Pulmonary Heart Disease

Hemodynamic measurements. Lack of a simple, reproducible technique for measuring pressure in the pulmonary circulation in patients with lung disease has hampered physiologists and epidemiologists interested in the pathophysiology and demographics of pulmonary hypertension. In contradistinction to the systemic circulation, relatively little is known about the effect of age and aging on pulmonary artery pressures in healthy individuals. Holmgren et al. (1) and Ekelund and Holmgren (2) performed right heart catheterization in 16 healthy older men (aged 61 to 83 years). Pressures and flows were recorded at rest and during submaximal supine bicycle exercise. Hemodynamic measurements obtained from these healthy elderly subjects were compared with data from 36 healthy young men who performed the same test protocol. Rest pulmonary artery mean pressures and pulmonary vascular resistances were slightly higher in the elderly subjects. During submaximal exercise, mean pulmonary artery and pulmonary capillary wedge pressures increased as did cardiac output, and the slope of the regression line relating pulmonary pressure to cardiac output was steeper in the elderly.

Pulmonary vascular resistance decreased with exercise in both age groups, but the decrease was greater in younger individuals as compared with their older counterparts. From these and other studies, it appears that decrements in pulmonary arterial vascular compliance occur with aging even in normal, healthy individuals, but the changes are relatively small, and hemodynamic measurements in healthy aged subjects are generally within the range of values seen at younger ages (1–4).

Aging and pulmonary structure and function. These findings are compatible with what is known about the effects of age on other aspects of lung structure and function. There is a progressive decline in ventilatory function and pulmonary diffusing capacity and increasing nonuniformity of function after the age of 35. The basic physiologic alteration appears to be an age-dependent change in the elastic characteristics of the lung (5). This is accompanied by an increase in alveolar size observed morphometrically. All of these findings suggest that aging produces mild diffuse connective tissue changes that lead to a decreased reserve of the pulmonary vascular bed as well as a decrease in ventilatory function.

Response to hypoxemia. There are no data concerning the effect of age on the pulmonary vascular response to hypoxemia. Because hypoxemia is considered a major determinant of the pulmonary hypertension accompanying chronic pulmonary disorders, such information would be invaluable in understanding the effect of age on pulmonary heart disease.

Specific Causes of Pulmonary Heart Disease (Precapillary Pulmonary Hypertension)

The commonest causes of precapillary pulmonary hypertension in the United States are chronic pulmonary disease (such as emphysema and chronic fibrosing alveolitis), pulmonary embolism, congenital heart lesions with secondary pulmonary vascular disease and primary pulmonary hypertension. Other than anecdotal information, little is known about any potential additive effect of age on these conditions or even how commonly some of these illnesses occur in an elderly population.

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease is the commonest cause of cor pulmonale and right ventricular failure, and the majority of deaths from chronic obstructive pulmonary disease occur after the age of 65. The degree of pulmonary hypertension in these patients is more closely related to the severity of hypoxemia than to the extent of the ventilatory impairment (6). The improved survival with supplemental oxygen in hypoxic patients with chronic obstructive pulmonary disease (7) is generally ascribed to its beneficial effects on the pulmonary circulation.

Ventricular function. Although there is still debate, most authorities believe that left as well as right ventricular function is compromised in elderly patients with chronic obstructive pulmonary disease (8). There is a problem, however, in totally excluding the presence of concomitant heart disease in these patients, especially among the elderly. Indeed, the diagnosis of cor pulmonale in elderly patients with chronic obstructive pulmonary disease is difficult. The classic electrocardiographic findings of right ventricular hypertrophy are often absent. Newer diagnostic techniques, including isotopic studies and possibly echocardiographic...
methods, may allow better assessment of right ventricular function and provide indirect evidence of pulmonary hypertension. It remains uncertain, however, whether these techniques are sufficiently precise to allow one to follow the course of pulmonary hypertension in order to assess the effects of therapeutic measures. The reference standard for quantifying pulmonary hypertension remains direct measurement of pulmonary artery pressure with a pulmonary artery catheter (9).

Chronic obstructive pulmonary disease and mortality. Whether or not there is obvious cardiac disease, a high mortality rate is noted in older patients with chronic obstructive pulmonary disease (10), and this is related, at least in part, to a high rate of complicating cardiovascular problems. In this regard, it is interesting that mortality is much less closely related to the severity of the ventilatory abnormality in subjects >65 years than in younger patients with chronic obstructive pulmonary disease (10). The degree of pulmonary hypertension that develops in older patients may be accentuated because of the decreased pulmonary vascular compliance that occurs with age.

Pulmonary Embolism

Pulmonary embolism is common in geriatric patients in whom risk factors for this condition abound (sedentary existence, prolonged periods of bed rest, cardiopulmonary disease). Indeed, Dalen and Alpert (11) estimated that as many as 25% of deaths in nursing homes and chronic disease hospitals might be attributable, at least in part, to pulmonary embolism. In most of these cases, however, the pulmonary embolism represents a complication (and sometimes a terminal event) in the course of a serious underlying disorder and may be difficult to recognize (12). The syndrome of chronic cor pulmonale secondary to recurrent pulmonary embolism is infrequently recognized among the elderly. This may reflect the inherent problems in diagnosing pulmonary embolism in this age group in which areas of decreased lung perfusion may be found by isotopic scanning even in the absence of embolic disease.

Congenital Heart Disease

Few patients with pulmonary vascular disease secondary to congenital heart disease reach old age, although an occasional patient with an uncomplicated congenital heart lesion (such as atrial septal defect or ventricular septal defect) may live beyond age 65. Pulmonary vascular resistance increases progressively with age in patients with large ventricular septal defects, but few of these patients survive beyond age 45 (13).

Other Causes

In idiopathic fibrosing alveolitis, mortality increases with age (14), an effect that has been attributed to a high rate of concomitant cardiovascular disease. However, the specific effect of age on the development of pulmonary heart disease in these patients has not been reported despite the relatively high prevalence of the disorder among the elderly (14).

Primary pulmonary hypertension is an unusual disorder that has a predilection for younger adults. However, anecdotal experience (both personal and published) indicates that this entity occasionally occurs in the elderly. Because other causes of pulmonary hypertension are far more common in older patients, the diagnosis may be missed (15).

Passive Pulmonary Hypertension

Passive pulmonary artery hypertension is almost always the result of left ventricular failure or mitral valve disease, or both (16). An occasional patient with long-standing passive pulmonary hypertension secondary to mitral valve disease develops reactive pulmonary hypertension that is often quite severe (16). Because left ventricular failure and mitral regurgitation are quite common in elderly individuals, morbidity and mortality secondary to these entities with complicating passive (and occasionally reactive) pulmonary hypertension are probably common in elderly individuals. The exact demographics in the elderly of passive and reactive pulmonary hypertension with or without associated right ventricular failure are unknown. It is also unknown whether the pulmonary circulation of elderly individuals responds differently to left ventricular failure or mitral valve disease, or both, than is the case with younger patients.

Therapy of Pulmonary Heart Disease in the Elderly

Therapeutic interventions that are clearly efficacious include anticoagulation for patients with pulmonary embolism and supplemental oxygen for patients with hypoxemic chronic obstructive pulmonary disease. These interventions may lead to amelioration of pulmonary hypertension and a decrease in signs and symptoms of right ventricular failure.

Anticoagulant therapy. Anticoagulant therapy, initially with heparin and subsequently with warfarin, remains the treatment of choice for pulmonary embolism despite the increased bleeding risk in the elderly. Chronic anticoagulation with warfarin is believed by some to be of benefit in patients with primary pulmonary hypertension.

Oxygen therapy. Elderly patients appear to respond to oxygen therapy as well as do younger individuals, and the recommendations of the Nocturnal Oxygen Therapy Trial Group (17) are applicable at all ages. Continuous oxygen supplementation is indicated for all patients with chronic obstructive pulmonary disease with an arterial oxygen tension that is persistently <55 torr at rest. It is also recommended for patients with secondary signs of hypoxemia (including right ventricular hypertrophy) whose rest arterial
oxygen tension is <60 torr. This therapy has been shown to improve the quality of life and prolong survival.

**Vasodilator drugs.** Digitalis therapy in patients with cor pulmonale is marginally efficacious at best, regardless of the patient’s age. Pulmonary vasodilation with a resultant decrease in mean pulmonary artery pressure and pulmonary vascular resistance can be elicited in selected individuals with primary pulmonary hypertension. Unfortunately, however, pulmonary vascular responsivity to vasodilator drugs (calcium blockers, hydralazine, nitrates, isoproterenol) appears to be less common in elderly than in younger patients with primary pulmonary hypertension. Vasodilator agents are not indicated for pulmonary hypertension in chronic obstructive pulmonary disease; they may produce serious adverse effects in such patients.

**Combined cardiac and pulmonary disease.** Certain therapeutic problems may arise when treating patients who have both cardiac and pulmonary disease, and these are especially common in elderly patients. The use of relatively nonspecific beta-receptor blockers for hypertension or coronary artery disease may induce bronchospasm in patients with chronic airway disorders. This is sometimes the first indication of the underlying lung disease. On the other hand, the beta-blocking agents and theophylline used in patients with chronic obstructive pulmonary disease may have adverse effects on cardiac function and even induce serious arrhythmias, particularly if the dosage is not carefully controlled. Corticosteroids, which are so often given to patients with chronic lung diseases, may have adverse effects on serum electrolytes and fluid balance, complicating the management of any concomitant congestive heart failure.

**Exercise.** Finally, the importance of a regular graded exercise program in patients with chronic obstructive pulmonary disease deserves emphasis. Regular exercise, although not producing measurable changes in pulmonary or cardiac function, minimizes disability from the disease and can improve the quality of life (18).

**References**