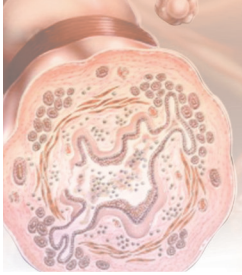


integrated approach that capitalizes upon synergies of chronic respiratory diseases with other chronic diseases. GARD focuses specifically on the needs of low and middle income countries and vulnerable populations. The Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) is part of GARD.

WHO Framework Convention on Tobacco Control (WHO FCTC)

The WHO Framework Convention on Tobacco Control (WHO FCTC) was developed in response to the globalization of the tobacco epidemic, with the aim to protect crores of people from devastating impact of tobacco consumption and exposure to tobacco smoke. It is the first global health treaty negotiated under the auspices of the World Health Organization, and has been ratified by more than 140 countries.

Programme on Indoor Air Pollution

WHO, as the global public health agency, collects and evaluates the evidence for the impact of household energy on health and for the effectiveness of interventions in reducing the health burden on children, women and other vulnerable groups. Cooking and heating with solid fuels on open fires or traditional stoves results in high levels of indoor air pollution. Indoor smoke contains a range of health-damaging pollutants, such as small particles and carbon monoxide, and particulate pollution levels may be 20 times higher than accepted guideline values.

As the problem of indoor air pollution mainly affects the low and middle income countries, WHO through this programme provides support to the developing countries. This is based on capacity building, training, research and evidence for policymakers.

PRACTICAL APPROACH TO LUNG (PAL) HEALTH[30]

Objectives

- To improve the quality of respiratory case management for the individual patient.
- To improve the efficiency and cost-effectiveness of respiratory care within health systems.

Focus of PAL

- Tuberculosis (TB)
- Acute respiratory infections (ARIs), with a focus on pneumonia
- Asthma
- Chronic obstructive pulmonary disease (COPD)

Components

- Standardization of health service delivery through the development and implementation of clinical practice guidelines.
- Coordination among different levels of healthcare as well as between TB control programmes and the organization and management of general health services.

STEPS TAKEN BY GOVERNMENT OF INDIA TO PREVENT AND CONTROL COPD

National Health Mission: COPD is included in the list of non-communicable diseases. However, it is not one of the priority areas as a public health problem by the Government of India. More advocacy is needed so that political will is generated to tackle this health issue. There is no national health programme on COPD by the Government of India.

Some steps taken by the government indirectly play role in keeping lungs healthy, thus preventing COPD also. For example, the cigarette and other tobacco products, prohibition of advertisement and regulation of trade and commerce (COTPA Act) attempts to reduce tobacco use and also prohibits smoking in public places.

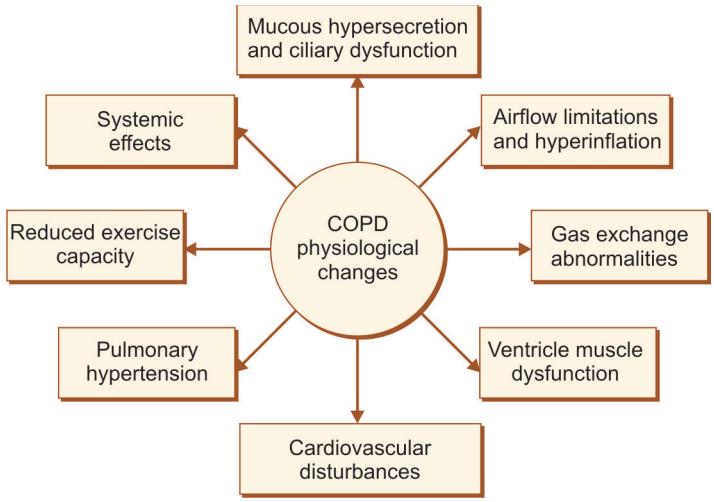


Fig. 2.4: Physiological changes in COPD

number of goblet cells and increased the size of bronchial submucosal glands in response to chronic irritation caused by noxious particles and gases. Ciliary dysfunction is due to squamous-metaplasia of epithelial cells and results in dysfunction of the muco-ciliary escalator and difficulty in expectorating.

Airflow limitation and hyperinflation/ air trapping. Chronic airflow limitation is the physiological hallmark of COPD. The main site of airflow limitation occurs in the small conducting airways that are <2 mm in diameter. This is because of inflammation, narrowing (airway remodelling) and inflammatory exudates in the small airways. Other factors contributing to airflow limitation include loss of lung elastic recoil (due to the destruction of alveolar walls) and destruction of alveolar support (from alveolar attachments).

The airway obstruction progressively traps air during expiration, resulting in hyperinflation of the lungs at rest and dynamic hyperinflation during exercise. Hyperinflation reduces the inspiratory capacity and, therefore, the functional residual capacity during exercise. These features result in the breathlessness and impaired exercise capacity typical of COPD.

Gas exchange abnormalities. Gas exchange abnormalities occur in advanced disease and are characterised by arterial hypoxaemia with or without hypercapnia. An abnormal distribution of ventilation/ perfusion ratios—due to the anatomic alterations described in COPD—is the main mechanism accounting for abnormal gas exchange. The extent of impairment of diffusing capacity for carbon monoxide is the best physiological correlate to the severity of emphysema.

Ventricular muscle dysfunction: The number of factor leads to ventricular muscle dysfunction in COPD. A major factor is the consequence of lung hyperinflation, which alters the geometry of the thorax and decreases the resting length of the diaphragm, thus placing the diaphragm in a suboptimal contractile position that limits its force generation capacity. It ultimately leads to the inspiratory muscles at a mechanical disadvantage. Severe lung hyperinflation increases intrathoracic pressure that results

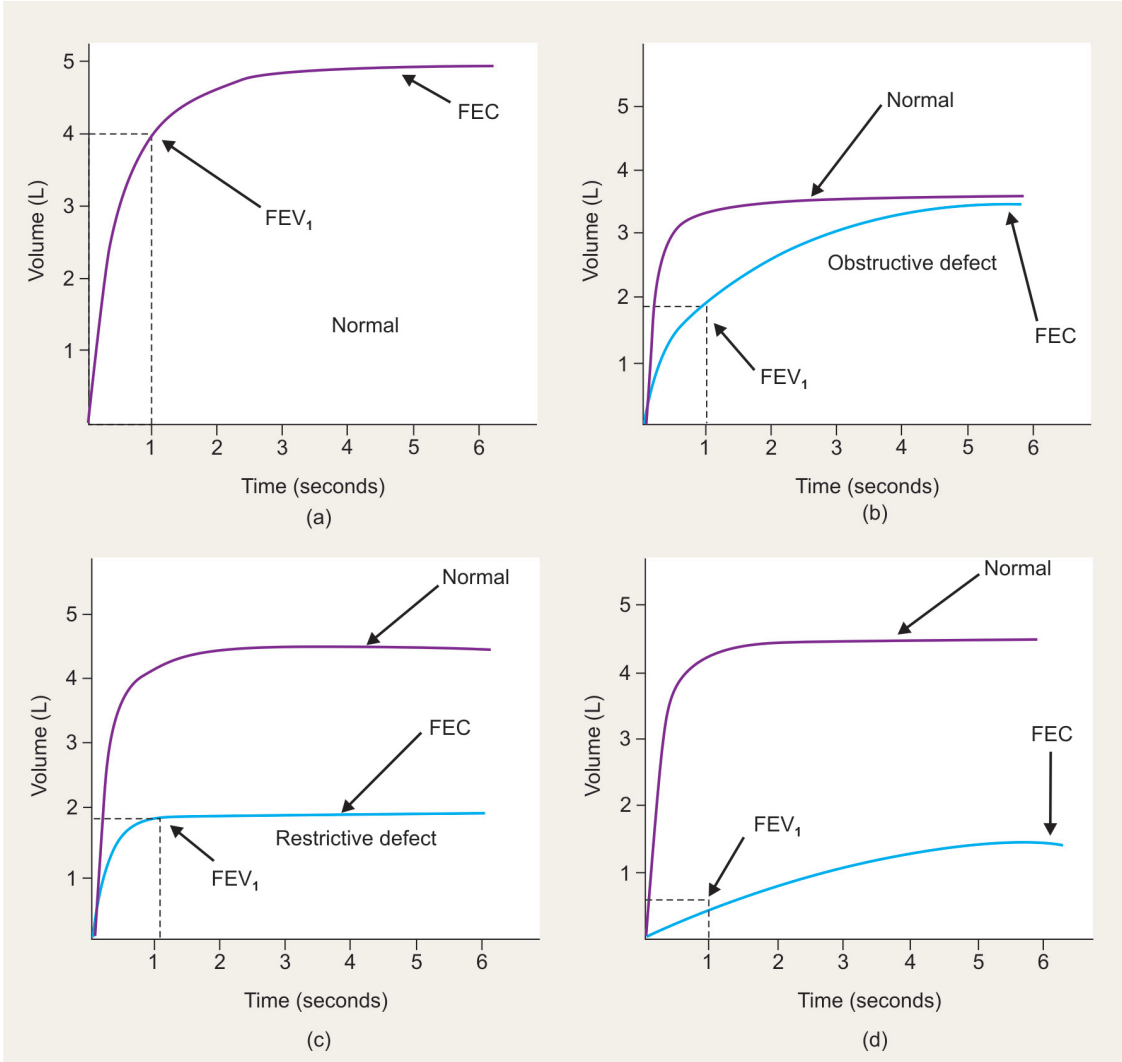
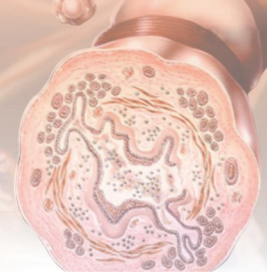


Fig. 2.9: (a) Normal volume/time tracing; (b) An obstructive ventilatory defect; the FEV_1 is reduced while FVC is normal; (c) A restrictive ventilatory defect; proportionally reduced FEV_1 and FVC; (d) Mixed obstructive and restrictive ventilatory defect; both FEV_1 and FVC are disproportionally reduced.

withstand certain types of major operations. An MVV much greater than $FEV_1 \times 40$ indicates that the FEV_1 test was poorly performed.

Bronchodilator Reversibility Testing

Spirometry before and after treatment with bronchodilators or corticosteroids (reversibility testing) is not necessary for suspected COPD, although doing so should be considered when asthma is thought likely or when the response to treatment is surprisingly good. However, asthma can usually be differentiated from COPD on account of the history, examination and baseline spirometry (which is usually normal without an exacerbation). The



mucus secretion are the large airways, small airways (<2 mm) remain the major site of airflow resistance. Cigarette smoking induced inflammation is a critical factor affecting both the processes.

Airway inflammation: The principal inflammatory cell in chronic bronchitis is the CD8+ cytotoxic T lymphocyte, observed in the sputum. It diffusely infiltrates the bronchial tree. Actively involved in viral clearance, CD8 lymphocytes utilize contact-dependent effector mechanisms including release of perforin and FAS ligand to activate mediators of cell death. Interferon-γ (IFN-γ) and tumor necrosis factor-α (TNF-α), secreted by these cells in response to viral infection are the principal mediators of T cell induced lung injury. Disease progression and acute bacterial exacerbations in chronic bronchitis is also associated with neutrophils expressing high levels of myeloperoxidase (MPO) and leuketriene B_4 (LTB_4). Exacerbations in COPD were associated with an increased expression of cytokines and chemokines which functions to maintain the inflammatory response and activation of epithelial and endothelial cells. IL-6, IL-1β, TNF-α, growth related gene-α (Gro- α), monocyte chemoattractant protein-1 (MCP-1) and IL-8 were overexpressed in sputum, while bronchial epithelium over-expressed MCP-1 and its receptor CCR2, IL-8 and MIP-1α which correlated with airflow limitation.

Increased number of activated eosinophils in peripheral blood positive for IL-12 has also been linked to exacerbations in chronic bronchitis. It has been suggested that eosinophils might play a role in promoting Th-1 response (in contrast to the Th-2 response typically seen in asthma) by promoting the development of Th-1 cells, facilitating CD8+ T cell responses, enhancing the lytic activity of NK cells and inducing the secretion of IFN-γ from both T cells and NK cells.

Mucus: An increase in luminal mucus attributed to increased production of mucins, increased secretion from goblet cells, goblet cell hyperplasia and/or metaplasia and accumulation of inflammatory cells and cell debris as described in chronic bronchitis. Intrathecal instillation of pancreatic elastase in mouse models have showed goblet cell hyperplasia and mucus hypersecretion suggesting a role of elastase proteolytic activity driven inflammatory process documented by an increase in IL-5 and Gro-α levels. Besides elastase, LPS, TNF-α, IL-1β also induces mucus hypersecretion by activating various downstream signaling cascades. The role of various growth factors in goblet cell hyperplasia is well established. Signals induced by epidermal growth factor-α (EGF-α) and transforming growth factor-α (TGF-α) has been found to play important roles in mucin production in human airway epithelial cells.

Cigarette smoke or oxidative stress causes epidermal growth factor receptor activation (EGFR) via reactive oxygen species (ROS) and activation of the TNF-α converting enzyme (TACE) which releases TGF-α in epithelial cells leading to goblet cell hyperplasia and increased mucus production. Increased levels of VEGF and IL-13 in COPD airways also contribute mucus gland hyperplasia and bronchial smooth muscle hypertrophy. Cigarette smoke has also been found to inhibit the expression of the cystic fibrosis transmembrane conductance regulator (CFTR), a cAMP regulated chloride channel leading to impaired anion transport, increased intracellular Ca^{2+} and activation of the NF-κB signaling. The net effect is abnormal mucus secretion which adheres to the cell surface, thereby reducing mucociliary clearance and enhancing retention of pollutant and pathogens.

Small airway remodeling: With disease progression, the small airways in COPD exhibit increased thickness, goblet cell