AEROSOL INHALATION LUNG IMAGING; THE EFFECTS OF PARTICLE SIZE AND CARRIER GAS.

T., Teshima, T., Isawa, T., Hirano, A., Ebina and K., Konno. Tohoku University, Sendai.

The effects of aerosol particle size, inspiratory flow rate during inhalation and airways abnormalities in aerosol inhalation lung images have not been well studied yet. We had measured the size of aerosol particle and the inspiratory flow rate and studied deposition patterns by using models simulating airways pathology.

Based on these basic findings, we have analyzed the actual aerosol inhalation lung images obtained in normal subjects and patients with lung cancer, COPD and bronchial asthma.

Aerosol was generated from 99m-Tc-albumin solution by an ultrasonic nebulizer. When a reservoir was placed between the generator and a mouth piece, aerosol size ranged mostly from 1 to 3 μm in diameter, while without the reservoir it tended to be larger. As a carrier gas, either air or a mixture of 80 % helium (He) and 20 % oxygen (02) was used. Theoretically Reynolds' number should become smaller and less turbulent flow would occure with a gas of low density such as the He-02 mixture. Besides immediate inhalation lung images, delayed images were obtained sequentially one to three hours or longer following aerosol inhalation.

In patients with lung cancer who have COPD at the same time, the penetration of aerosol to the lung periphery was better and differentiation of hot spots due to malignant invasion from excessive aerosol deposition due to obstructive airways disease was easier, when the He-02 mixture was used as a carrier gas instead of air. In patients with lung cancer who have no COPD, simply placing a reservoir and using air as a carrier gas were good enough for the visualization of hot spots distal to the segmental bronchus. Malignant lesions in the major airways were recognized as well by using air and even without the reservoir. In patients with only COPD, placing a reservoir was extremely useful and characteristic aerosol deposition patterns in COPD were also helpful in the differential diagnosis of COPD.

Regarding hot spots, ones due to cancer became increased in size or were simply persistent on sequential images if mucociliary action of the airways was disturbed by malignant invasion. Excessive deposition due to COPD usually became decreased in size if mucociliary action was well preserved.

In summary placing a reservoir between an ultrasonic nebulizer and a mouth-piece and a use of the He-02 mixture as a carrier gas are recommended as outlined above in selected cases. Placing a reservoir makes the size of aerosol to be inhaled more uniform and smaller and a better penetration of inhaled aerosol to the lung periphery is possible with the He-02 mixture.

AEROSOL INHALATION SCINTIGRAPHY IN PATIENTS WITH EMPHYSEMA

Akira Shida*, Yoshitsugu Minami*, Makoto Murao*, Masayori Furudate**

*The First Department of Medicine, **Department of Radiology, Hokkaido University School of Medicine, Sapporo

The relationship between pulmonary radioaerosol inhalation scan abnormality and pulmonary dysfunction was investigated in 21 patients with pulmonary emphysema. Diagnosis was established clinically, in cluding two criteria: 1) FEV_1/FVC was $< 70\%$ and RV/TLC was $> 35\%$ 2) findings of selective alveolo-bronchography consisted with pulmonary emphysema. Average values of VC, FEV_1/FVC and RV/TLC were 2.4ℓ, 44% and 55% respectively. Radioaerosol of ^{99m}Tc labelled Albumin made by Monahan ultrasonic nebulizer was inhalated. In all cases hyperdeposition occurred in hilar regions (central type deposition: CTD). Grading 3 levels, 1 to 3, scores of CTD were related to Raw and FRC measured by body plethysmography (r=0.62, 0.61). In 10 cases, spotty irregular radioactivity (peripheral type deposition: PTD) was located in the lung fields associated with CTD. Grading 4 levels, 0 (without PTD) to 3, the scores of PTD were related to the increase of PCO_2 and the decrease of PO_2 (r=0.64, -0.49). In 11 cases without PTD the increase of Raw was related to the increase of FRC measured by body plethysmography, but not in the cases with PTD.

In conclusion CTD may be caused from increased large airway resistance due to loss of radial traction, and PTD may be caused of coexisting chronic bronchitis as Isawa (1970) pointed out.