brightness from apex to base of the lung representing the gravity dependent gradient. The brightness for the base was 3~4 times as much as the apex, $\dot{V}/\dot{Q}$-images showed inverse distribution. In cases with mitral stenosis, $\dot{Q}$-images showed just inversion of normal pattern, descresing from the apex to the base, while $\dot{V}$-images showed diffuse distribution. In pulmonary thrombosis, the affected areas were shown as cold areas in $\dot{Q}$-images and hot areas in $\dot{V}/\dot{Q}$-images, indicating the effect of dead space. In chronic obstructive lung disease, each of total and differential lung volume for TLC, FRC, FRC/TLC was increased. Both $\dot{V}$-images and $\dot{Q}$-images showed multifocal irregular distribution. MTT-images showed multifocal areas with delayed washout by which the extent and the degree of the obstruction were estimated.

This on-line computer-aided ^{133}Xe pulmonary function study facilitates the quantitative determination of total, differential and regional pulmonary functions and is considered very useful for diagnosis and follow up of various lung diseases.

Dynamic Analysis for Regional Pulmonary Function Using ^{133}Xe

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Using ^{133}-Xe, a Xenon lung function unit (Nuclear Associates, Inc.) and a large area scintillation camera (the effective field, 34 cm in diameter), combined with the computer system (TOSBAC 3400 Model 31), the regional pulmonary function was evaluated in 8 normal subjects, 13 patients with PSS (progressive systemic sclerosis), 7 patients with FLD (fibrosing lung disease) and 16 patients with COLD (chronic obstructive lung disease). As the regional pulmonary function together with the data of pulmonary function (%VC, $FEV_{1.0\%}$, PaO_2, and so on), ventillation index ($\dot{V}$) and perfusion index ($\dot{Q}$) were obtained by single breath method, and clearance half time ($T_{1/2}$) and ratio of disappearance constant (λ_i/λ_t) were calculated from wash out curves for equilibrated ^{133}-Xe gas in the steady state. Statistical Analysis was performed for these data. Preliminary results obtained are as follows.

(1) Results of the principal component analysis by using the data of total pulmonary function suggested that the normal subjects, the patients with PSS, FLD and COLD were effectively distinguished each other.

(2) As the results of the analysis with the parameter of regional pulmonary function in each division of lung field, in the case of the $\dot{V}$, $\dot{Q}$, $T_{1/2}$, the normal and the abnomal groups might be separated with high probability. But the effects of the discrimination between the groups of the abnormal were inferior to those with the data of total pulmonary function measured by the spirometer.

Data Processing for Regional Ventilation Study Using ^{133}Xe

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We made a computer program for the convenient processing of the data obtained in regional ventilation study, which has beenused for clinical diagnosis.

LFOV gamma camera, Ventil-con and minicomputer (Scintipac 200) were used. Ninety frames of lung images after inhalation of ^{133}Xe gas were obtained with 5 seconds interval by use of scintipac 200. The image consists of 64 × 64 pixcel.

We supposed that ^{133}Xe gas concentration in the lung during washout was proportional to the first term of the following equation; $I=I_0 \exp(-Kt)+B$, where B is background count, I_0 initial count, t time elapsed and K constant. K and B were obtained by use of the successive approximation with the least square method. Initial value K was obtained using several frames of initial washout and approximate formula, $\exp(-Kt) = 1-Kt$. Counts of the last frame was used for B. The number of iteration was usually about 10. Six ROI's were set in both lung fields and mean transit time, which were reciprocal of K were calculated in each ROI by use of BICOM.

Since BICOM is built-in language of scintipac 200 and based on BASIC language, programming and operation of the data processing were very easy. Clinical usefulness of regional mean transit time will be reported elsewhere.

Gamma Camera Imaging of Closing Phenomenon in the Lung

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Closing phenomenon is known to be an expression of small airway closure at the state of low transpulmonary pressure and thought to be a sensitive means for early pathophysiological changes of the small airway. Since this phenomenon has never been materialized so far, we attempted to visualized it using radioactive gas and gamma camera, and compared it with the conventional resident gas method.

Ten normal volunteer with or without a history of smoking habit and eight patients with a variety of cardiopulmonary disease were investigated. A bolus of ^{81m}Kr or ^{133}Xe gas as a marker gas was inhaled at the level of reserve volume with the subsequent slow maximum inspiration, the image of inspiration distribution was recorded by the gamma camera and stored into the storage system for further analysis. This image was compared with the image of volume distribution of the radioactive gas which was obtained by the recording of the equibrated state at the level of maximum inspiration within a closed circuit during rebreathing.

In the case of smoker as well as of the patients with interstitial edema, closing phenomenon were observed as inspiratory defect at the dependent lower lung region with a horizontal demarcation. The level of this boundary was well correlated with the closing capacity measured by the conventional resident gas method. The radioactivity value was converted into volume value by a digital computer, and this estimated value was better correlated with the closing capacity ($r=0.947$, $p<0.005$). In the case with other diseases such as chronic obstructive pulmonary disease and lung fibrosis, closing phenomenon was expressed in a form of a exaggerated defect at diseased region.

Studies on the Mechanism of the Phase IV in a Single N_2 Method by Using ^{81m}Kr

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The phase IV in a single breath N_2 washout has been well recognized to be useful for early detection of small airway disease. In this paper the mechanism of the phase IV was studied by ^{81m}Kr.