CIGARETTE SMOKING AND LUNG DISEASE

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The intimate relationship that exists between the lungs and the external environment serves the useful purpose of Gas exchange but leaves the lungs susceptible to the unusual constituents of the ambient air. There is increasing evidence to suggest that a large proportion of the Pulmonary Diseases are related to the inhalation of foreign substances placed in the air by a variety of human activities. A landmark document published by the Advisory Committee to the Surgeon of the United States in 1964 (1) assembled a massive volume of data indicating that the epidemic increase in lung Carcinoma and Chronic Obstructive Pulmonary Disease (COPD) were related to the increasing consumption of cigarettes. This document concluded with the quotation that "cigarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action". This report played a big part in changing the smoking habits. While the smoking among men has declined, smoking among women has fluctuated. The most disconcerting observation being that twice as many teenage girls smoked in 1974 as compared to 1968. This shift has already resulted in a relative increase in COPD and lung Carcinoma amongst women.

Natural History of Smoker's Lung

The advent of newer Pulmonary function tests, closing volume and mid-maximal flow rate (MMFR) has helped to identify the early changes found in asymptomatic smokers. The observation of McFadden et al (2) and McCarthy et al (3) have shown that up to 75% of asymptomatic smoking adults have significant alteration in the closing volume and MMFR indicating small airway damage. The interesting aspect of McFadden's study was that a large proportion of these patients reversed these abnormalities after cessation of smoking.

Many young cigarette smokers have normal pulmonary functions when studied by the conventional studies. This paradox is best explained by the work of Macklem and Mead (4) who showed that smaller airways (those less than 2mm in diameter, consisted of smaller bronchioles, terminal and respiratory bronchioles) contributed less than 10% to the total airway resistance. Thus the ventilatory tests such as maximum expiratory flow rate, forced expiratory volume, or direct plethysmographic measurements of airway resistance all depend on total airway resistance and may be normal in the presence of extensive small airway disease.

The pathological confirmation of this data can be obtained in the study by Niewoehner, Kleinerman and Rice (5) who did autopsy studies on youthful victims of sudden and unexpected death (SUD). They studied 39 such patients with an average age of 25 years. Of the 20 nonsmokers 3 had evidence of respiratory symptoms. The 19 nonsmokers showed loss of bronchial epithelium and evidence of bronchial wall inflammation. The most striking abnormality was the presence of bronchiolactitis, a lesion of the small airways found in all the smokers. Clusters of brown pigmented macrophages were also seen in these youthful smokers suggesting an injury to one of the major defense structures of the lung. These pigment laden macrophages are probably responsible for the "black lung" associated with air pollution, coal miners, and cigarette smokers, these macrophages can be harvested from the lungs of smokers. The observation by Laurenzi et al (6) that tobacco smoke inhibited bacterial clearance in mice led to the confirmation of the

fact that smokers have a greater tendence towards developing respiratory infections. Thus cigarette smoking may lead to SUD, increased susceptibility to infections and over the years to COPD-Chronic Obstructive Pulmonary Disease.

Further increase in exposure to cigarette smoke leads to progression of small airway involvement to extensive bronchial and alveolar disease. Mitchell et al (7) observed that exposure averaging almost 40 pack years led to severe chronic airways obstruction. Aurebach et al (8) found that the amount of alveolar rupture and fibrosis corelated with both age and smoking history. A gradient could be established, with heavier smokers having more alveolar rupture than those who smoked less. Forty per cent of smokers fell in the "most severe" category of alveolar rupture, while not a single non smoker was observed to have that degree of abnormality.

Using the whole lung section technique of Gough and Wentworth, Anderson et al (9) showed that 17 per cent of smokers had severe emphysema, while 26 per cent had moderately severe emphysema. In contrast, none of the non smokers had severe emphysema, and only 16 per cent had moderately severe disease. Centrilobular emphysema was rare in non smokers, panlobular emphysema was found in both smokers and non smokers. In another study, Auerbach et al (10) studied whole lung sections from 1831 individuals and identified a striking relationship between cigarette exposure and frequency of emphysema. In an autopsy study from an unselected group of sudden and unexpected deaths, Spain et al (11) found almost 40 per cent of smoking men who were presumably healthy had significant emphysema.

The steps identifying the sequence of events leading from ciliary stasis to respiratory bronchiolitis and ultimately to bronchitis and emphysema are pretty well worked out.

Smoking and Neoplasia

Lung cancer is the most common cause of cancer death in USA. While this cancer was a medical curiosity in 1930, (12) in 1972 there were 72,000 deaths from lung cancer in USA which increased to 83,800 in 1976. For this year its projected there will be 98,000 newly diagnosed cases and 89,000 deaths.

Since all individuals who smoke do not exhibit identical manifestations, individual susceptibility must modify the tissue responses to inhaled irritants. The highest incidence of abnormalities is in those who are not predisposed and who do not smoke.

Considerable evidence exists for the belief that the irritant potential of cigarette smoke first manifest itself as bronchitis and emphysema and ultimately leads to neoplasia. Although this unitary concept does not rule out different components of cigarette smoke producing inflammatory and neoplastic consequences, it emphasizes the frequent occurrence of both chronic lung disease and lung cancer in the same individual. Evidence for this comes from the early work of Auerbach et al. (8)

Now it's believed that Polycyclic aromatic hydrocarbons are putative carcinogens present in the cigarette smoke. Most polycyclic aromatic hydrocarbons must be activated to the reactive epoxide form in order to interact with DNA. An enzyme important in this activation appears to be arylhydrocarbon hydroxylase (AHH). AHH is a membrane-bound inducible enzyme which occurs in the microsomal fraction of mammalian cells. It has been isolated from lymphcytes, monocytes and alveolar macrophages. A greater proportion of patients with lung cancer have intermediate or high inducibility rates as compared to healthy controls. This high inducibility characteristic may predispose some cigarette smokers to lung cancer. If this is so, it might be possible to isolate high risk groups from the large population of cigarette smokers (Kellerman et al). (13)

Smoking, Air Pollution and Occupational Health

Asbestos and smoking coincidence is well worked out. (14) Cigarette smoker has an 11 times greater chance of dying from lung cancer than a non smoker, whereas a smoking asbestos worker had a 92 times greater chance of developing lung cancer compared to unexposed non smokers. This suggests a true synergism between asbestos and cigarette smoke. Similar observations have been made with URANIUM, CHROMIUM, NICKEL and ARSENIC workers. BUSSINNOSIS is another example.

Cessation of Smoking

McFadden (2) has observed the beneficial

effect of cessation of cigarette smoking in young asymptomatic patients with evidence of Small Airway Disease. All patients showed improvement in MMEF after cessation of smoking.

Most patients who stop smoking experience a decrease in cough and sputum production following cessation of smoking and objective measurements of pulmonary function improvement. Perhaps the most dramatic evidence of the beneficial effects of smoking cessation is the change in mortality rates among British Physicians. During past 20 years, half of all British physicians stopped smoking. In the period 1961-65, compared to 1953-57 deaths among physicians from chronic obstructive lung disease decreased 24 percent and from carcinoma lung 38 percent. A reduction of cigarette smoking was not observed in the rest of the British population. In the public at large, mortality from chronic lung disease decreased by only four percent and mortality from lung cancer increased by seven percent.

Passive Smoking

An outbreak of angina pectoris aboard the French ship, Embuscade in 1958 was attributed to high concentrations of tobacco smoke below decks. More recently Russel et al (15) showed that blood carboxyhemoglobin increased from 1.6 to 2.6 percent saturation in 12 non smokers who spent 278 minutes in a smoked filled room. 3 to 5 percent carboxhemoglobin has been shown to have deleterious effects in patients with coronary artery disease, emphasizing that passive smoking may be harmful in certain individuals. Passive smoking may also produce pulmonary symptoms. Colley et al (16) demonstrated that the incidence of pneumonia and bronchitis in the first year of life was related to parents smoking habits, incidence was highest when both parents smoked, lowest when neither parent smoked.

Conclusion

Cigarette smoking seems like a true death wish. It may well act in a true Darwinian fashion, eliminating individuals with inappropriate genes and favoring those with a more durable genetic constitution.(18)

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