held nebulizer treatment using albuteral 2.5 mg or xopenex 1.25 mg. If the patient is too tired to hold the nebulizer then the nebulizer can be connected to a non-rebreather mask.



In the event that the patient is not able to breathe deep enough to get the medication into the bronchioles then the patient's respirations should be assisted with a BVM that has a nebulizer connected. Three adapters will be necessary in order to make the proper connections. It is important to note that the paramedic and the patient will have to work together since a breath must given by the medic at the same time that a breath is taken by the patient. It is tempting in such situations to sedate and intubate the patient and if assisting respirations is not successful then RSI should be done but if possible the patient should be allowed to remain conscious. Non-invasive positive pressure ventilation (NPPV) is a way to provide a patient airway support without intubation. NPPV has a proven and successful record in

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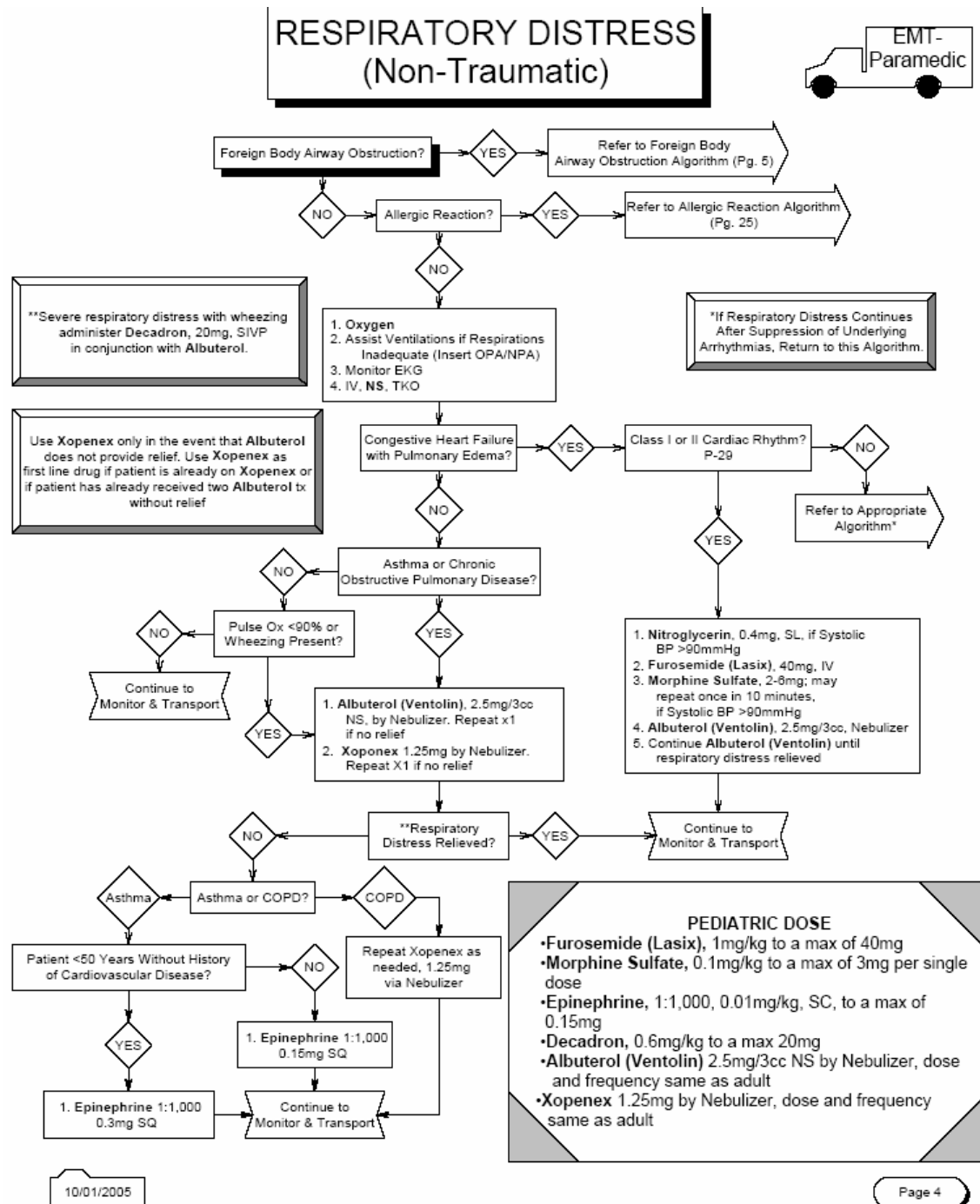
hospitals where it has been used for many years. C-PAP and BI-PAP are both forms of NPPV that are being used to ventilate patients with asthma, COPD and CHF. NPPV is especially successful in cases of acute asthma.

Since the patient is still conscious they are able to exhale with as much force as possible. This allows more of the inhaled medication to get into the lungs with deeper penetration into the lower airway where the medication may be needed most. In patients who have been intubated emptying of lungs is dependent on the elasticity of the lungs and ribcage.

In the event that the patient's level of consciousness becomes decreased then intubation should be performed in order to improve the patient's tidal volume and to protect the airway from aspiration. An intubated asthma patient should be given slow deep breaths. The lungs should be kept inflated longer than normal to give the oxygen and medication time to penetrate the mucus. A long expiration time should also be given to allow the lungs to empty. End tidal monitoring is especially useful because you can see when the patient has stopped exhaling.

Caution should be used however with patients who are intubated. Pneumothorax can occur whenever a PEEP valve is being used or when the patient is being aggressively ventilated. This is a particular concern when the lungs are all ready hyperdistended and the treatment

being given results in more distention then the plural lining of the lungs can tolerate.



The SPEMS protocol allows use of seven different medications under the “Respiratory Distress Non-Traumatic” algorithm. Among these, four medications are used for the treatment of asthma. Lubbock EMS also carries one medication Brethine (terbutaline) under variance. Brethin does not appear in the algorithm but Lubbock EMS may still use it with out gaining orders from medical control for the treatment of COPD (per 2003 protocols) but not for the treatment of asthma unless medical control gives you an order.

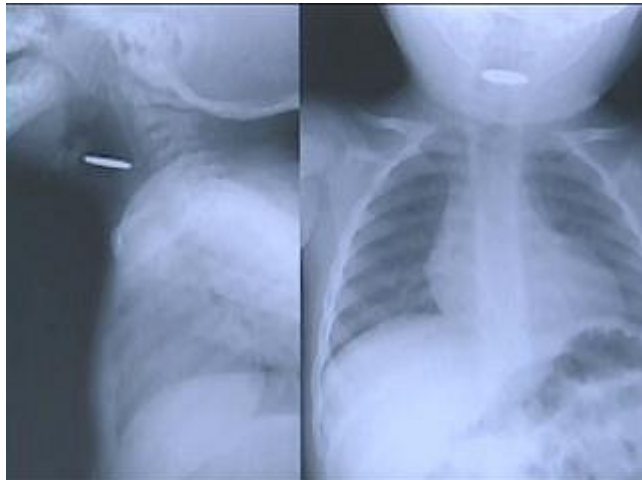
- Albuteral relaxes bronchial smooth muscle by acting on beta-2 receptors. It has little effect on cardiac muscle contractility but may cause tachycardia. It is administered as an inhaler with a dose of 90 mcg/puff or it may be nebulized with oxygen at a dose of 2.5 mg mixed 3 cc of normal saline. The dose is the same for children as it is for adults. Since albuteral acts on beta receptors patients who take beta blockers may have a diminished response. You should use caution when administering albuteral to patients with a cardiac history since the tachycardic side affects increase myocardial oxygen demand. Albuteral is the first line med for treating asthma but if a patient has already received albuteral and did not relive the asthma then xopenex should be used. Xopenex should also be used as the first line drug if that is the medication that the patient uses. Albuteral should be repeated once prior to switching to xopenex.
- Xopenex (levalbuterol) relaxes bronchial smooth muscle by acting on selected beta-2 receptors.

Xopenex has very little effect on the heart. It is administered by nebulizer at a dose of 1.25 mg. The dose for children is the same as adult. Beta blockers also affect the efficacy of xopenex. Xopenex should be used if it is the medication that the patient has been prescribed for home use or if the asthma is not responding to albuteral. Xopenex may only be repeated once.

- Decadron (Dexamethasone) is a corticosteroid that is similar to a hormone produced in the human adrenal gland. Decadron is a fast acting medication used to treat inflammatory diseases including asthma and severe allergic reaction. It has no short term side affects. Decadron is given to patients with severe shortness of breath and wheezing. The dose for Decadron is 20 mg slow IVP. In children decadron is given 0.6 mg/kg to a max of 20 mg. Decadron is only given once and is not repeated.
- Epinephrine 1:1000 has a long history in treating asthma. Epinephrine is a naturally occurring neurotransmitter that has both alpha and beta qualities. The therapeutic action for asthma is through its beta effects. Epinephrine relives broncospasms, decreases swelling and causes broncodialation. Epinephrine affects beta receptors so it may be inefficient in patients who take beta-blockers. Epinephrine increases the heart rate and myocardial contractility. Epinephrine likewise increases the myocardial oxygen demand as well. It should not be used for patents that also have a cardiac complaint. The dose for

epinephrine 1:1000 is 0.3 mg sq for patients younger than 50 years old that do not have a cardiac history. For patients that are older than 50 years old or have a cardiac history a smaller dose should be given, 0.15mg sq.

When navigating through the algorithm the paramedic must make some decisions based upon their assessment and diagnosis of the problem. First of all is this a foreign body obstruction? Patients who are severely hypoxic may not be able to tell you if their distress started as a foreign body obstruction. Assessment of breath sounds should be able to provide you with an answer. If wheezes are localized in one spot then you may suspect an airway obstruction. If the wheezing is wide spread then asthma is a more likely possibility.



Your next decision will deal with the possibility of an allergic reaction.

Asthma is commonly the result of a response to allergens. Based upon your assessment you should decide if the patient will benefit more from the treatment of allergies or asthma. The primary difference between the two treatments is the use of Benadryl and if needed the two algorithms can run concurrently.

As for the rest of the decisions in the algorithm it is up to the medic to decide the best course of treatment for the

patient based upon their assessment. Keep in mind that “all that wheezes is not asthma”. In a patient with CHF and asthma, wheezing may just as easily be related to CHF as it is the asthma. Asthma also shares many of the same symptoms as COPD and many patients have both. It is up to the medic to decide the best options for the patient. Constant reassessment is critical for determining the effectiveness of your treatment.



In almost all cases the best treatment for the patient is prompt transport to the emergency department. More time spent in the field results in the options running out before you reach

definitive care. In severe cases where a long transport time is expected air transport should be considered.

Credits

“Asthma” Peter Canaday MD FCCP 12/06/04

“Asthma” Girish Sharma MD 8/24/05

“Asthma” Michael J Morris MD 12/06/05

“Status Asthmaticus” Constantine Saadeh MD 6/4/04

“Status Asthmaticus” Adam Schwarz MD 6/2/04

SPEMS Protocol 2005 and 2003

Special Thanks to Dr. Sasin for protocol clarification.

Photographs and graphics were found using Google image search.

BVM/Nebulizer photograph taken by L. Forbes