



A Comprehensive Review on Chronic Obstructive Pulmonary Disease

¹Ankita C Deokar, ²Sneha S Kanase, ³Swapnil G Kale, ⁴Divya A Gore,
⁴Naman K Gandhi.

¹Student, ²Professor, ³Professor, ⁴Student, ⁴Student.

¹Department of Pharmacology.

¹Arihant College of Pharmacy, Kedgaon, Ahilyanagar, Maharashtra, India, 414005.

Abstract :-

The evolution of knowledge concerning COPD and its components – emphysema, chronic bronchitis, and asthmatic bronchitis – covers 200 years. The stethoscope and spirometer became important early tools in diagnosis and assessment. Spirometry remains the most effective means of identification and assessment of the course of COPD and responses to therapy, and is grossly underused for this purpose. Knowledge of the pathogenesis, course and prognosis, and new approaches to therapy have dramatically improved our understanding of this important clinical entity. Smoking cessation improves the early course of disease. Long-term oxygen improves the length and quality of life in selected patients with hypoxemia. Surgery benefits a select few. Today, COPD is a steadily growing global healthcare problem, with increasing morbidity and mortality. Early identification and prevention, and treatment of emerging stages of disease through smoking cessation and a growing number of bronchoactive drugs promises to change the outcome. Chronic obstructive pulmonary disease (COPD) is responsible for early mortality, high death rates and significant cost to health systems. The projection for 2020 indicates that COPD will be the third leading cause of death worldwide (from sixth in 1990) and fifth leading cause of years lost through early mortality or handicap (disability-adjusted life years) (12th in 1990). Active smoking remains the main risk factor, but other factors are becoming better known, such as occupational factors, infections and the role of air pollution. Prevalence of COPD varies according to country, age and sex. This disease is also associated with significant comorbidities. COPD is a disorder that includes various phenotypes, the continuum of which remains under debate. The major challenge in the coming years will be to prevent onset of smoking along with early detection of the disease in the general population.

Keywords :-

Pulmonary, Morbidity, Mortality, Smoking, Spirometer.

Introduction :-

Chronic obstructive pulmonary disease is finally gaining the attention needed to begin to solve this common problem. It is defined as chronic airflow obstruction that is progressive and only partly reversible emphysema, and chronic asthmatic bronchitis.

Today, COPD is the fourth most common cause of death in the USA, and is the only disease state that is rising in morbidity and mortality amongst the top five killers. It resulted in a \$32.1 billion loss to the USA economy in direct and indirect costs in 2003, and by 2020 is expected to become the third most common cause of death.

Approximately 16 million adult Americans have COPD. Probably an equal number have asymptomatic or even symptomatic disease but are not diagnosed or treated. Interest in COPD is a recent development and few know the origins of this interesting disease spectrum. This review offers a glimpse into the rich history in the development of our present understanding of COPD.

Chronic obstructive pulmonary disease, usually referred to as COPD (Chronic obstructive pulmonary disease), is a group of progressive lung diseases. The most common are emphysema and chronic bronchitis. Many people with COPD have both of these conditions. Emphysema slowly destroys air sacs in the lungs, which interferes with outward air flow while, Bronchitis causes inflammation and narrowing of the bronchial tubes, which allows mucus to build up. Both the condition cause obstruction of air flow in the respiratory system and develops respiratory problems. COPD is a preventable and treatable respiratory disorder largely caused by smoking and long term exposure to chemical irritants. It is characterized by progressive, partially reversible airflow obstruction and lung hyperinflation with significant extra pulmonary (systemic) manifestations and comorbid conditions all of which may contribute to the severity of the disease in individual patients.

The co-morbid conditions associated with COPD include ischemic heart disease; osteopenia, osteoporosis and bone fractures; cachexia and malnutrition; normochromic normocytic anemia; skeletal muscle wasting and peripheral muscle dysfunction, diabetes mellitus; sleep disorders; cataracts and glaucoma, lung cancer, and anxiety and depression both of which increase in incidence with disease severity, It is a disease that usually takes a long time to develop. It is estimated that about 30 million people in the United States have COPD. As many as half are unaware that they have it. COPD is the major cause of chronic morbidity and will rank seventh of global burden of diseases in 2030. The estimated prevalence of COPD are 4-20% worldwide in adults over 40 years of age and 6.3% in Asian population, Furthermore, it is the fourth most common causes of hospitalization and most economic burden among chronic diseases in old age patients. Exacerbation of COPD is "an acute event characterized by a worsening of the patient's respiratory symptoms that is beyond normal day-to-day variations and leads to a change in medication

COPD statistics Globally, it is expected that about 65 million people have moderate to severe COPD. About 12 million adults in the United States have a diagnosis of COPD. It is estimated that million more have the disease, but don't know it yet. Most people with COPD are 40 years of age or older. The majority of people with COPD are smokers or former smokers. Smoking is the most important risk factor that can be changed. Between 20 and 30% of chronic smokers develop COPD that shows symptoms and signs. Between 10 and 20% of people with COPD have never smoked in. An account of up to 5% of people with COPD, found that their cause is a genetic disorder involving a deficiency of a protein called alpha-1-antitrypsin. COPD is more prevalent and cause of hospitalizations in industrialized countries. In the year 2000, it was noted that there were over 700,000 hospital admissions and approximately 1.5 million emergency visited hospital in United States. Among people with lung cancer, between 40 and 70% also have COPD, About 120,000 people die from COPD each year in the United States. It is the third leading cause of death in the United States. It is estimated that the number of patients diagnosed with COPD will increase by more than 150% from 2010 to 2030. Much of that can be attributed to an aging population. It has been also observed that the case of COPD has been also increase in India each year.

Early Historical Landmark :-

Some of the earliest references to the description of emphysema include: CitationBonet's description of "voluminous lungs" in 1679 (CitationBonet 1679); CitationMorgagni's (1769) description of 19 cases in which the lungs were "turgid", particularly from air; and Baille's illustrations of the emphysematous lung, thought to be that of Samuel Johnson (Baillie 1789; CitationBishop 1959).

The beginnings of our clinical understanding of the chronic bronchitis component of COPD can be traced to CitationBadham (1814), who used the word catarrh to refer to the chronic cough and mucus hypersecretion that are cardinal symptoms. He described bronchiolitis and chronic bronchitis as disabling disorders (CitationBadham 1814).

The emphysema component of disease was beautifully described by CitationLaënnec (1821) in his Treatise of diseases of the chest. Laënnec, a clinician, pathologist, and inventor of the stethoscope, did careful dissections of patients that he had studied during life. He recognized that emphysema lungs were hyperinflated and did not empty well (CitationLaënnec 1821).

In his A treatise on the diseases of the chest and on mediate auscultation (1837, p 81) Laënnec wrote on emphysema:

The disease which I designate by this title is very little known and has not hitherto been correctly described by any author. I for a long time thought it very uncommon, because I had observed only a few cases of it: but since I have made use of the stethoscope, I have verified its existence as well on the living as the dead subject, and am led to consider it as by no means infrequent. I consider many cases of asthma, usually deemed nervous, as depending on this cause. The chief reason of this affection having been so completely overlooked is, that it is in some sort merely the exaggeration of the natural condition of the viscus.

In this era, smoking was rare, but it is a fact that emphysema may occur in non-smokers, particularly with a familial predisposition or from environmental-provoking factors. Laënnec continued:

In opening the chest, it is not unusual to find that the lungs do not collapse, but they fill up the cavity completely on each side of the heart. When experienced, this will appear full of air.

The bronchus of the trachea are often at the same time a good deal filled with mucous fluid (CitationLaënnec 1821, p 89).

John Hutchinson invented the spirometer in 1846 (CitationHutchinson 1846). The spirometer is key to the diagnosis and management of COPD, yet its use is still poorly applied to the diagnosis and management of COPD in most locations in the world today. Hutchinson's instrument only measured vital capacity. It took another 100 years for Tiffeneau to add the concept of timed vital capacity as a measure of airflow, for spirometry to become complete as a diagnostic instrument (CitationTiffeneau and Pinelli 1947).

CitationOsler's Principles and practices of medicine (1916) says little about emphysema. Osler believed emphysema was caused by excessive pressure in the alveoli (CitationOsler 1916), and reference to the spirometer cannot be found in this classic text. In 1912, another author did not mention spirometry, but shows a nice picture of the sphygmomanometer, invented by Rico Rossi in 1896, and excellent quality EKG strips are shown (CitationBovard 1912). This occurred 50 years after Hutchinson's invention. A textbook of Disease in the chest in 1918 makes only brief mention of spirometry with no illustrations (CitationNorris and Landis 1918).

Gaensler introduced the concept of the air velocity index based on Tiffeneau's work and later the forced vital capacity, which is the foundation of the FEV1 and FEV1/FVC percent (CitationGaensler 1950, Citation1951).

In 1944, one of the great teachers of emphysema, Ronald Christie, suggested that “The diagnosis should be considered certain when dyspnea on exertion, of insidious onset, not due to bronchospasm, or left ventricular failure, appears in a patient who has some physical signs of emphysema together with chronic bronchitis and asthma” (CitationChristie 1944, p 145). It is clear from this statement that Christie recognized the individual components of COPD and relied on the history and physical examination for his diagnosis. Oswald described the clinical features of 1000 cases of chronic bronchitis in 1953 (CitationOswald et al 1953).

CitationBarach and Bickerman (1956) edited the first comprehensive text book, Pulmonary emphysema, which nicely describes the treatment of the era. These two physicians were early champions of treatment for emphysema. Contributors to this book included Dayman, the first to recognize the spirometric and flow volume patterns indicative of dynamic expiratory airway collapse in emphysema; Dickerson Richards, Nobel Laureate, who wrote on the pulmonary circulation and cor pulmonale; Reuben Cherniack, who described respiratory acidosis and has made major contributions to our understanding of the diagnosis and treatment of emphysema for over half a century; and Menelee and Callaway, who described pulmonary function tests in emphysema patients. In all, 17 leading clinicians and clinical scientists contributed to this classic volume of the 1950s.

The first edition of CitationHinshaw and Garland (1956) (now Murray and Nadel) Textbook of respiratory medicine shows a nice picture of a Collins 13.5 liter recording spirometer, and shows capacity spiograms that demonstrate airflow limitation in emphysema.

EPIDEMIOLOGY :-

The highly cited, influential GBD studies estimated that COPD causes the death of at least 2.9 million people annually. Estimates of global mortality in 1990 (1) were updated in 2006 (12), and will be next available and expanded in 2011 (13). The GBD highlights that COPD was the sixth leading cause of death in 1990, has been the fourth since 2000, and is projected to be the third by 2020. These estimates are likely to be conservative, as they did not account for deaths where COPD is a contributory cause, although misclassification can be large (14). Subsequent to that date, even assuming the most pessimistic scenario regarding the global spread of human immunodeficiency/acquired immune deficiency virus, by 2030, COPD will be the direct underlying cause of 7.8% of all deaths, and represent 27% of deaths related with smoking, only surpassed by 33% for cancer and 29% by cardiovascular disease (15).

Even the simplest of questions, "How many individuals are there in the World with COPD?" was surrounded by a halo of vagueness until very recently. Estimates varied by author and publication, and figures up to 600 million have been widely used, and are available elsewhere (16). It is agreed by consensus that an estimated number of 210 million people have COPD worldwide. In the absence of population spirometry, and with a staggering 80-90% COPD under diagnosis in all world regions and scenarios (18), this figure is useful, yet must be used with caution. Overall, the prevalence of COPD in the general population is estimated to be around 1% across all ages, rising steeply to 8-10% or higher among those aged 40 years or older (19).

- 1) Chronic bronchitis, with an obstructive ventilatory pattern that is defined by the existence of chronic bronchitis with permanent obstruction of airways (forced expiratory volume in 1 s (FEV₁) to forced vital capacity (FVC) ratio <70%)
- 2) Chronic respiratory failure, which is defined by the existence of chronic obstructive bronchitis with hypoxemia
- 3) Emphysema, which is defined at the anatomical level by destruction of the walls of the alveolar sacs/ducts beyond the terminal bronchiole with an abnormal increase in sine of distal airways [1].

Centrilobular emphysema is a result of the dilations destruction of respiratory bronchioles It is a form of emphysema associated with cigarette smoking. Panlobular emphysema is more often associated with a deficit in antitrypsin, and is the result of dilation or destruction of all the lobules (2) It should be noted that centrilobular and par lobular emphysema can be mutually associated

In primary care, an important issue is how to define air obstruction, te how to conclude that the given test is normal or abnormal. Without exception, guidelines recommend using a post-bronchodilator FEV1/FVC ratio <0.70 to define irreversible airflow obstruction, whatever the age and the sex of the patients 151. This approach is recognised to be easy to perform however, it must be appreciated that this advantage should be balanced against the disadvantage of possible false diagnoses. It is already known that using pre-bronchodilator spirometry can overestimate COPD prevalence by as much as 30% [6]. In primary care, SCHERMER et al. [7] showed in a large population of patients (n-14,056) that this ratio overestimates airflow obstruction in middle-aged and elderly patients. The proportion of false positive diagnoses using the fixed ratio 0.70 wa 8.9% in 31-40 yr age stratum: 15.5% for those aged 41-5 yrs 23.9% for those aged 51-60 yrs 33.2% for those aged 61-710 yrs 38.7% for those aged 71-50 yrs, and, finally, 42.7% for those aged over 81 yes [7]. Other papem have reported an over diagnosis, HANUs et al. [8] reported overdiagnosis od 207% and Swassars et al. [9] reported false positive rates of up to 60%.

Types of COPD :-

The term "COPD" indicates a group of lung conditions that can make breathing difficult. Most COPD patients also have chronic bronchitis and emphysema, while individual differences may exist in the severity of each condition. Below are the two main types of chronic obstructive pulmonary disease (COPD):

- 1)Chronic bronchitis
- 2)Emphysema

1)Chronic bronchitis :-

It is a long-term inflammation of the bronchi (the lungs' breathing passages) that causes mucus production to increase along with other changes. Such changes may cause breathing problems, frequent infections, coughing and weakness.

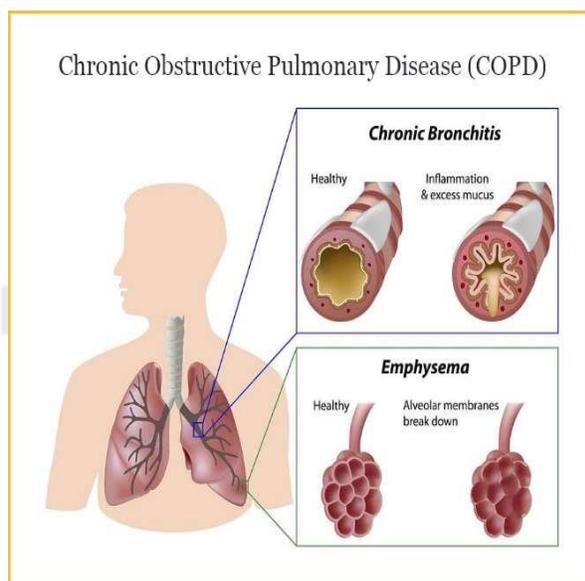


Fig 1 : Types of COPD

2) Emphysema :-

Emphysema is a long-term lung condition that can cause the lungs' alveoli, or the air sacs, to become destroyed, narrowed, collapsed, stretched, or overinflated. Breathlessness and a decrease in respiratory function may result from it. Damage to the air sacs causes permanent "holes" in the lung tissue, which is irreversible.

Pathophysiology of COPD :-

Abnormal inflammatory response of the lungs due to toxic gases



Response occurs in the airways, parenchyma



Narrowing of the airway takes place



Destruction of parenchyma leads to emphysema



Destruction of lung parenchyma leads to an imbalance of proteinases/antiproteinases



Pulmonary vascular changes

- Thickening of vessels
- Collagen deposit
- Destruction of capillary



Mucus hypersecretion (cilia dysfunction, airflow limitation, cor pulmonale (RVF))



Chronic cough and sputum production

Risk Factors of COPD :-

1) Smoking :- The leading cause of COPD, both active smoking and exposure to secondhand smoke significantly increase risk.

2) Air Pollution :- Long-term exposure to outdoor air pollution and indoor pollutants (like smoke from cooking and heating) can contribute to the development of COPD.

3) Occupational Hazards :- Jobs that expose individuals to dust, chemical fumes, or other pollutants (such as mining, construction, or factory work) increase the risk.

4) Genetic Factors :- A genetic condition known as alpha-1 antitrypsin deficiency can predispose individuals to COPD.

5) Age :- The risk of COPD increases with age, typically developing in middle age or later.

6) Gender :- Historically, COPD was more common in men, but the gap has narrowed as smoking rates among women have increased.

7) History of Respiratory Infections :- Frequent respiratory infections in childhood or a history of severe lung infections can increase the risk.

8) Low Socioeconomic Status :- Limited access to healthcare, education, and living in areas with high pollution can elevate risk.

9) Asthma :- Individuals with a history of asthma may have a higher risk of developing COPD later in life, especially if asthma is poorly managed.

10) Physical Inactivity :- Lack of physical activity can contribute to the worsening of symptoms and overall lung health.

Signs and Symptoms of COPD :-

- 1) Coughing up lots of mucus.
- 2) Shortness of breath, especially when you're physically active.
- 3) Wheezing when you breathe.
- 4) Tightness in the chest.
- 5) Frequent colds or flu.
- 6) Blue fingernails.
- 7) Low energy.
- 8) Losing weight.
- 9) Swollen ankles, feet or legs.
- 10) Respiratory infections.

Diagnosis of COPD :-

1) Medical History :- The doctor will take a detailed history of symptoms, smoking history, occupational exposure, and family history of lung diseases.

2) Physical Examination :- A physical exam may include listening to the lungs with a stethoscope for abnormal breath sounds, checking for signs of respiratory distress, and assessing overall health.

3) Pulmonary Function Tests (PFTs) :- The most definitive test for diagnosing COPD is spirometry, which measures how much air you can inhale and exhale, and how quickly you can do so. Key measurements include:

a) Forced Vital Capacity (FVC) :- The total amount of air exhaled forcefully after taking a deep breath.

b) Forced Expiratory Volume in 1 second (FEV1):- The amount of air exhaled in the first second of the FVC test.

c) FEV1/FVC Ratio :- A ratio of less than 70% indicates an obstruction, which is characteristic of COPD.

4) Imaging Tests :-

a) Chest X-ray :- Can help rule out other lung conditions and show signs of COPD, such as hyperinflation or changes in lung structure.

b) CT Scan :- A computed tomography scan provides more detailed images of the lungs and can help identify emphysema and assess the severity of the disease.

5) Arterial Blood Gas Analysis :- This test measures the levels of oxygen and carbon dioxide in the blood, which can indicate how well the lungs are functioning.

6) Alpha-1 Antitrypsin Test :- If there's a family history of COPD or early onset, this blood test checks for alpha-1 antitrypsin deficiency, a genetic risk factor for COPD.

7) Six-Minute Walk Test:- This test measures the distance a person can walk in six minutes and assesses exercise tolerance and oxygen levels during activity.

8) Questionnaires :- Tools such as the COPD Assessment Test (CAT) or the Modified Medical Research Council (mMRC) dyspnea scale can help assess the impact of symptoms on daily life.

CLASSIFICATION -

1) Short Acting B₂ adrenergic agonist (SABA) :-
eg. Albuterol, Levalbuterol.

2) Long Acting B₂ adrenergic agonist (LABA) :-
eg. Formoterol, Indacaterol, Olodaterol.

3) Inhale corticosteroids :-
eg. Formoterol or budesonide, fluticasone, Salmeterol.

4) Long Acting Anticholinergic (LAMA):-
eg. Glycopyrronet, tiotropium

5) LABA and LAMA combination :-
eg. Formoterol or glycopyrronet, Indacaterol or Glycopyrronet

6) Other agents :-
eg. Theophylline, Roflumilast

Treatment of COPD :-

Yet, chronic obstructive pulmonary disease (COPD) has no known cure; however, the below treatment can help manage symptoms and decrease the disease's progression.

1) Chronic bronchitis :-

The main objectives of treating chronic bronchitis are to reduce symptoms, avoid complications, and delay the disease's course. The treatment options for chronic bronchitis include the following:

I) Lifestyle modifications

II) Pharmacological therapy -

1) Bronchodilators

2) Steroids

3)Antibiotics

4)Vaccines

III) Oxygen therapy

IV) Pulmonary rehabilitation program

V)Surgery

VI) Lung transplant

2) Emphysema :-

There is no proven cure that can change the course of the disease. On the other hand, managing symptoms and modifying risk factors can effectively reduce the progression of the disease and improve quality of life.

I) Medical therapy -

1)Bronchodilator

2)Anti-inflammatory

drugs :- Corticosteroids, phosphodiesterase-4 inhibitors

II) Supportive therapy -

1)Oxygen therapy

2)Ventilatory support

3)Pulmonary rehabilitation of COPD

4)Palliative care

III) Interventional therapy –

1)Lung volume reduction surgery

2)Lung transplantation

*Complications of COPD :-

Respiratory function is affected by chronic obstructive pulmonary disease (COPD) and people may develop additional complications if they don't get enough oxygen. Below are the complications of COPD:

1.Chronic bronchitis :-

The possible complications of chronic bronchitis include :-

1)Bronchiectasis (a permanent dilation of the bronchi)

2)Pneumonia

3)Heart failure

4)Abnormal heart rhythms

Cor pulmonale (heart disorder)

5)Emphysema

6)Respiratory failure

2. Emphysema :-

Individuals with emphysema are at risk for several problems, some of which can be severe. The following are some of the most common emphysema complications that are encountered :-

1)Pneumothorax

2)Pneumonia

- 3)Respiratory failure
- 4)Cor pulmonale
- 5)Recurrent respiratory tract infections
- 6)Interstitial emphysema
- 7)Respiratory acidosis
- 8)Hypoxia (reduced oxygen levels in the body tissues)
- 9)Coma
- 10)Chronic atelectasis (a partial or whole collapse of the lung or a lobe- a specific portion of the lung).

Prevention of COPD :-

Most chronic obstructive pulmonary disease (COPD) cases are preventable. If patients don't smoke, they may significantly reduce the risk of getting COPD. Below are some of the preventive measures of COPD:

1.Chronic bronchitis :-

The quality of life and morbidity are significantly impacted by chronic bronchitis. By taking the following preventative measures, people may be able to avoid bronchitis or reduce the risk of developing it again:

- a) Cessation of smoking
- b) Avoiding passive smoking
- c) Avoiding dust and chemical fumes
- d) Avoiding air pollution
- e) Alteration in the lifestyle
- f) Regular vaccination against pneumonia can lower the morbidity rate in those with chronic bronchitis.
- g) Taking regular vaccinations for influenza every year.

2.Emphysema :-

Following are some of the preventive measures of emphysema:

- a)Cessation of smoking
- b) Engaging in physical activity and being fit
- c)Wearing masks or other personal protection equipment (PPE) whenever people work in an environment with dust or chemicals.
- d) Getting vaccinated against “pneumococci”
- e) Vaccination against “Haemophilus influenzae”
- f) Protecting from a cold environment
- g)Avoiding other respiratory irritants.

Conclusion :-

To conclude, the various risk factors mentioned above could have a different impact on respiratory function, depending on the age of the subject. Respiratory function evolves in several. main stages, a development stage which takes place in ateni, a pulmonary growth stage which continues to young adulthood (20 yes), a maturity stage between the ages of 20 and 30 yrs and a stage of physiological decline, which is thought to begin after the age of 40 yrs. The possibility of cumulated risks should also be taken into account, because of the simultaneous. presence or absence of these various risk factors in the same individual, showing a possible variability. of natural history of COPD

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