The pathophysiological and epidemiological differences seen in asthma, chronic bronchitis and emphysema

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Introduction

The aim of this article is to discuss the differences seen in asthma, chronic bronchitis and emphysema in relation to pathophysiology and epidemiology. In addition, the view of Traditional Chinese Medicine (TCM) will be noted.

In general, the function of the airways is to facilitate the movement of gases into and out of the lungs. As the airways branch out from the major bronchi, they decrease in size and lose their cartilaginous support. At the point where the cartilaginous support ceases and the diameter is reduced to 1mm, the bronchi become bronchioles. Rings of smooth muscle joined by diagonal muscle fibres surround the epithelial lining of the bronchioles. Contraction and relaxation of the smooth muscle layer, controls the resistance of airflow through the bronchioles and extends into the wall of the alveolar ducts. The bronchioles are lined with simple columnar and cuboidal epithelium, which contains ciliated and secretory cells. The smooth muscle layer of the bronchioles is innervated and sensitive to chemical mediators. As Porth states (1990, p446) any airway obstruction can result in thickened secretions, spasm of the bronchial smooth muscle, or disease conditions that disrupt the structure of the bronchioles and alveoli.

Asthma, chronic bronchitis and emphysema are all classified as respiratory diseases. As Price and Wilson explain (1992, p548) they all share a common pathophysiological feature: a long duration characterised by an increase resistance to airflow.

Asthma can be divided into two categories, extrinsic or intrinsic. Extrinsic (allergic) asthma is found mainly in children and only in a minority of adult patients. It is caused by the inhalation of pollen, animal dander, mould spores and feather dust. Exposure to these protein-containing allergens even in minute quantities will cause a type I inflammatory response. Intrinsic (idiopathic) asthma is more commonly found in patients over the age of 40 and is triggered by infections, weather changes, emotion, exercise, airborne irritants and drugs such as aspirin (Porth 1990, p448). Both types of asthma are characterised by hypersensitivity of the tracheobronchial tree from external stimuli, leading to constriction of the airways caused by bronchospasm.

Chronic bronchitis and emphysema are classified as chronic obstructive pulmonary diseases (COPD). The most common cause of COPD is cigarette smoking. Chronic bronchitis means a prolonged inflammation of the bronchi.

It is a clinical disorder characterised by an excessive production of mucus in the bronchi. It manifests as a chronic cough, with production of phlegm for a minimum of 3 months a year for at least two consecutive years. Emphysema however, can be either centriacinar or panacinar. Centriacinar emphysema mainly occurs in smokers and those already with chronic bronchitis. Panacinar emphysema mainly occurs in the elderly and those with a α^1-antitrypsin deficiency. Both types are characterised by the anatomic alteration of the lung parenchyma with abnormal enlargement of the alveoli and alveolar ducts along with the destruction of the alveolar walls.

Discussion

Asthma is initiated by a type I, IgE immune response. The mast cells of the bronchial tissues release chemical mediators, histamine, slow reacting substance of anaphylaxis, eosinophil chemotatic factors, platelet-activating factors and prostaglandins. These produce bronchial smooth muscle spasm, vascular congestion, an increased vascular permeability, oedema, production of thick tenacious mucus and an impaired mucociliary function. When combined with the epithelial cell damage caused by eosinophil infiltration it results in hyper responsiveness of the airways. The obstruction of the airways by bronchospasm and excessive mucous production increases resistance to airflow especially expiratory. As McCance *et al*. (1994, p1167) state, the continued trapped air within the lung increases intrapleural and alveolar gas pressure and causes decreased perfusion of the alveoli, with an uneven ventilation-perfusion relationship within the different segments of the lung. This causes early hypoxemia without CO_2 retention, which increases still further hyperventilation through the respiratory system, causing the partial pressure of carbon dioxide in the arterial blood ($PaCO_2$) to decrease and pH to increase (respiratory alkalosis).

In Traditional Chinese Medicine (TCM), the pathology of asthma is a combination of phlegm and damp blocking the air passages and impairing the dispersing and descending functions of the Lung (Chen and Li 1996, p188). This impairment of function leads to wheezing, coughing and respiratory obstruction.

Asthma does not discriminate with age and can affect anyone, although the majority of cases are found in children. A sample survey carried out in America during 1996, (http://www.lungusa.org/data/asthma/part2.pdf 25 Nov. 2000) showed that nationally there were 14,596,000 cases of asthma. The figures showed a broad difference between sufferers less than 18 years of age, 4,429,000 (30.3%), to those over 65, 1,445,000 (9.9%). This is contributed to several factors. Individuals who sufferer from asthma will see their respiratory condition either cease or deteriorate into that of chronic bronchitis and emphysema as the attacks become more frequent with age. In addition, new research has shown that the quantity of junk food consumed by children rather than the elderly can cause a greater risk of symptoms. As Seaton (2000, p778) points out a diet that lacks vitamins, nutrients and vegetables will cause a 2-3-fold increase in asthma rates. There were also a

higher number of female asthmatics, 8,845,000 (60.5%) than males, 5,751,000 (39.4%). This trend is carried on in chronic bronchitis sufferers.
Chronic bronchitis is characteristic of hypertrophy of the bronchial mucosal glands, an increase in the number and size of goblet cells along with inflammatory cell infiltration and oedema of the bronchial mucosa causing excessive mucous production. As McCance *et al*. (1994, p1167) state, the thick mucous and hypertrophied bronchial smooth muscle obstructs the airways making breathing more difficult, especially expiratory. This trapping of gases in the distal part of the lungs, leads an uneven ventilation-perfusion relationship, hypoventilation, increased $PaCO_2$ and hypoxemia. These mechanisms of ball valving, are shared both by asthma and by chronic bronchitis but not emphysema.

In TCM, chronic bronchitis is caused by the weakness of the Spleen and Lung. This results in the impairment of fluid movement and the retention of phlegm. Patients will suffer from syndromes such as a cough, stuffy or runny nose and thin watery sputum (Kaptchuk 1983, p217).

Emphysema can be centriacinar or panacinar depending upon the location. Centriacinar emphysema is characteristic of inflammation of the bronchioles and the destruction of septa within the respiratory bronchioles and alveolar ducts. It mainly occurs in smokers and those already with chronic bronchitis. Whilst panacinar emphysema the whole acinus is involved and is more randomly distributed. It mainly occurs in the elderly and those with a α^1-antitrypsin deficiency. As stated by Porth (1990, p451) alpha-antitrypsin is a proteinase inhibitor; it blocks the action of the proteolytic enzymes that are destructive to elastin and other tissue components in the alveolar wall. This characteristic is only seen in a number of emphysema sufferers. Both types are characterised by the destruction of the alveolar septa, which eliminates parts of the pulmonary capillary bed, increases the volume of air in the acinus and affects airway calibre. This is probably due to the breakdown of elastin within the septa, which makes expiration difficult as the loss of elastic recoil reduces the volume of air that can be expired passively. This is different to that of asthma and chronic bronchitis in that tissue damage does not occur, instead inflammation is a common factor. It can be seen that the combination of an increased residual volume and a decreased calibre of the bronchioles will also lead to each part of inspiration being retained in the acinus, and the development of bullae and blebs. This is only characteristic of emphysema sufferers.

In TCM, emphysema is similar to chronic bronchitis. It is caused by external Wind-Cold attacking the Lung, which then develops into Heat. Wind-Heat interferes with the dispersing function of the Lung and allows phlegm to build up. The phlegm blocks the airways and disturbs the normal function of the Lung, giving rise to expectoration of purulent sputum. Patients will often manifest foul smelling sputum flecked with blood (Scott 1984, p7).

As Price *et al*. (1992, p550) conclude, chronic bronchitis and emphysema are often found together when patients suffer from COPD. It mainly affects people between the ages of 45 and 65. It usually affects men more than women due to their heavy smoking, although this trend is now reversing as shown in the sample survey carried out in America during 1996 (http://www.lungusa.org/data/copd/copd2.pdf 25 Nov. 2000). Nationally there were 14,150,000 cases of chronic bronchitis, whereas the number of emphysema sufferers was 1, 812,000. As can be seen, there is a higher number of chronic bronchitis sufferers than those of emphysema. This is due to the high number of people who smoke between the ages of 18-44. As the disease progresses throughout their life and is left untreated, it develops into emphysema. In addition, a number of chronic bronchitis patients will die before they reach old age so leaving a lower number of emphysema sufferers. The number of females affected with chronic bronchitis was 8,101,000 (57.3%) compared to the male equivalent of 6,049,000 (42.7%). This is largely a new trend and is probably based upon the fact that more women are now smoking. The number of males affected with emphysema stood at 956,000 (52.5%) whilst the number of females was 866,000 (47.6%). This number of emphysema sex related sufferers' mimics that of pass trends. This will undoubtedly change in line with chronic bronchitis, as the generation of (predominately female smokers) 18-44 year olds grows older. The age differentiation for chronic bronchitis showed that the largest number were between the ages of 18-44, at 4,904,000 (34.7%). This is due to the heavy smoking of people between the ages of 18-44 and to a lesser degree the quantity of industrial work carried out. This is contrary to that of asthma where the greater percentages of asthmatics are below the age of 18 and do not smoke nor are they exposed to industrial pollutants. However, the highest number of emphysema sufferers was between the ages of 45-64, with 701,000 (38.5%). Emphysema is commonly found in elderly individuals, although it can come secondary to chronic bronchitis and cigarette smoking.

Conclusion

Asthma, chronic bronchitis and emphysema are all characterised by coughing, wheezing dyspnoea and respiratory impairment. This is due to obstruction of the airways that leads to the trapping of gases in the distal part of the lungs. However, in emphysema the retained gas is caused by the breakdown of elastin within the septa. Whereas in asthma sufferers gas retention is caused by bronchoconstriction, whilst in emphysema sufferers gas retention is caused by mucous build up. There is however, an etiological and sequential relationship between chronic bronchitis and emphysema that does not exist with asthma. Asthma is due to an allergic reaction or other factors such as emotion, weather or infections, which triggers bronchoconstriction. Both chronic bronchitis and emphysema are triggered by cigarette smoking and industrial pollutants. Although emphysema may develop in old age or come about from a α^1-antitrypsin deficiency.

As we have seen, asthma is commonly seen in those less than 18 years of age, whilst chronic bronchitis is common between the ages of 18-44 and emphysema is seen mainly in those between the ages of 45-64. There is an additional trend seen in sex related sufferers. There are a higher number of female asthmatics than males. This is reiterated in chronic bronchitis, whilst at present there are a higher number of male emphysema sufferers than female. Although this will undoubtedly change in line with asthma and chronic bronchitis trends as the generation of chronic bronchitis sufferers, deteriorate into old age.

Biography

Attilio D'Alberto graduated from a program jointly run at Middlesex University and Beijing University of TCM with a BSc (Hons) in Traditional Chinese Medicine (Middlesex University) and a MD (Beijing University). He currently practices in various busy clinics in London. Correspondence: www.attiliodalberto.com/contact.php

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