ADVERSE EFFECT OF OXYGEN ON TRACHEAL MUCUS FLOW*

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Abstract The effect of oxygen on tracheal mucus flow was measured in young cats by a particle-transport technic. Any deviation from ambient oxygen tension in the inspired air, high or low, had an adverse effect on mucus flow; 100 per cent oxygen produced marked impairment. Basal mucus flow was improved, and the adverse oxygen effects were prevented and reversed by epinephrine compounds and adenosine triphosphate. These results, which are interpreted in terms of inhibition of carbohydrate metabolism by oxygen and the positive effect of catecholamines on this function, suggest a subtle, but potentially dangerous, form of oxygen toxicity.

THE increased sputum production in chronic bronchitis is the result of hypersecretion of mucus.[1] This observation correlates well with the histologic demonstration of bronchial-gland hyperplasia, and the greater tenacity of sputum can be related to an increase in mucus-secreting glands in relation to serious types. Glynn and Michaels[2] suggest that there is an actual transformation of serous into mucus acini, followed by an increase in size of the latter. The combination of large amounts of tenacious sputum and the inflammatory changes in the bronchial mucosa is good reason to suspect that mucociliary function is disrupted. Indeed, clearance studies with aerosolized radiotagged particles indicate that mucus flow is markedly impaired.[3]

During acute exacerbations of bronchitis there is further functional deterioration owing to greater ventilatory obstruction from the intensified inflammation, secretions and actual infection. It is during this phase of the bronchitic patient's course that modern therapy has its greatest success, since many of the bronchial changes are reversible. To accomplish this purpose, in addition to antibiotics, mechanical ventilation and oxygen, there is an increasing use of medications by inhalation, including bronchodilators, antibiotics, mucolytic agents, proteolytic enzymes, and steroids. Since mucociliary function constitutes an important respiratory defense, it is essential to understand the individual and combined effects of these agents on mucus flow. Almost invariably, oxygen is given in various concentrations during the acute phase, and in some patients, it must be administered chronically. Many recent reports have described a variety of deleterious effects of oxygen on bronchopulmonary tissue.[4,5] For these reasons, this study was planned to determine the effects of oxygen breathing on mucus flow. The observations are made possible by the development of a highly effective technic for measuring mucus flow in the tracheas of intact animals.

MATERIALS AND METHODS

Mucus flow was measured by a particle-transport technic in which artificial particles were deposited on the tracheal mucosa of anesthetized cats, and their cephalad progression was observed directly.[6,7] Three-month-old cats weighing 0.90 to 1.35 kg were anesthetized by the intraperitoneal injection of sodium pentobarbital in doses of 55 mg per kilogram of body weight. The intact trachea was exposed through an incision in the front of the neck, and the cat was then placed in a transparent plexiglass chamber in which the air was kept at a temperature of 37°C. Temperatures were measured by rectum, and at various times, tracheal temperature was monitored through a Thermistor probe connected to an electrotemp indicator.† The body was supported in the prone position, and the animal's

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