dissolved in saline solution and injected intravenously before the procedures. The ventilation image on the lung, on the other hand, was obtained from the counts of radioactivity of inhaled ^{133}Xe gas. Scintiphotograph was taken during breath holding for 10 to 20 sec. after a single deep breath.

The regional radioactivities on the ventilation and perfusion in terms of the counts in each 55 (=11×5) matrices converged from 1375 (=55×25) matrices in each unilateral lung which was postulated to represent a regional lung field were recorded on the computor system.

Alveolar ventilation volume ($\dot{V}_{alv}$) was calculated as follows:

$$\dot{V}_{alv}(ml/m^2)=\frac{\text{minute ventilation volume (ml)} - \text{dead space (ml)} \times \text{respiratory frequency}}{\text{BSA } (m^2)}$$

Regional ventilation volume (V) was got by following calculation:

$$V=\dot{V}_{alv}\times\frac{\text{individual count in each regions}}{\text{total count in entire lung field}}$$

Cardiac output was obtained by ^{99m}Tc-albumin technique and regional perfusion (Q) were calculated in the same way as regional ventilation. Furthermore, regional ventilation-perfusion ratio (V/Q) was calculated from V and Q. Finally, the representation of distribution with mean and standard deviation, image and histogram display of the regional V/Q were obtained by the computor system.

As results, the distribution pattern of regional V/Q was diffusely uniform in control group, but in COLD group was changed markedly. Histogram display of regional V/Q had a high and sharp peak in controls, while low or several indented peaks and long lower slopes with irregularity were seen in COLD group.

Aerosol Deposition in the Central Airways

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Aerosol deposition in the human respiratory tract was studied by theoretical and experimental methods. Theoretical analysis was obtained by applying Weibel's model and deposition equations under laminar flow. Aerosol particle was considered to be dry, spherical and monodisperse aerosol. The calculation was done during one cycle of respiration. According to our calculation, the flow speed of inhaled air in the central airways was high because total volumes of each bronchial generation were not so increased in these area. Therefore, impaction was the major mechanism of deposition in central airways when larger particles were inhaled. More deep inspiration did not cause peripheral penetration of these particles.

This was because filtration of central airways to larger particles became more effective by taking deep inspiration with same cycle. Segmental bronchi had specific features in aerosol deposition. Larger particles deposited most in these area according to our calculation, because airflow speed was highest in segmental bronchi. The aerosol particles produced by ultrasonic nebulizer was not monodisperse but was considered to be about 2 microns as mass median diameter. This aerosol was medium sized particles, therefore, its distribution in human airways was showed in central as well as distal airways. When this aerosol was inhaled by deep breath with the same cycle of normal respiration, hot spots of aerosol were observed in segmental bronchi particularly of upper lobe. It was suspected from these theoretical and experimental analysis that segmental bronchi were liable to be attacked by medium to large sized particles.

Simulation Studies of Regional Pulmonary Ventilation Using Xenon-133

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Eight subjects consisting of three normal persons and five patients with pulmonary diseases were studied with Xenon-133 washout and N_2 washout to evaluate ventilatory function.

All studies were carried out with the subjects in the upright position and camera placed against the posterior thorax. 5 mCi of xenon-133 was injected into cubital vein. The subject held his breath for ten sec and he then rebreathed from the closed system until equilibrium was attained. The system then closed off and the subject breathed room air, while washout data were recorded on magnetic tape for computer analysis. All of the xenon-133 washout curves were corrected for the effect of xenon-133 uptake by the chest wall.

For the purpose of studying regional ventilation mathematical model was applied. In the model the only variable was tidal volume of each region and that was calculated by fitting closely computed points to an experimental curve using digital computer.

In the patients with obstructive diseases the value of regional minute ventilation per unit volume (VE/V) of slow compartment appeared to be lower and the volume ratios of slow compartment divided by the total lung volume to be higher compared with normal subjects.

Comparison of the results of xenon-133 clearance with standard N_2 washout studies indicated the sensitivity of the radioxenon technique because the radioxenon techinique demonstrated clearly the increase of volume of slow space in a patient with chronic bronchits whose index of inspired gas distribution taken from N_2 washout curve was within normal range.