Respiratory Function in the Elderly and the Effects of Beta Blockade

A.E. Tattersfield
Respiratory Medicine Unit, City Hospital, Nottingham, UK

Summary. Bronchoconstriction, the main respiratory side effect from beta-blocking drugs, can be severe and precipitous in patients with asthma, but at most is very minor in patients with chronic bronchitis. Elderly patients with asthma and chronic bronchitis appear to run a similar risk from beta-blocking drugs as younger patients with these conditions, though there are no direct comparisons. Several studies have looked at the response of elderly patients to beta-blocking drugs, and the profile and incidence of respiratory side effects has been similar to those seen in studies of younger subjects. There is a greater danger in the elderly that a past history of asthma may be overlooked or that bronchoconstriction from a beta-blocking drug is attributed to other causes.

Key Words. beta blockers, asthma, elderly

The effect of beta-blocking drugs on airway function has not been studied in the elderly specifically. This article reviews what is known about the effect of aging on pulmonary function and the effect of beta-blocking drugs on pulmonary function in general. The likely effects of beta blockade on pulmonary function in the elderly are then discussed.

Physiologic Effects of Aging on Pulmonary Function

As the lung ages it slowly loses elasticity (Figure 1). This causes increased closure of the more dependent airways and some shunting of blood past poorly ventilated alveoli [1]. As a consequence, there is a small reduction in arterial oxygen tension with increasing age and an increase in the alveolar-arterial oxygen tension difference [2]. A second consequence of the loss of lung elasticity is that airway distending pressure is reduced so that airways are smaller and measures of airflow such as the forced expiratory volume in 1 second (FEV1) show a gradual reduction with age from the early 20s onwards [3,4]. Longitudinal studies have shown the average loss of FEV1 to be 10–20 ml a year in nonsmokers [4]. An annual loss of 20 ml would leave a subject with an FEV1 of 4 l at the age of 20 with an FEV1 of 3 l by the age of 70. Aging has also been shown to be associated with some reduction in the ventilatory response to hypoxia and hypercapnia [5].

Cigarette smoking has a very large effect on lung function [4], and it can be difficult to separate the effect of smoking from the process of aging. The effect of smoking is underestimated in cross-sectional surveys of the elderly, since premature death in smokers causes them to be underrepresented [6]. Lung function in the elderly is also more likely to be impaired as a result of occupational factors, by certain diseases such as Parkinson's disease, and by drugs, e.g., sedatives, tranquilizers, and muscle relaxants.

Asthma and Chronic Bronchitis in the Elderly

The prevalence of asthma in elderly patients is uncertain. In a random sample of 1 in 8 people aged over 70 years, 6.5% had a history of asthma, 3% having current asthma, and 3.6% a history of asthma at some time [7]. One third of the patients in this study (37%) had developed symptoms after the age of 55.

Chronic bronchitis increases steadily with increasing age. For example, the number of patients consulting their general practitioners in the United Kingdom because of chronic bronchitis, emphysema, or chronic airways obstruction is twice as high in patients over 65 than in patients aged 15–65 [8]. The problem of diagnostic transfer between asthma and chronic bronchitis is greater in the elderly.

Problems in Assessing the Effect of Drugs on Pulmonary Function in the Elderly

Studies carried out on elderly patients are usually carried out on very selected patient populations, and
there are dangers in extrapolating the results from these studies to the elderly in general. The main factor that determines whether bronchoconstriction occurs with beta-blocking drugs is the existence of preexisting lung disease, asthma in particular, and chronic bronchitis to a lesser extent. The results of a beta blocker in any study, in young or elderly patients, will depend on the care with which such patients are excluded at the start of the study. Results in different studies can only be compared when the same criteria of exclusion have been used.

**Beta-Blocking Drugs and Respiratory Function**

Beta-blocking drugs have been associated with various adverse effects on the lung, directly or indirectly. Pulmonary edema, an indirect effect, is not considered here, nor are pleural and retroperitoneal fibrosis, which have not been associated consistently with any beta-adrenoceptor antagonist other than practolol. Some depression of ventilation has been noted in normal subjects rebreathing carbon dioxide after propranolol [9,10], but this has not been shown to be clinically important and would be unlikely to be so, except possibly in patients with ventilatory failure, in which ventilatory control is precarious. The main problems are due to blockade of the sympathetic tone that maintains bronchodilatation in asthmatic patients, though not in normal subjects. The precise source of this sympathetic activity has not been clarified, since airways have very few sympathetic nerve endings and catecholamine levels are not increased in asthma [11]. There may be overspill of noradrenaline from sympathetic nerve endings on vascular smooth muscle, or perhaps more likely, increased activity of sympathetic nerve activity to parasympathetic ganglia where stimulation of beta receptors inhibits parasympathetic nerve activity (Figure 2).

In practice bronchoconstriction is seen in a large proportion of patients with asthma given a beta-blocking drug, around 50% in most studies [12-15]. Since somewhere around 10% of the population has asthma, this is by far the most important respiratory problem with beta-blocking drugs. Bronchoconstriction does not occur in patients with previously normal lungs, though it can occur in patients whose asthma is causing minimal symptoms [16]. In patients with asthma, bronchoconstriction can be precipitous and fatal [17]. There is at present no easy way to identify patients who bronchoconstrict with beta-blocking drugs from those who do not, though there is some evidence that patients with more severe asthma and those with a greater increase in bronchial reactivity are more likely to bronchoconstrict [14,15].

Patients with chronic bronchitis and little reversibility with beta agonists usually show a small fall in FEV\textsubscript{1}, with beta-blocking drugs [18-22]. They have not been shown to develop dramatic bronchoconstriction, as seen in some asthmatic patients, though the problem of diagnostic confusion between asthma and chronic bronchitis has to be recognized. A patient with marked bronchoconstriction following a beta-blocking drug would inevitably be reassessed in the light of this event and would be very likely to be recategorized as having asthma.

Bronchoconstriction is more likely to occur with