**Respiratory Failure**

results from inadequate gas exchange by the respiratory system, meaning that the arterial oxygen, carbon dioxide, or both cannot be kept at normal levels. A drop in the oxygen carried in the blood is known as hypoxemia; a rise in arterial carbon dioxide levels is called hypercapnia. Respiratory failure is classified as either Type 1 or Type 2, based on whether there is a high carbon dioxide level, and can be acute or chronic. Respiratory failure causes an altered mental status due to ischemia in the brain.

The typical partial pressure reference values are oxygen Pa O2 more than 80 mmHg (11 kPa) and carbon dioxide Pa CO2 less than 45 mmHg (6.0 kPa).

Several types of conditions can potentially result in respiratory failure:

Causes

1. Conditions that reduce the flow of air into and out of the lungs, including physical obstruction by foreign bodies or masses and reduced breathing due to drugs or changes to the chest.
2. Conditions that impair the lungs' blood supply. These include thromboembolic conditions and conditions that reduce the output of the right heart, such as right heart failure and some myocardial infarctions.
3. Conditions that limit the ability of the lung tissue to exchange oxygen and carbon dioxide between the blood and the air within the lungs. Any disease which can damage the lung tissue can fit into this category. The most common causes are (in no particular order) infections, interstitial lung disease, and pulmonary oedema.

Type 1

Type 1 respiratory failure is defined as a low level of oxygen in the blood (hypoxemia) with either a standard (normocapnia) or low (hypocapnia) level of carbon dioxide (PaCO2) but not an increased level (hypercapnia). It is typically caused by a ventilation/perfusion (V/Q) mismatch; the volume of air flowing in and out of the lungs is not matched with the flow of blood to the lungs. The fundamental defect in type 1 respiratory failure is a failure of oxygenation characterized by:

PaO2 decreased (< 60 mmHg (8.0 kPa))

PaCO2 normal or decreased (<50 mmHg (6.7 kPa))

PA-aO2 increased

This type of respiratory failure is caused by conditions that affect oxygenation, such as:

1. Low ambient oxygen (e.g. at high altitude)
2. Ventilation-perfusion mismatch (parts of the lung receive oxygen but not enough blood to absorb it, e.g. pulmonary embolism)
3. Alveolar hypoventilation (decreased minute volume due to reduced respiratory muscle activity, e.g. in acute neuromuscular disease); this form can also cause type 2 respiratory failure if severe.
4. Diffusion problem (oxygen cannot enter the capillaries due to parenchymal disease, e.g. in pneumonia or ARDS)
5. Shunt (oxygenated blood mixes with non-oxygenated blood from the venous system, e.g. right to left shunt)

Type 2 RF

Hypoxemia (PaO2 <8kPa or normal) with hypercapnia (PaCO2 >6.0kPa).

The basic defect in type 2 respiratory failure is characterized by:

PaO2 decreased (< 60 mmHg (8.0 kPa))or normal

PaCO2 increased (> 50 mmHg (6.7 kPa))

PA-aO2 normal

pH <7.35

Type 2 respiratory failure is caused by inadequate alveolar ventilation; both oxygen and carbon dioxide are affected. Defined as the buildup of carbon dioxide levels (PaCO2) that has been generated by the body but cannot be eliminated. The underlying causes include:

1. Increased airways resistance (chronic obstructive pulmonary disease, asthma, suffocation)
2. Reduced breathing effort (drug effects, brain stem lesion, extreme obesity)
3. A decrease in the area of the lung available for gas exchange (such as in chronic bronchitis)
4. Neuromuscular problems (Guillain–Barré syndrome, motor neuron disease)
5. Deformed (kyphoscoliosis), rigid (ankylosing spondylitis), or flail chest

Treatment

Type 1 respiratory failure may require oxygen therapy to achieve adequate oxygen saturation. Lack of oxygen response may indicate other modalities such as heated humidified high-flow therapy, continuous positive airway pressure or (if severe) endotracheal intubation and mechanical ventilation. Respiratory failure resulting from an overdose of opioids may be treated with the antidote naloxone

Type 2 respiratory failure often requires non-invasive ventilation (NIV) unless medical therapy can improve the situation. Mechanical ventilation is sometimes indicated immediately or otherwise if NIV fails. Respiratory stimulants such as doxapram are now rarely used.

**Chronic obstructive pulmonary disease (COPD)**

is a type of progressive lung disease that is preventable and treatable. COPD is characterized by long-term respiratory symptoms and airflow limitation. The main symptoms include shortness of breath and a cough, which may or may not produce mucus. COPD progressively worsens with everyday activities such as walking or dressing becoming difficult.

The two most common conditions of COPD are emphysema and chronic bronchitis, and they have been the two classic COPD phenotypes.

Emphysema

 is defined as enlarged airspaces (alveoli) whose walls break down resulting in permanent damage to the lung tissue, This reduces the total alveolar surface available for gas exchange leading to a reduction in oxygen supply for the blood. Emphysema usually affects the middle aged or older population because it takes time to develop with the effects of smoking, There are four types of emphysema, centrilobular type is associated with smoking.

 The presence of emphysema is a clear risk factor for the development of lung cancer.

Symptoms can include a cough (with or without sputum), wheezing, a fast breathing rate, breathlessness on exertion, and a feeling of tightness in the chest Other symptoms include weight loss.

Osteoporosis is a major comorbidity of emphysema. Both conditions are associated with a low body mass index. There is an association between treating emphysema, and osteoporosis; the use of systemic corticosteroids for treating exacerbations is a significant risk factor for osteoporosis,

Investigation;- history and clinical examination, CXR, CT scan

Treatment; stop smoking, treat infection, bronco dilators, oxygen therapy.

**Chronic Bronchitis** is a lower respiratory tract disease,. defined by a productive cough that lasts for three months or more per year for at least two years. Chronic bronchitis is marked by mucus hypersecretion and mucins.

The excess mucus is produced by an increased number of goblet cells, and enlarged submucosal glands in response to long-term irritation. Effective mucociliary clearance depends on airway hydration, ciliary beating, and the rates of mucin secretion. Each of these factors is impaired in chronic bronchitis.

Diagnosis, and treatment is the same as Emphysema.

**Asthma**

is a long-term inflammatory disease of the airways of the lungs. It is characterized by variable and recurring symptoms, reversible airflow obstruction, and easily triggered bronchospasms. Symptoms include episodes of wheezing, coughing, chest tightness, and shortness of breath. Asthma is thought to be caused by a combination of genetic and environmental factors. Environmental factors include exposure to air pollution and allergens. Other potential triggers include medications such as aspirin and beta blockers.

Diagnosis is usually based on the pattern of symptoms, response to therapy over time, and spirometry lung function testing. Asthma is classified according to the frequency of symptoms, forced expiratory volume in one second (FEV1), and peak expiratory flow rate.

Diagnosis with history and spirometry.

Treatment is with short acting and long acting bronchial dilating and anti-inflammatory drugs and inhalers