Lung Diseases: When It Could Be Your Patient's "Last Gasp"

by Sylvie Mulvaney and Louis A. Sforza

EMT Objectives

After reading this article, the EMT will be able to:

- list some of the more common lung diseases and their symptoms;
- describe the pathophysiology and causes of these diseases;
- explain how to assess various lung disease patients and interventions for acute episodes of the diseases;
- describe how the respiratory system works.

Introduction

Lung disease refers to any problem in the lungs that prevents them from working properly. There are 40 ailments on the American Lung Association Lung Disease List, from acute bronchitis to tuberculosis. How many of them will you face during patient encounters throughout your EMT career? Which lung diseases are you most likely to confront and what can EMS do for these patients?

Shortness of breath (SOB) or difficulty breathing calls to 911 are fairly common, but none should be "routine." Trouble breathing is serious business – it is, after all, the "B" in the EMS "ABC" acronym – and can be anxiety producing for the EMT as well as the patient. Every patient, every situation is different, and should be approached with a fresh perspective.

Because there are so many lung diseases, some of which are extremely rare, this article will focus on a handful of the more common ones, including (alphabetically) asthma, cancer, chronic obstructive pulmonary disease (COPD), pulmonary edema and pulmonary embolism. We'll review pathophysiology, causes, assessment and interventions for these diseases, as well as statistics, when available.

Some lung disease signs and symptoms, especially during acute exacerbations, might appear similar: anxiety; altered mental status; dizziness; confusion; cyanosis; coughing; fatigue. The processes of each disease, however, affect the body in different ways. Knowing how lung diseases affect the body will help give the EMT clues on what to look for and how best to help each patient.

Interventions discussed include many that are outside of the EMT's scope of practice, but they are worth noting to help in the EMT's understanding of the diseases.

Before delving into the diseases themselves, however, we'll review the respiratory system and anatomy – especially the lungs – how they work, what they do and what can happen when there is a breakdown in the system.

The Respiratory System

The respiratory system is comprised of several structures that enable ventilation and oxygenation. Inhalation moves oxygen into the bloodstream. Blood cells pick up carbon dioxide, which is then excreted through exhalation. We'll discuss the actual respiration process while reviewing the structures themselves.

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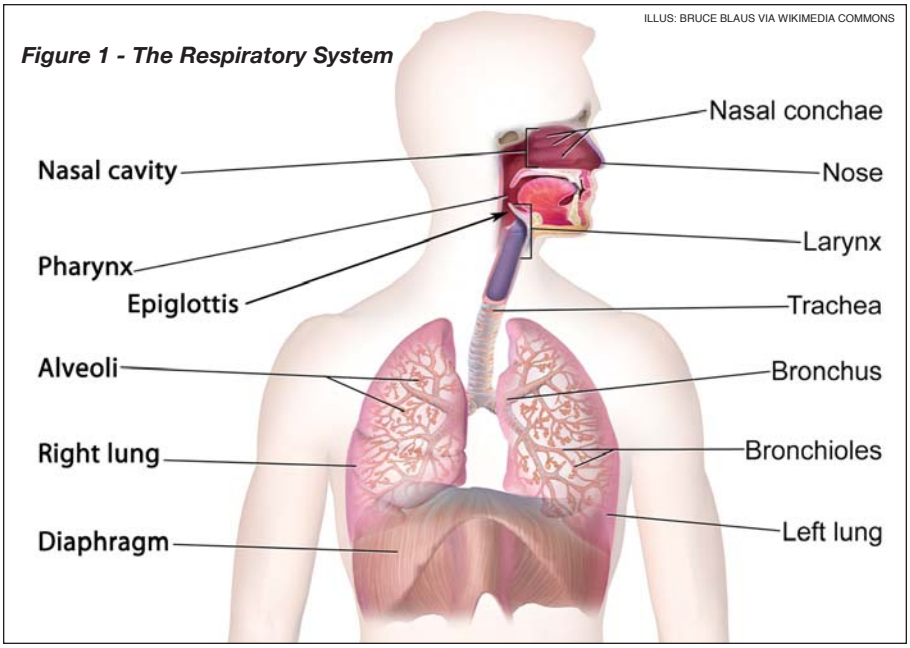
Figure 1 - The Respiratory System



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The Upper Airway

The upper airway starts at the nose and mouth, and extends to the cricoid cartilage, the ring-shaped structure that forms the lower portion of the "voice box," or larynx. Air entering the nostrils is warmed, moistened and filtered before it continues through the nasopharynx, the area directly posterior to the nose. Air also enters the mouth and through the oropharynx, the area directly posterior to the mouth. Together, the nasopharynx and oropharynx are called the pharynx, or the throat. *(See Figure 1.)*

At the lower portion of the pharynx, just below the thyroid cartilage (also known as the "Adam's apple") and the cricoid cartilage, are the trachea, which is the passageway for air to the lungs, and the esophagus, through which food and water travel to the stomach. A small, leaf-shaped flap of tissue at the top of the trachea, called the epiglottis, opens to allow breathing and closes during swallowing to prevent food and fluids from entering the trachea. It also helps keep air from entering the stomach through the esophagus. If the epiglottis fails to close, food, fluids, vomit, blood, secretions or a foreign object can enter the larynx and trachea, cause an obstruction and force a person to choke. Anything but air that reaches the lungs can also cause an infection.

A small, leaf-shaped flap of tissue at the top of the trachea – the epiglottis – opens to allow breathing and closes during swallowing to prevent food and fluids from entering the trachea.

The Lower Airway

The lower airway starts at the cricoid cartilage and extends to the alveoli in the lungs. The trachea, or windpipe, extends from the larynx to the carina, the point at which it divides (bifurcates) into its to major branches, the right and left mainstem bronchi. These cartilaginous bronchi extend into the lungs, like tree branches, splitting into increasingly smaller sections called bronchioles. Lined with smooth muscle and mucus membranes, the bronchioles can contract. When the mucus membrane becomes irritated and swollen – as in asthma – it can lead to narrowing or constriction of the bronchiole and increased airway resistance that makes moving air in and out of the alveoli more difficult. Work of breathing (WOB) as a result of increased airway resistance can lead to fatigue and respiratory failure.

At the end of the bronchioles are thousands of tiny air sacs called alveoli, where the gas exchange – oxygen and carbon dioxide – occurs with the bloodstream.

Made of elastic tissue, the lungs expand and recoil. The right lung is divided into three lobes; the left lung into two lobes. Surrounding the lungs are two layers of connective tissue called the pleura. The visceral pleura is the moist, innermost membrane that adheres to the lung tissue. The parietal pleura is the moist, thicker, more-elastic membrane that adheres to the chest (thoracic) wall, diaphragm and mediastinum, the central compartment of the thoracic cavity. Between these two layers is the pleural space, which contains serous fluid that acts as a lubricant when the layers rub against each other.

The diaphragm is a large muscle that separates the thoracic and abdominal cavities. During inhalation, the rib cage muscles (intercostal muscles) and the diaphragm contract. The diaphragm lowers and the ribs move upward and outward. This expands the size of the chest and creates negative pressure inside the chest cavity, pulling air into the lungs. During exhalation, the diaphragm and intercostal muscles relax. The ribs move downward and inward, and the diaphragm rises. With this, the chest becomes smaller and positive pressure builds inside the chest cavity, pushing air out of the lungs.

During inhalation, air moves through the airway into the alveoli, where the gas and carbon dioxide are exchanged with the pulmonary capillaries that surround each alveolus. This is called ventilation.

Oxygenated blood moves from the lungs to the heart, which pumps it into the body's circulatory system. The blood travels through the arteries to, eventually, capillaries. Oxygen that was carried by the blood from the lungs is transferred through the capillary walls into the cells. Carbon dioxide moves into the capillaries, then to the veins, which return to the heart and lungs, and the process begins anew. The process of moving gases and other nutrients between cells and the blood is called respiration.

Breathing (inhaling and exhaling air) is either adequate – sufficient to support life – or inadequate. The EMT's assessment involves not only counting patient respirations (not guessing a number), but also evaluating the patient's breathing effort and chest movement. In addition, knowing normal respiratory rates for your patients *(see Figure 2)* is key.

Lung Diseases

Asthma: Asthma is a lifelong, or chronic, disease that can't be cured, but its symptoms and exacerbations can be controlled. Asthma can strike the young and old. Asthma attacks can be fatal, but between episodes, patients can be perfectly healthy.

Pathophysiology – Inflammation of the air passages results in a temporary narrowing of the airways (bronchioles) that carry oxygen to the lungs. In

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Figure 2 - Normal Patient Respiratory Rate Ranges

Age	Breaths Per Minute
Newborn	30-50
1-5 months	30-40
6-11 months	25-35
1 year	20-30
2-5 years	15-25
6-12 years	12-20
13+ years	12-18

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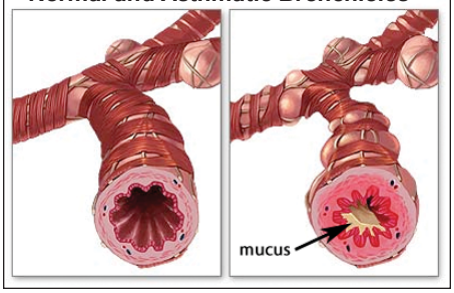
addition, overproduction of thick mucus occurs. *(See Figure 3.)*

Figure 3 - Normal and Asthmatic Bronchioles



Causes – No one knows why some people have asthma and some don't, but it's believed a combination of environmental and genetic factors, as well early childhood respiratory infections are to blame. Allergens and irritants that can trigger asthma symptoms include: insect bites; airborne pollen and pollutants; animal dander; mold; dust; cold symptoms; cold weather; exercise; certain medications; anxiety, stress or emotional episodes; some foods or additives.

Assessment – Symptoms include coughing, wheezing, SOB and complaints of chest tightness. Assess the patient for tachypnea, work of breathing (WOB), accessory muscle use, conversational dyspnea. Auscultate for evidence of wheezing, diminished, tight or inadequate lung sounds.

Interventions – Avoiding triggers; "rescue" inhalers; albuterol; steroids; prompt transport to the nearest ED. If available, advanced life support (ALS) can administer albuterol nebulizer treatments en route, if necessary.

Statistics – From the Centers for Disease Control and Prevention (CDC):

- Adults with asthma – 18.7 million (2012 figure)
- Children with asthma – 6.8 million (2012 figure)
- Emergency Department (ED) visits annually due to asthma – 1.8 million (2011 figure)
- Deaths due to asthma – 3,630 (2013 figure)

Cancer

Lung cancer is complicated. Anyone can get lung cancer, although some factors (listed below) increase a person's chances of developing the disease. It kills so many people because it is difficult to diagnose during its early stages.

Pathophysiology – Lung cancer occurs when cells in the lungs mutate or change.

Causes – They include: smoking; radon; exposure to carcinogens; pollution; genetic predisposition.

Lung cancer kills so many people because it is difficult to diagnose during its early stages.

Assessment – Patient's reported history; diminished or absent lung sounds, especially over fields where a lung or partial lung has been removed; thin or cachectic patient.

Interventions – They include: supplemental oxygen; prompt transport to the nearest hospital; inhalers; albuterol; steroids; radiation; chemotherapy.

Statistics – From the American Lung Association:

- People affected annually in the U.S. – more than 370,000
- It's the leading cancer killer in men and women in the U.S.
- Lung cancer causes more deaths than colorectal, breast and prostate cancers combined. An estimated 158,040 Americans are expected to die from lung cancer in 2015, accounting for approximately 27 percent of all cancer deaths.
- Blacks – men especially – are more likely to develop and die from lung cancer than persons of any other racial or ethnic group.
- The lung cancer incidence rate for black women and white women is roughly equal.
- Lung cancer causes the most cancer deaths worldwide, accounting for 1.3 million deaths annually.

Chronic Obstructive Pulmonary Disease (COPD)

COPD includes emphysema, chronic bronchitis, black lung and other respiratory illnesses that cause similar symptoms. COPD mostly affects middle-aged or older people because their symptoms develop over time, as lung tissues react and change to irritants.

Pathophysiology – With emphysema, the alveolar walls break down, reducing the surface area available for gas exchange. The lungs lose some of their elasticity. Stale, carbon dioxide-laden air is trapped in the lungs. With chronic bronchitis, the bronchiole lining is inflamed and excess mucus is produced. The damaged or destroyed hair-like cilia cannot help sweep away the excess mucus accumulations. *(See Figure 4.)*

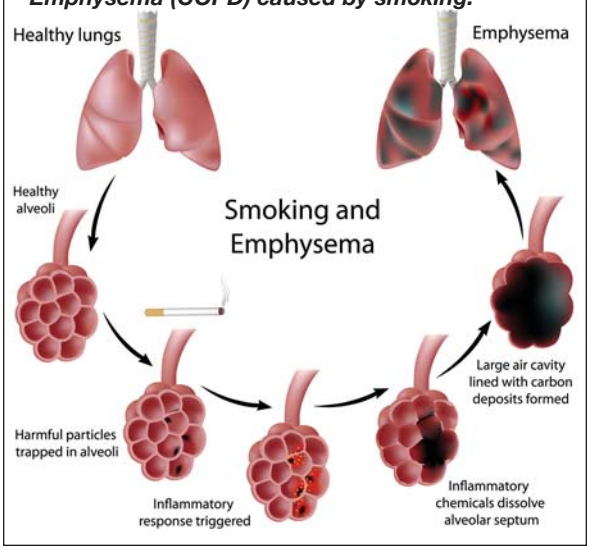
Causes – Smoking is the main cause, but chemicals, pollutants and frequent lung infections can contribute.

Assessment – They include the patient's reported history; SOB; dyspnea on exertion; fatigue; diminished or absent lung sounds; flaring nostrils; pursed lips; cyanosis; coughing; wheezing; straining neck and facial muscles; accessory muscle use; tripod position; fever; green or dark sputum.

Interventions – They include: supplemental oxygen; prompt transport to the nearest ED; inhalers; albuterol; steroids.

Statistics – From the American Lung

Figure 4 - Emphysema (COPD) caused by smoking.



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Association:

- COPD is the third leading cause of death in America, claiming 134,676 lives in 2010.
- For more than a decade, more women than men have died of causes attributable to COPD.
- According to one survey, half of all COPD patients say their condition limits their ability to work. It also limits them in normal physical exertion, household chores, social activities, sleeping and family activities.

Smoking is the main cause of COPD but chemicals, pollutants and lung infections can contribute.

Pulmonary Edema

Pulmonary edema is the abnormal accumulation of fluids in the alveoli.

Pathophysiology – When the left side of the heart is damaged, it has difficulty pumping out to the rest of the body the blood it has received from the lungs. Pressure then builds up for the lungs, and fluid accumulates in the alveoli. This impairs gas exchange and causes SOB. Patients with congestive heart failure (CHF) often have failure to both sides of the heart. If the right side of the heart, which receives fluid from the systemic circulation, can't adequately pump, the fluid backs up into the systemic circulation, causing lower extremity edema.

Causes – Heart failure, myocardial infarction; low atmospheric pressures of high altitudes.

Assessment – Patient's report of orthopnea (inability to lie flat), increasing dyspnea, rapid (fluid) weight gain, anxiety, pale skin, diaphoresis, elevated heart rate, respirations and blood pressure, and a low oxygen saturation. On lung auscultation, crackles and wheezes might be present.

Interventions – High-flow supplemental oxygen via mask unless ventilation is required; keep the patient's legs in a dependent position to avoid allowing fluid to back up into the already overloaded circulatory system; prompt transport to the nearest ED. ALS might be able to administer medications, such as Lasix and nitroglycerin, to help ease the patient's symptoms.

Statistics – From the Centers for Disease Control and Prevention:

- Pulmonary edema is more common among women, non-Hispanic blacks, and people age 75 or more.
- Pulmonary edema occurs at all ages, and the incidence of it increases with age.

Pulmonary Embolism

Pulmonary embolism (PE) occurs when a blood clot lodges in an artery in the lung, blocking blood flow to part of the lung.

Pathophysiology – The more vessels blocked, the more severe the condition, obviously. Blood clots often originate in the legs and travel up in the

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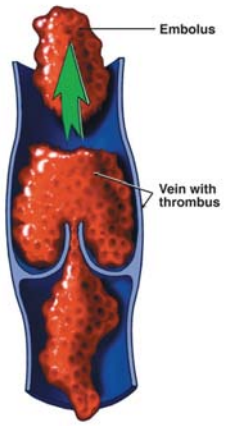
inferior vena cava, through the heart's right atrium and right ventricle before reaching the pulmonary arteries. *(See Figure 5.)* In cases of atrial fibrillation, clots can originate in the right atrium of the heart.

Due to its wide range of differential diagnoses, PE often is difficult to identify in young people who typically are in good health and have good pulmonary reserve. For people with comorbid factors such as CHF, COPD or hypertension, even a small clot can cause symptoms.

Figure 5 -
Cut-away view through vein with an embolus breaking off and traveling up towards the heart and lungs



A thorough patient history – and a high index of suspicion – can help the EMT narrow the list of probable causes of the patient's symptoms.

Causes – Three predisposing factors are: local trauma to a vessel wall; stasis of the blood; and hypercoagulability. This is known as *Virchow's Triad.* The EMT should look for a history of cigarette smoking, a prior blood clot, sedentary lifestyle, long-bone fractures, pregnancy, recent hip or leg surgery, contraceptive use or stasis of position, as would be the case with a long car trip or air travel.

Assessment – PE patients can present with acute onset of dyspnea without explanation, diaphoresis, cough, anxiety, tachycardia and tachypnea, complaints of pleuritic chest pain or lower back pain, a change in mental status due to hypoxia, cyanosis, even sudden death. Good auscultation of lung sounds is a must.

Interventions – Ensure adequate oxygenation with either supplemental oxygen via nasal cannula, nonrebreather mask or a bag-valve mask and transport the patient promptly to the nearest ED.

Summary

Shortness of breath complaints are staples in any EMT's call diet. Although symptoms might appear similar from call to call, the causes can be completely different. By familiarizing yourself with some of the more common reasons patients develop difficulty breathing, you will be more confident and better able to help your patients.

And as a rule, it's always best to request ALS assistance for respiratory calls. You can always cancel the paramedics if, once you arrive, you find they aren't needed.

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Resources: American Lung Association - www.lung.org; Centers for Disease Control and Prevention - www.cdc.gov; Mayo Clinic - www.mayoclinic.org; National Institutes of Health - www.nih.gov

A Personal Perspective…

According to the American Lung Association, 70,759 U.S. women died of lung cancer in 2012. My 74-year-old mother was one of them.

Mom had always been a healthy, active person. She never smoked, but was exposed to second-hand smoke in public (as were most people before public smoking became less accepted) and before she forced my father to quit decades ago. As far as she knew, she hadn't been exposed to asbestos or any other such carcinogens.

Her only health issues were high cholesterol (she grew up in France, loved cheese) and osteoporosis. Based on symptoms she described to me, I suspect she also experienced at least a couple of transient ischemic attacks with no apparent lasting effects during her last few years.

In late 2009, a routine chest x-ray showed a nodule on the upper lobe of her right lung. After the lobectomy in early 2010, her physicians told her she needed no radiation or chemotherapy. For more than a year, her follow-up visits, x-rays and CT scans looked great.

The cough started in the second half of 2011 and grew more persistent. Then there was the rapid weight loss. By the summer of 2012, she had developed multiple lung nodules, including a large one on her right bronchus – the cause of much of her coughing.

In late summer, when diminishing eyesight developed into sudden, total vision loss in her left eye, Mom reluctantly agreed to a lumbar puncture, which confirmed the cancer had spread to her brain. Despite chest radiation, followed immediately by brain radiation – Mom refused chemotherapy – her decline was rapid and not without complications. Mom died days after Superstorm Sandy, on Nov. 2, 2012.

So what caused my mom's lung cancer? We'll never know for sure. My money is on radon, an invisible, odorless, tasteless, radioactive gas. It's the second leading cause of lung cancer. She'd done remediation in her retirement-community home – or so she thought – after test results indicated high radon levels. She was still waiting for the post-remediation test results when she entered hospice care.

As for the smoking stigma often associated with lung cancer, I admit my siblings and I agreed her obituary should include that she was a non-smoker. Nothing against people who do smoke. I can't explain it; it is what it is. *- SM*