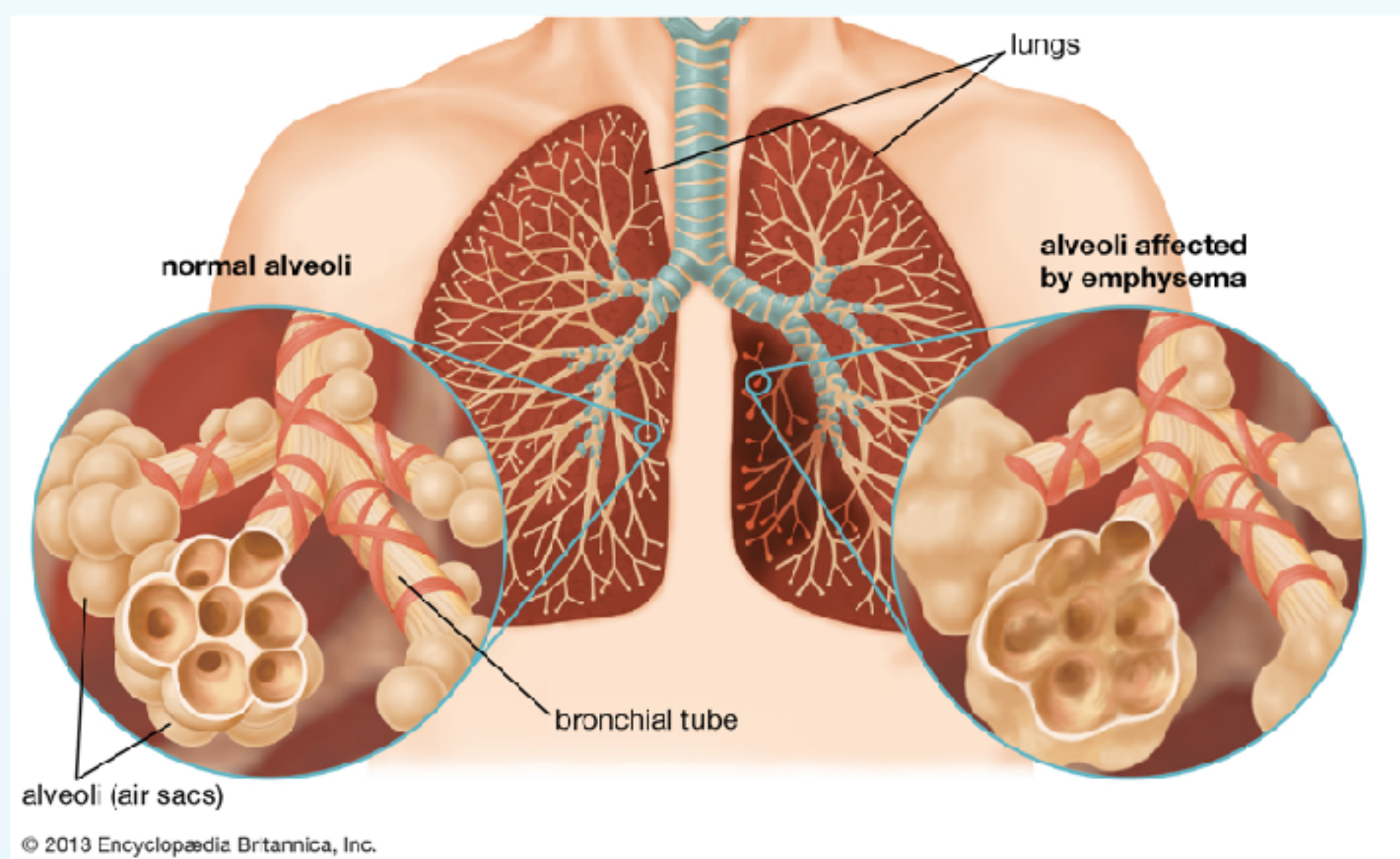


Imaging Breathes New Life to Chronic Obstructive Pulmonary Disease (COPD)

What is COPD?

Chronic obstructive pulmonary disease (COPD)

- One of the most common respiratory diseases in the US
- Most often seen in those who are avid smokers or those exposed to harsh chemicals, smoke or inhalants over a long period of time (i.e farming or construction).
- More prominent in those over the age of 40
- The first stages of COPD are very difficult to diagnose and when symptoms are noticeable, there is already significant damage to the lungs.
- Starts with a dry nagging prominent cough and shortness of breath that worsens.



- Diagnostic breathing tests and radiographic imaging are crucial in diagnosing and tracking the progression within patients.
 - Radiographic procedures give insight to the respiratory system, as well as, helping therapeutically.

Diagnostic Scans used to Diagnose COPD

- Computed Tomography (CT)
- Nuclear Medicine
- Single Photon Emission Computed Tomography (SPECT)
- Positron Emission Tomography (PET)
- Magnetic Resonance Imaging (MRI)
- These scans can be used to evaluate the visualization of pulmonary structures and function in patients with COPD, as well as, rule out other diseases that may be causing the symptoms.
- Chronic obstructive pulmonary disease may not be curable, but with the help of imaging, the life expectancy is much higher.

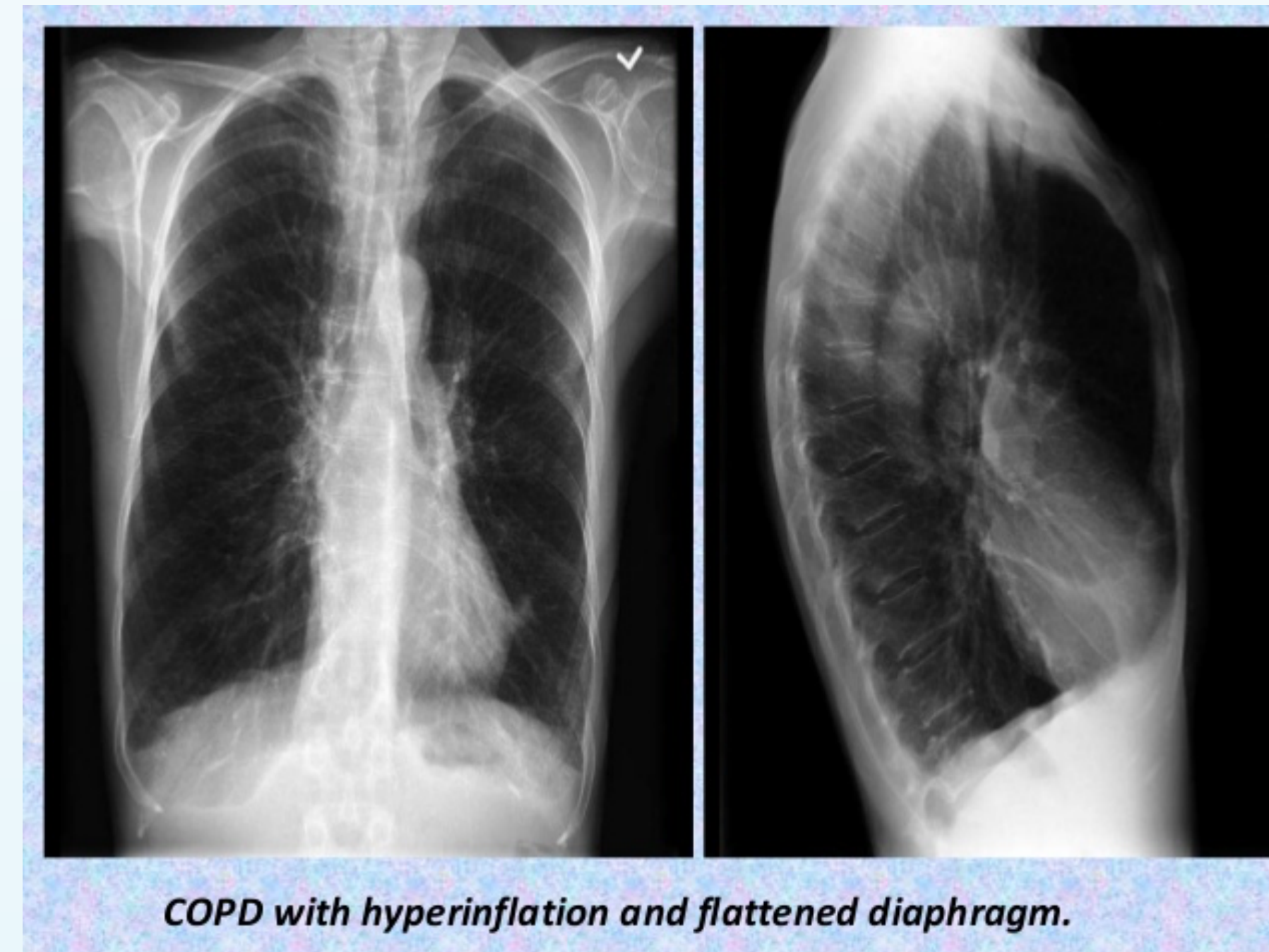
Symptoms of COPD

- Shortness of breath
- Mucus production
- Wheezing
- Chest tightness
- Chronic cough
- Frequent respiratory infections
- Lack of energy
- Unintended weight loss
- Swelling in the ankles, feet or legs
- Patients are likely to experience episodes called exacerbations, which is when their symptoms become worse than the usual day-to-day variation and persist for at least several days.

Diagnostic X-ray

Chest Radiographs

- Two view chest x-rays are usually acquired when a patient is suspected to have the COPD.
 - Shows the size, shape, and overall condition of the patient's lungs.
- Those with COPD will have thinner chest walls and a flattened diaphragm compared to normal chest anatomy.
 - Pulmonary vascular changes, including thickening of the vessel walls of the lungs, are characteristic markings of COPD.



Associated Illnesses

- Emphysema and chronic bronchitis are two major illnesses associated with the disease and their markers can be noted in the lungs with the help of radiographic imaging.
- **Emphysema:** A condition in which the alveoli at the end of the bronchioles of the lungs are destroyed as a result of damaging exposure to cigarette smoke and other harsh chemicals.
- **Chronic Bronchitis:** Inflammation of the lining of the bronchial tubes, which carry air to and from the alveoli or air sacs of the lungs.
- The main symptom with these illnesses is an ongoing cough with production of sputum.

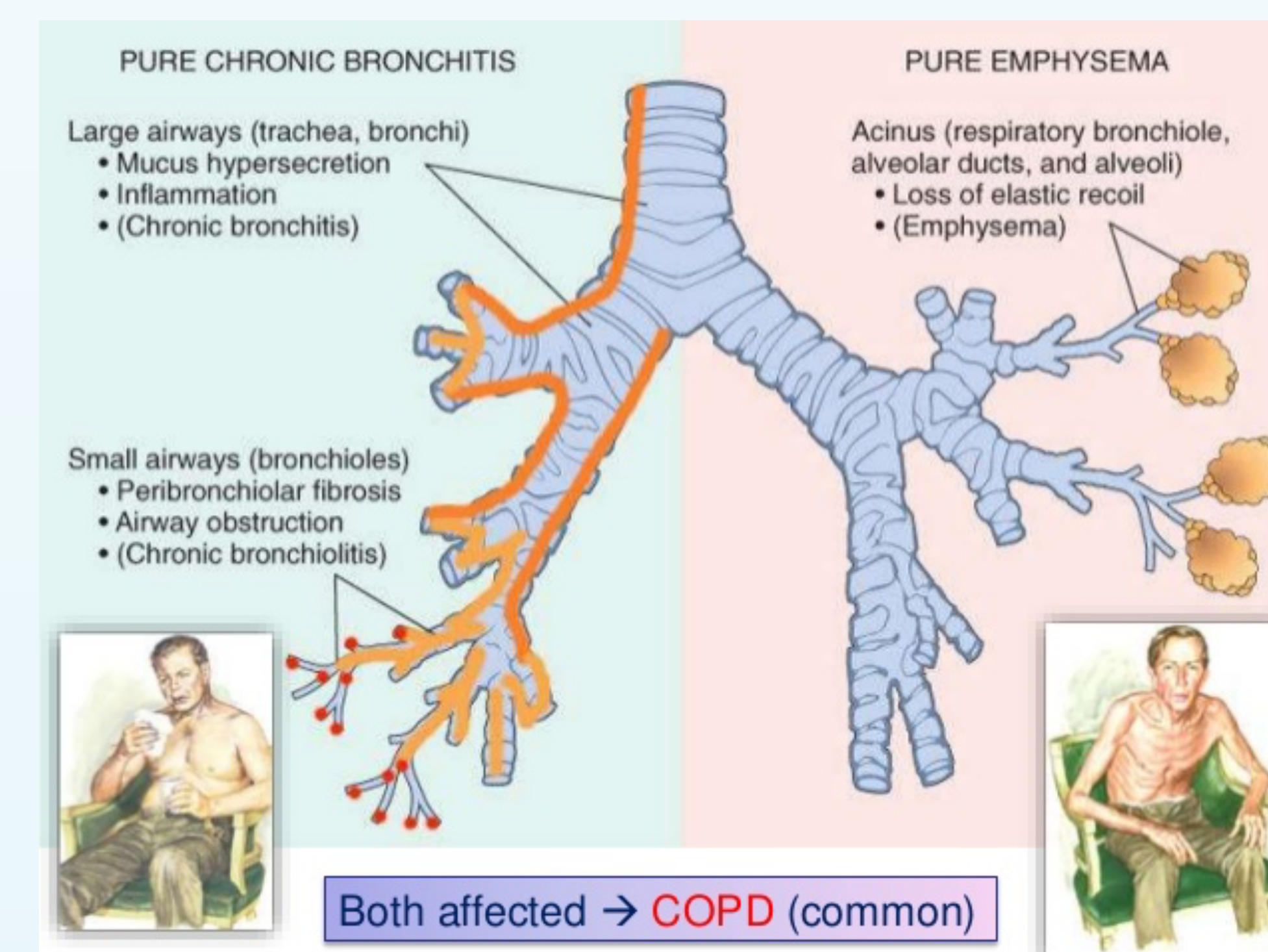
Computed Tomography

- Equipped with the technology to remove overlapping structures and anatomy to obtain a better view of the respiratory structures.
- CT has relatively high spatial resolution, and high signal-to-noise ratio.
 - Shows the anatomy of the trachea, lungs, and diaphragm in better detail than a diagnostic x-ray.
- Apparent x-ray attenuation values of the lungs obtained during a CT scan can be used to estimate lung density.
 - Values can then be combined with lung volume to calculate lung mass, tissue volume, and airspace volume.
 - Used to determine the severity or stage of a patient's COPD.

- The more abnormalities found in the initial CT scan, the more likely the patient is to have additional imaging ordered such as SPECT and PET scans.

- Emphysema and bronchitis are also visible in CT scans using specific techniques, such as the threshold cutoff and percentile point analysis.

- **Threshold Analysis:** Uses a predetermined cutoff value of attenuation values to separate emphysematous from unaffected lungs.
- **Percentile Method:** A specific point on the frequency distribution curve of the X-ray attenuation values is defined and compared between subjects or groups of subjects.



Nuclear Medicine

Computed Tomography in Nuclear Medicine

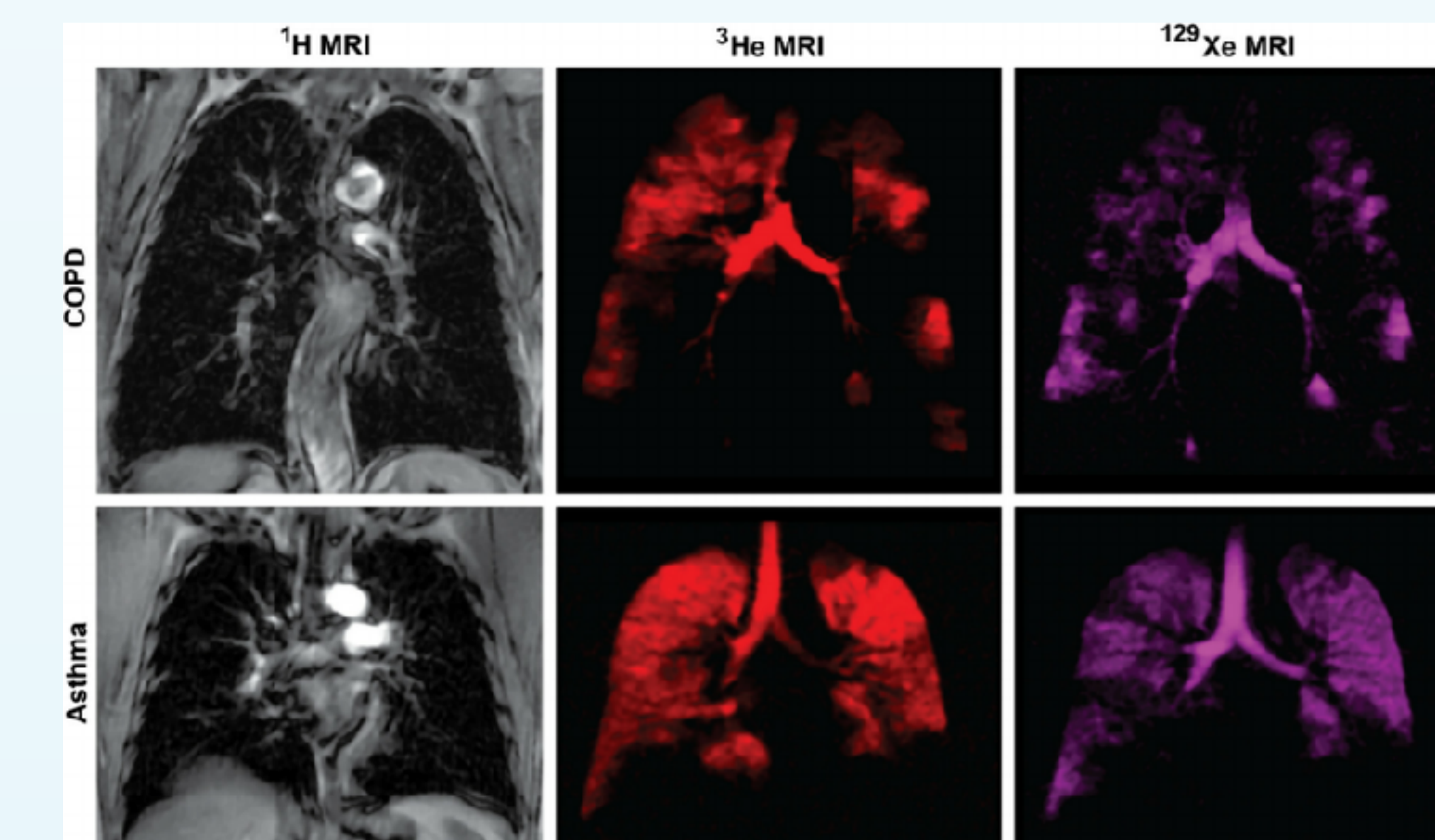
- SPECT is a nuclear medicine technique combined with the use of computed tomography that gives a 3-dimensional functional map of the ventilation and perfusion of the lungs.
 - Typically used to diagnose or follow up on the possibility of a pulmonary embolism.
 - More sensitive than a normal CT scan in detecting early airway changes and can differentiate between healthy airways and those damaged by COPD.
 - Can also be used to grade the degree of small airway obstruction.
- PET is based upon the detection of regionalized concentrations of a positron emitting radionuclide.
 - A radionuclide tracker is placed in the body with the help of a glucose molecule that makes its way to the patient's lungs.
 - Visible changes to the lung structures such as emphysema, suggest that at least part of the progression of COPD is due to vascular remodeling.

Magnetic Resonance Imaging

- MRI is not commonly used to help diagnose COPD, due to the excess amount of air in the lungs.
 - Lung parenchyma is predominantly composed of alveolar ducts and alveoli, which are air filled, so very little signal will be detected from the small amount of tissue present

Advanced MRI Procedures

- Technologists can perform enhanced studies using MRI with added oxygen and other inhaled gases like helium and xenon.
 - The added oxygen takes advantage of the physical properties of molecular oxygen resident in the lung.
 - When dissolved in blood, molecular oxygen shortens the T-1 relaxation time of the pulmonary venous blood, and this translates to an increased MR signal.



Gadolinium Enhanced

- Another additive that may be used to enhance or achieve a better view of a patient's respiratory system is injecting an intravenous contrast called gadolinium.
 - Provides sensitive and relatively reproducible measurements of signal increase and its change over time.
 - Contrast travels to the lungs which will show white or lighter against the rest of the surrounding anatomy that appears grey or dark.
 - The respiratory system is highlighted making the focal point of the images easier to visualize.
- In severe cases of COPD, this enhanced study can show signs of decreased pulmonary blood flow within the lungs.

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