

Epidemiology, pathophysiology, diagnosis of COPD and the implementation of GOLD guidelines – a short review



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Abstract

Chronic obstructive pulmonary disease (COPD) is a disorder characterized by reduced maximum expiratory flow and slow forced emptying of the lungs; features which do not change markedly over several months. Chronic bronchitis and emphysema are the two forms, but it is observed that most of the sufferers have a combination of both conditions. In the year 2007 guidelines from the Global Initiative for COPD was addressed and the management was clarified in detail. It provides evidence-based recommendations for COPD sufferers and doctors. Cessation of smoking, controlling the environmental indoor and outdoor pollutants is the main factors to be taken into consideration. GOLD was introduced with an aim of increase consciousness about COPD and to help millions of sufferers from premature death.

Key words

COPD, GOLD, human chronic disease



Background

Chronic obstructive pulmonary disease (COPD) is a disorder characterized by reduced maximum expiratory flow and slow forced emptying of the lungs; features which do not change markedly over several months [1]. Broadly, COPD is a condition when there is difficulty in breathing. COPD can be classified into two major types, chronic bronchitis and emphysema. Research revealed that, long-term exposure to harmful substances that irritate and damage the lungs is the primary cause of COPD. Narrowing and disappearance of small conducting airways, smoking, air pollution, chemical fumes, or dust may leads to this lung disorder. COPD is characterized by a chronic long-lasting course and irreversible reduction in forced expiratory volume in one second (FEV₁), increasing dyspneic condition along with other respiratory symptoms, and gradually worsening the health status [2-6]. In COPD, airflow obstruction and hyperinflation or air trapping occurs. Small conducting airways that are less than 2 mm in diameter are the vulnerable site for airway obstruction. Narrowing and inflammatory exudates in the small airways is the additional risk factors. Loss of elastic recoil of lungs and destruction of alveolar support also responsible for worsening the condition. Gas exchange abnormalities are a part of COPD in advanced disease conditions characterized by arterial hypoxaemia with or without hypercapnia. Ventilation: perfusion ratios also changes as a result of anatomical changes leading to abnormal gaseous exchange [7]. The main objective of this article is to highlight on COPD condition, prevalence and review GOLD guidelines, recommended for COPD management.

Epidemiology

Epidemiological data revealed that COPD affected approximately 5-15% of adults in industrialized countries. Although in the year 1990, COPD was considered to be at the twelfth position world-wide as a cause of combined mortality and disability but surprisingly scientists predicted that it will be the fifth cause by the year 2020 [6]. A number of sociodemographic factors which influences are occupation, low socioeconomic status, diet and some environmental exposures in early stages of life. After diagnosis of COPD, the 10-yr survival rate was measured, which was approximately 50%, with more than one-third of patients dying with a leading cause of respiratory insufficiency. Many people are suffering from this disease for years and they die prematurely because of it or its complications [6].

In the USA, a history of emphysema diagnosed by a physician or a measured level of impaired lung function (usually FEV₁<60 or 65% of its predicted value) was found in 4-6% of adult White males and 1-3% of adult White females [8].

Prevalence rates of chronic bronchitis were similar in several European countries with rates of 3.7% in Denmark, 4.5% in Norway, 4.8% in Spain [9-11]. A study by the Regional COPD working group revealed the condition of COPD in Asia. The high COPD prevalence rates reflected the risk factors for the 12 countries in Asia. The combined prevalence of 6.3%, which is considerably higher for Asian population [12].

Pathogenesis of COPD

Different Pathological changes are observed in the proximal airways, peripheral airways, lung parenchyma, and pulmonary vasculature, which includes chronic inflammation, with increased numbers of specific inflammatory cell types in lung tissue, and a number of structural changes are observed resulting from repeated injury and repair. Inflammation and these structural changes increase with severity of the disease, even persist on smoking cessation. Inflammatory response particularly in the small airways is a hallmark of COPD in smokers [13]. Study in Latin America, a systematic review and meta-analysis of 28 countries between 1990 and 2004, and a research work in Japan shows that the prevalence of COPD (stage I, mild COPD and higher) is comparatively higher in smokers and ex-smokers, in those older than 40 years compared with those younger than 40 years, and in men compared with women [14-16]. This normal protective response is augmented in COPD, leading to tissue destruction, impairment of the immune mechanisms that limit such destruction, and interference of the repair mechanisms. Imbalance between proteases and antiproteases and an imbalance between oxidants and antioxidants (oxidative stress) in the lungs also contributes in COPD. Airflow obstruction, hyperinflation and gas exchange abnormalities are the most common alterations in lung physiology in COPD [13].

Increase in the Inflammatory cell population - Numbers of neutrophils, macrophages, and T lymphocytes (CD8 more than CD4) increased in the lung tissue. Generally, severity of inflammatory response is related to the degree of the airflow obstruction. Cytokines and mediators released by these cells contributing the progress of the disease. This inflammatory pattern is dissimilar with asthmatic patients.

Imbalance in Protease and antiprotease & oxidative stress - Production of proteases increased and inactivation of antiproteases results in imbalance between these enzyme systems. Increase in oxidative stress, initiates inflammatory cells to release a combination of proteases and inactivates several antiproteases by oxidation. Cigarette smoke and reactive oxygen and nitrogen species which releases from the inflammatory cells contribute oxidative stress in COPD creating disturbance between oxidants and antioxidants.



Hypersecretion of mucous and ciliary dysfunction - hypersecretion of mucous results in a chronic productive cough. This is a characteristic feature of chronic bronchitis and not all patients suffering from COPD. Squamous metaplasia, is thought to be a reason. Increased goblet cells, and increased size of bronchial submucosal glands occurs by chronic irritation by noxious particles and gases.

Increased of blood pressure in the pulmonary artery - In the later stage of COPD, when there is severe gas exchange abnormalities, pulmonary hypertension may occur. Arterial constriction, endothelial dysfunction, hypertrophy and hyperplasia of smooth muscles of blood vessels are the responsible landmarks.

Pathophysiology of exacerbations - Exacerbations are often associated with increased neutrophilic inflammation and, in some mild exacerbations, increased numbers of eosinophils. Exacerbations can be caused by infection (bacterial or viral), air pollution, and changes in ambient temperature [7].

Introduction of GOLD for the COPD management

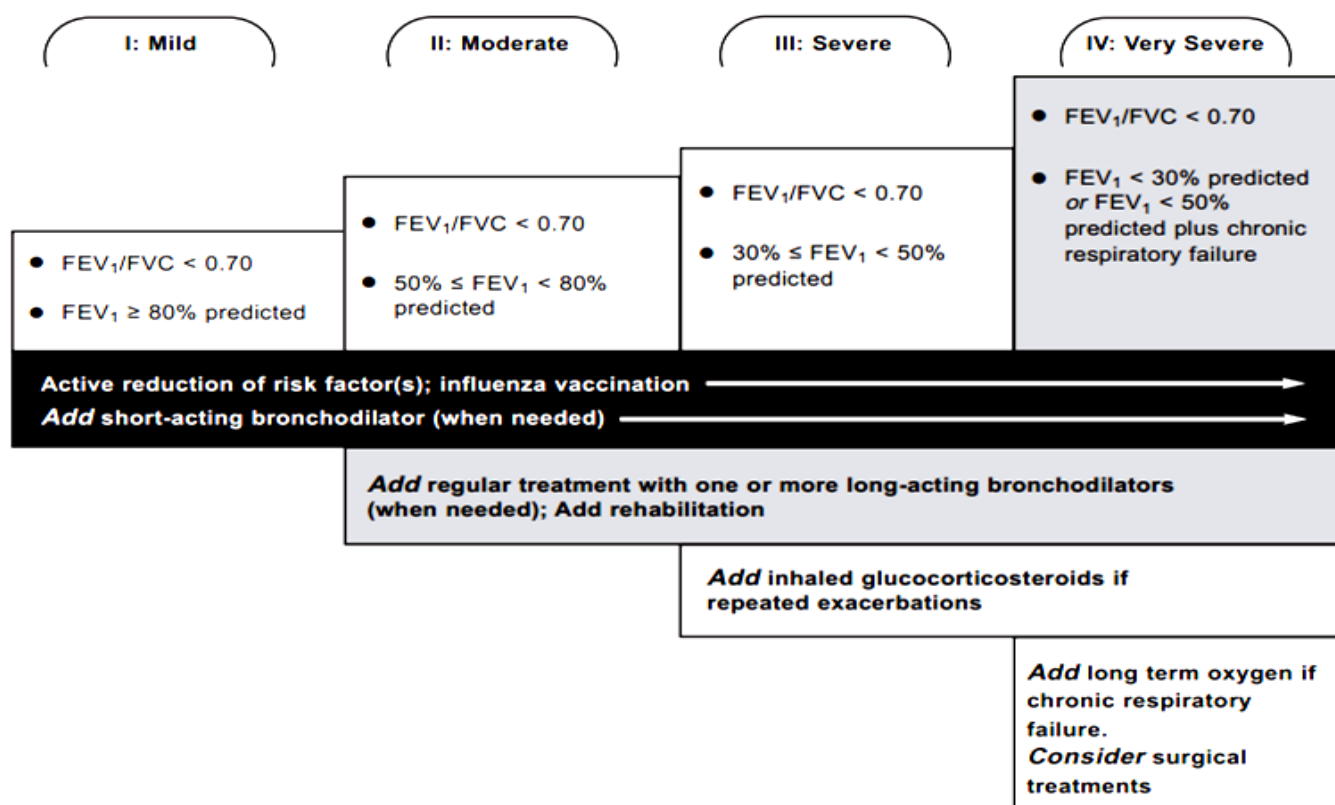
In the year 1998, an initiative has been taken to bring more attention to COPD, its management, and its prevention. A group of scientists proposed U.S. National Heart, Lung, and Blood Institute and the World Health Organization jointly to

form the Global Initiative for Chronic Obstructive Lung Disease (GOLD) [17].

World Health Organization's Global Alliance against Chronic Respiratory Diseases (GARD) took initiative for GOLD. GOLD is a partner organization. The active involvements of the GOLD committee members and collaboration with GARD can significantly improve the scenario of COPD in the next decade.

The aim of GOLD was to improve the prevention and management of COPD worldwide and also creating an encouraging atmosphere for health care researchers. GOLD report is based on recent concepts of COPD and latest management and prevention strategies adopted different parts of this worldwide. In the gold report, it was mentioned that although prevalence, morbidity, and mortality may vary across countries but the main causative factor is tobacco smoking. Air pollution resulting from the burning of wood and other biomass fuels has also been identified as susceptible factor. It is also predicted that the burden of COPD will be augmented in the coming decades due to sustained exposure to COPD risk factors. Changing age structure of the world's population is also a contributory factor [18].

Figure - 1. 2007 GOLD Guidelines [19].





Why GOLD?

Four-stage classification of COPD was released recently by the authority of GOLD to clarify the severity of pathophysiological conditions, which helps to health care professionals for the treatment [20].

GOLD Guidelines

GOLD report mainly based on the clinical management of COPD which consists of a management plan with four major components:

- (1) Assessment and monitoring of the disease,
- (2) Reduction in risk factors,
- (3) Management of stable COPD, and
- (4) Management of exacerbations.

Postbronchodilator FEV1 is recommended for the diagnosis and assessment of severity of COPD.

However, these GOLD guidelines not clarify to define the rationale supporting the suggested classification scheme. Some of the earlier researches show that worsening health condition only reflects augmented severity of COPD categorized on the basis of FEV1% to a limited extent. However, co morbidity plays an active role in defining health status, mainly in case of mild-to moderate COPD [21].

As patients do get benefits when their illness is better understood, more resources are required in prevention and in meeting their health-care needs, and when there are explicit recommendations regarding the best practices for diagnosis and treatment. Health-care providers benefit from evidence-based guidelines, which direct efforts to properly diagnose and manage their patients and achieve better outcomes. Research works in this area is required for proper diagnosing and treatment, which can be planned by government bodies to meet the challenges of tobacco prevention, resource allocation, and public awareness to prevent COPD as an epidemic. Through GOLD health care workers, authorities, and the general public can be benefited with state-of-the-art information about COPD and specific recommendations on some complicated cases for the proper management.

Diagnostic tool

Spirometry is recommended for diagnosis and it provides a useful description of the severity of pathologic changes associated with COPD. There are specific cut points values (e.g., post-bronchodilator FEV1/FVC ratio, 0.70 or FEV1, 80, 50, or 30% predicted) are used for purposes of simplicity; although, the clinical validation to be done. Report from a random population sample showed the post-bronchodilator FEV1/FVC exceeded 0.70 in all age groups, supporting the use of this fixed ratio [22]. However, because the process of aging does affect lung volumes, the use of this fixed ratio

may result in over diagnosis of COPD in the elderly, especially in those with mild disease.

Table – 1 Spirometric Classification of COPD Severity Based on Post-Bronchodilator FEV1

Stage I: mild COPD: Characterized by mild airflow limitation (FEV1/FVC, 0.70, FEV1 > 80% predicted). Symptoms of chronic cough and sputum production may be present, but not always. At this stage, the individual is usually unaware that his or her lung function is abnormal.
Stage II: moderate COPD: Characterized by worsening airflow limitation (FEV1/FVC, 0.70, 50% <FEV1, 80% predicted), with shortness of breath typically developing on exertion and cough and sputum production sometimes also present. This is the stage at which patients typically seek medical attention because of chronic respiratory symptoms or an exacerbation of their disease.
Stage III: severe COPD: Characterized by further worsening of airflow limitation (FEV1/FVC, 0.70, 30% <FEV1, 50% predicted), greater shortness of breath, reduced exercise capacity, fatigue, and repeated exacerbations that almost always have an impact on patients' quality of life.
Stage IV: very severe COPD: Characterized by severe airflow limitation (FEV1/FVC, 0.70, FEV1, 30% predicted or FEV1, 50% predicted plus the presence of chronic respiratory failure).

Respiratory failure is defined as an arterial partial pressure of O₂ (PaO₂) less than 8.0 kPa (60 mm Hg), with or without an arterial partial pressure of CO₂ (PaCO₂) greater than 6.7 kPa (50 mm Hg) while breathing air at sea level. Respiratory failure may also lead to effects on the heart such as cor pulmonale (right heart failure). Clinical signs of cor pulmonale include elevation of the jugular venous pressure and pitting ankle edema. Patients may have stage IV COPD even if their FEV1 is greater than 30% predicted whenever these complications are present. At this stage, quality of life is very appreciably impaired and exacerbations may be life threatening [19].

Conclusion

COPD is serious threat for the industrialized countries. Cigarette smoke, reactive oxygen and nitrogen species are mostly responsible for this condition. Comprehensive management of COPD includes proper assessment, monitoring of disease, reduction of risk factors, the management of stable COPD, and the prevention and management of exacerbations. The 2007 COPD guidelines from the Global Initiative for Chronic Obstructive Lung Disease address each of these aspects of COPD management in detail and provide evidence-based recommendations for patients and health-care professionals.



Limitations and future scope of the study

This review work is based on data from relatively few research works; a systematic review, based on recent worldwide scenario of COPD may be more helpful in this context.

Abbreviations

Chronic obstructive pulmonary disease (COPD), forced expiratory volume in one second (FEV1), Global Initiative for Chronic Obstructive Lung Disease (GOLD).

Competing interests

Authors declare that he has no competing interests.

Authors' contribution

GD drafted the manuscript, revised and finalized it.

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