

has been reported in smokers (7,8). Further, in animals, cigarette smoke has been shown to cause airway epithelium to become permeable to even large molecules (such as horseradish peroxidase) that have molecular weights similar to that of HSA (9).

In the study of Isawa et al., one of the main objectives is to investigate mucociliary clearance. It is clear that the ideal substance for such an investigation should have most of the following properties. First, it should be inert to the pulmonary epithelium in order to avoid ambiguity during measurement of mucociliary function. Second, it should retain its radiolabel during the course of the study. Third, it should be of sufficient size so that its residence in the airway would not be shortened by a change in the permeability characteristics of the epithelium, or influenced by either active or passive mechanisms known to exist in the pulmonary epithelium. While no ideal marker has been found, it seems to us that Tc-99m sulfur colloid has distinct advantages over Tc-99m HSA in this type of study.

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## Reply

We appreciate the interest and comments of Logus and Man regarding our findings of a seemingly faster clearance of inhaled aerosol from the lungs in healthy smokers than in nonsmokers (1).

We have used Tc-99m albumin aerosol for more than 15 years now as an "inert and nonpermeable" substance to the pulmonary epithelium to investigate not only the ventilatory status or the space of aeration in the lungs (1-3), but also to study their mucociliary clearance mechanisms (1,5,6). We have never been bothered by increased background activity due to poor tagging of albumin.

We have been aware of the reports regarding increased per-

meability of the pulmonary epithelium in smokers when DTPA aerosol is inhaled (7-9). This is a very interesting finding, but the molecular sizes of DTPA and albumin are so different that it is hard for us to accept the factor of increased epithelial permeability to explain the seemingly faster clearance of inhaled radioactivity in the normal smokers. The fact that DTPA diffuses through the lung epithelium was first reported in 1968 (10). Actually when airway clearance efficiency is calculated, there is no difference between smokers and nonsmokers, and net clearance is not accelerated even in the smokers.

As we stated in the text (1), we believe that the increased mucus production and subclinical bronchoconstriction in smokers might be the main cause of this phenomenon.

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## Re: Quantitative Evaluation of Cerebrospinal Fluid Shunt Flow

The meticulous laboratory and clinical evaluation of cerebrospinal fluid flow in Rickham-Holter ventriculoperitoneal or ventriculocardiac shunts described by Chervu et al. (1), while clearly