

### Model Experiment on the Mode of Aerosol Deposition

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The present report deals with the modes of aerosol deposition in models simulating diseases of the human airways.

Aerosol used in this experiment was generated from a  $^{99m}\text{Tc}$ -albumin solution by an ultrasonic nebulizer (EN-142, Mistogen). Its median diameter was  $2.8\ \mu$  with geometric standard deviation of 1.79 as reported previously. The trachea, the primary and secondary bronchi were simulated by glass- or vinyl tubes of 15, 10 and 6 mm in diameter, respectively. A unidirectional constant flow of air containing radioactive aerosol was applied to each tube. Stream lines were assessed by applying flowing water mixed with a marker instead of using air according to the law of similarity (Reynolds).

In straight tubes simulating a normal airway, the stream lines were straight and aerosol deposition was uniform throughout. In tubes with circumferential stenosis, the more aerosol deposition occurred, the more severe the degree of stenosis, and the smaller the tube diameter. The mode of

deposition was either single- or double-peaked according to the speed of air flow. Distal to stenosis, the separation of the boundary layer was occasionally observed. In tubes with a partial obstruction simulating bronchogenic carcinoma, a double peaked deposition pattern was the rule. The amount of aerosol deposition increased as the ratio of obstruction or the speed of air flow increased or as the tube diameter decreased. The initial and the second peaks were due to impaction and turbulence, respectively and the separation of the boundary layer always occurred distal to the obstruction. In curved tubes simulating the displaced bronchi, the more aerosol deposited, the smaller the tube diameter and the more curved the tube. In a tube with dichotomy, aerosol deposited at bifurcation. A slight increase in aerosol deposition was observed in a straight tube with a rough surface.

These findings in models help understand and analyze clinical aerosol inhalation lung images. Further studies are in progress.

### Respiratory Impedance, Rhonchi and Radioaerosol Scintigraphy

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The purpose of the study is to show relationship among respiratory impedance, presence of rhonchi and radioaerosol lung images. The patients investigated were 61 cases of chronic obstructive pulmonary diseases (COPD), 11 with remarkable obstruction of the upper airways with rhonchi and 13 with pulmonary fibrosis. All subjects were examined by routine spirometry including respiratory impedance by oscillation method and precise auscultation, followed by radioaerosol lung scintigraphy.

All subjects with rhonchi had a high value of

respiratory impedance as well as remarkable hot spots of radioaerosol. While a single spot of aerosol was found in cases of upper airway obstruction, multiple spots were observed in advanced COPD. In pulmonary fibrosis, however, this spot formation was scarce in accordance to low value of respiratory impedance. There were some cases of early COPD to be substantiated further, in which respiratory impedance as well as routine spirometry were normal in spite of patchy aerosol depositional pattern.