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NUMERIZATION OF "UNEVENNESS" ON LUNG IMAGES AND LUNG FUNCTION DATA.

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The purpose of this study was to establish a methodology to numerize the "unevenness" on perfusion and inhalation lung images for functional estimation.

The original matrix data were made in frame mode in 64x64 matirces by a γ-camera and its computer system, and processed with 9-point smoothing. From the count profile of each of the 64 rows, number of peaks;Ni, the mean of the differences between maximal and neighboring minimal values;Di, its standard deviation;SDi, the coefficient of variation;VARi, and the sum of the differences between maximal and minimal values;Li were computed. Maximum count of each row:CMAXi, its coordinate;JMi, and half width;HWi were also determined. These values in each row were added and averaged vertically for the columns involved (Horizontal analysis). The similar procedures were repeated horizontally for columns versus rows (Vertical analysis). Both horizontal and vertical analyses were also simultaneously performed (H & V analysis). Obtained individual averaged values were indicated by respective capital letters without suffix as in the following.

In perfusion studies, lung function data and these indexes tended to correlate weakly with each other but in aerosol inhalation studies, N had a definitely better correlationship with VC, $\%FEV_{1.0}$, and $\dot{V}_{50}/\dot{V}_{25}$ by H & V analysis (r=0.7556, -0.8927, -0.7206, respectively, p<0.05, n=8). SD, VAR, L, CMAX, and HW also seemed to serve as good indexes to estimate the degree of airway obstructive disturbances. The "unevenness" on lung images could be evaluated objectively and quantitatively by means of computer analysis as reported here. This methodology is potentially applicable to any organ images in nuclear medicine.

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AN IMPROVED METHOD FOR THE MULTIPLE COMPARTMENT ANALYSIS OF THE INSPIRED GAS DISTRIBUTION BY XENON-133 WASHOUT TEST.

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To make functional image more precise, and the same time, reducing statistical error, we defined measure units as every other colum and row of 64X64 matrics, and assigned each measure unit to representative value which was the sum of neighboring 9 matrix elements and represented the measured data in the form of 32X32 matrix.
We made a histogram representing peak count in vertical axis, against T-I/2 in horizontal axis.
By employing the amount of ventilation volume obtained by the flow meter, we converted the above-mentioned histogram as against the ventilation volume.
We examined the accuracy of compartment analysis by way of this method and ascertained the availability for itspractical use.

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REGIONAL LUNG FUNCTION STUDIES BY SEMI-EQUILIBRIUM METHOD IN BALLOON BOX SYSTEM.

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We examined regional lung clearance of inhaled 133-Xe with a new inhalation system (balloon box system) and a new breathing maneuver named semi-equilibrium method (SE) which consisted of 3 deep breaths of 133-Xe from residual volume to total lung capacity followed by tidal ventilation of 133-Xe gas, and washout with air. Three different clearance time indexes were calculated from 133-Xe activity curve in a divided lung matrix; real half time ($T_{1/2}R$), half time estimated from exponential curve fitting ($T_{1/2}exp$), and the area under the clearance curve divided by the difference in the count rate between the tidal ventilation and 120 seconds (T(A/H)) after washout with air started. When the 3 indexes were calculated in a single matrix out of 16 x 16 matrixes, there was a good correlation between $T_{1/2}R$ and T(A/H) (r=0.92), but the correlation between $T_{1/2}R$ and $T_{1/2}exp$ was less good (r=0.75). In the single breath method (SB) previously reported, the area under the activity curve was divided by the difference in count rate between 10 and 130 seconds of washout and the index was called TA,H. Correlation between the present T(A/H) and the previous TA,H and that between $T_{1/2}exp$'s calculated from SE and SB were good with correlation coefficients of 0.88 and 0.85, respectively.

In conclusion we could get almost the same clearance time indexes in SB and SE. However, SE was better because more 133-Xe was inhaled in the lungs, and lung volume changed less during washout. Furthermore we could monitor respiratory cycles by using our balloon box system.

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ESTIMATION OF THE IMPROVEMENT OF REGIONAL VENTILATION BY THE Xe-133 WASHOUT METHOD.

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We used the Xe-133 washout method to estimate the improvement of regional ventilation, caused by pursed lip breathing (PLB). During a 3 min washin and 7 min washout, the scintigraphic data were stored by the gated list mode with a 1 msec time mark. From these data, a regional Xe activity-breath number curve and a regional Xe activity-time curve were made. Then the regional half clearance breath number ($B^{1/2}$) was calculated from the Xe activity-breath number curve as the half clearance time ($T^{1/2}$) from the Xe activity-time curve, and a functional image was made. Furthermore, a histogram was made to estimate the distribution of $B^{1/2}$ or $T^{1/2}$ objectively. We used a computer GAMMA-11 for the calculation. In this study, the PLB maneuver was modeled by loading the resistance on expiration.

By loading the expiratory resistance, regional ventilation was improved in patients with emphysema. This improvement was caused by reducing the dynamic compression of the air way with resulting a change of air flow.

We think it is better to estimate the ventilation by the breath number than by the time. Usually compartment analysis of the ventilatory function was done by using a N_2 concentration-breath number curve. So we think $B^{1/2}$ is clinically a better index than $T^{1/2}$ to estimate the regional ventilation.