Considerations in Evaluating Pulmonary Disease in the Elderly

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The process of aging has essentially 4 characteristics; it is universal, intrinsic, progressive, and decremental. Few of the structural changes observed with aging are specifically characteristic of it as they are the result of accumulations and alterations that occur throughout life (1,2). Therefore the question arises as to how much of the loss of respiratory function is due to wear and tear and how much is due to the normal aging process? Neither process is well demarcated and they are often indistinguishable from one another. It is generally recognized however that the accumulated effects of disease has a greater impact on the respiratory system than do age related changes.

The respiratory system is not an isolated entity but interacts with other organs of elimination to remove toxic elements from the body and maintain homeostasis. In particular the lungs interact closely with the kidneys in order to maintain the blood pH within the narrow range (7.34–7.45) needed to sustain life. Therefore a change in one of these organ systems will affect the other as the emunctories work to maintain homeostasis.

Beginning at about age 50, a decline in muscle mass and the effects of repeated immune responses to environmental perturbations begins to influence respiratory function provided there isn’t a preexisting genetic deficit or previous lung disease. Age related changes affect not only ventilation and gas exchange but also the lungs ability to defend
itself against toxins and invaders. Changes in lung elasticity, chest configuration, and motion gradually affects compliance, and respiratory function as measured on lung function studies. Parameters such as focused expiratory volume (FEV1), forced expiratory flow (FEF), functional residual capacity (FRC) and residual volume (RV) begin to show changes. (2,3) In persons who do not exercise, these changes progress at about a 5% to 20% decline per decade while in persons who do exercise, decremental changes occur at a slower rate. Additionally the increasing rigidity of thoracic walls and less expiratory force will decrease cough usefulness and increase risk of respiratory infection.

As mentioned previously, it is unclear whether the increasing rate of decline in ventilatory function is a result of the normal aging process or from the effects of prior diseases, exposure to pollutants and toxins or the result of an abrupt and severe insult to the respiratory system. All of these lead to increasing symptoms of airway obstruction (AO). The gradual decline in lung function that occurs until age 40 from its peak at age 20 to 25 is mainly due to changes in body weight and muscle strength. After this period the rates of changes in FVC and FEV1 tend to follow a somewhat linear decline but varies from individual to individual. (2,3) Because of this variation the rate of decline cannot be predicted based upon age alone. Certainly the effects on lung function decline due to smoking are well documented and will not be discussed here.

As we age chest A to P diameter increases and kyphosis of the spine occurs which leads to a decreased compliance of the thorax and expiratory force. Because chest wall
compliance gradually becomes stiffer, the increased outer chest wall rigidity makes it more difficult for the diaphragm and muscles involved with respiration to counter the effects. Therefore this results in a slight increase in total lung capacity (TLC) as well as larger increases in FRC and RV or what remains in the lung at rest. (4) In an elderly patient this results in a decreased flow of inspired and expired air making it more difficult to assess airflow on auscultation.

**The Aging Respiratory System and Emphysema Have Much in Common**

There is some decrease in the number of alveoli with hypertrophy of others. This is especially seen in smokers or if there is a past history of smoking or exposure to polluted air. Because of age related loss of elasticity, early collapse of peripheral airways occurs leading to lower lung volumes and less perfusion. An aging lung and emphysema have much in common; both have less than maximum breathing capacity and FEV while residual volume and functional residual capacity are increased; the lungs become more rigid and distended. This change in compliance is quite regional rather than being evenly distributed across the lung. The effect is to slow passive exhalation in some lung areas while other lung areas empty normally. During quiet breathing, inspired gases will preferentially go to the more distensible upper lung areas leading to an uneven distribution of gas exchange. Therefore certain areas on auscultation may sound as if there is condensation while others do not. (1,2,3,4)

Blood volume does not change with age but the quantity of blood present in the pulmonary circulation at any given instant does decrease with age. There is no change in
arterial PCO2 but a 10-15% decrease in PO2 occurs while the percent saturation decreases about 5%. This, along with an uneven distribution of airflow, may account for the rise in PCO2 and decrease in PO2. In the elderly, maximum O2 utilized under stress can decrease to 50%. This is probably due to a perfusion failure and impaired O2 utilization in the tissues. (1,3)

There is also a change with age in the epithelial lining fluid (ELF) which is abundant in antioxidant defenses that minimizes oxidative injury to the respiratory epithelium following toxic exposure. ELF is high in superoxide dismutase, catalase, metal binding proteins, glutathione, and vitamins C and E. These antioxidant levels are reduced on exposure to ozone, nitrous oxide, and particulate matter regardless of age but the ability to recharge the ELF changes with production decreasing with age. This increases the susceptibility of older individuals to environmental toxic exposure and risk of infection. There is also some evidence that there is an increased ability of alveolar macrophages to release superoxide anion in response to stimuli in the elderly. These changes likely represent the combined affect of repetitive stimuli from environmental exposure but could also be an adaptation to loss of function in an aging lung. (4)

Interestingly, intravenous administration of small amounts of ozone as well as hydrogen peroxide seem clinically to provide some relief in patients with COPD or emphysema. This is possibly due to a stimulation of the vital force similar to that experienced with homeopathic medicines, but other as of yet unexplained mechanisms may play a role.

Despite these changes the respiratory system is capable of maintaining adequate oxygenation and ventilation during the entire life span provided the perturbation or insult
does not force the system out side of its set point margins. Because the respiratory system reserve becomes limited with age, diminished ventilatory response to hypoxia and hypercapnia makes it more vulnerable to respiratory failure during high demand states such as with pneumonia, heart or renal failure leading to increased risk of morbidity and poor outcomes. While the mechanism has not been fully elucidated, it is thought to be due to a decreased sensitivity of peripheral chemoreceptors and/or integration of central nervous system (CNS) pathways.

**Dementia as an Indicator of Compromised Respiratory Function**

Elderly patients who present with an acute onset dementia or a sudden change in their normal activities of daily living (ADL) should be worked up for a variety of possible etiologies, among them being acute pulmonary disease. (1) While a change in a person’s respiratory rate is a homeostatic response to hypoxia or hypercapnia and is a useful clinical sign, these responses are muted or often not present in older patients which can mean that acute pulmonary disease may be missed. Additionally, the effects of prescription medications may also affect a patient’s respiratory function and should be part of the differential diagnosis.

Because of a narrowing of the set point margins that accompany aging, and the increased difficulty of the aging person to adapt to changes in the environment, it becomes all the more important for the physician to be aware of these variations from the norm and be more proactive when treating the elderly population. Naturopathic medicine has long subscribed to the importance of antioxidants and metabolic and immune system
enhancement to accomplish this goal. Some more recent work suggests however that while these factors are important, what may be as important is how much fluctuation and variation from the set point margins as well as the organisms ability to return to homeostasis will affect the organism’s longevity the most. (5) Regardless of the disease process, addressing the determinants of health and the hierarchy of disease progression, as well a appreciating the aging process will help elderly patients in their later years.

References:


