
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 matrices 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, N; the mean of the differences between maximal and neighboring minimal values, Dl; its standard deviation, SDl; the coefficient of variation; VARl; and the sum of the differences between maximal and minimal values, li were computed. Maximum count of each row, CMAX; 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 correlation with VC, ZFEV1.0; and ZFEV1.0/FEV1.0 by H & V analysis (r=0.7556, -0.8927, -0.7206, respectively, p<0.05, n=8). SD, VAR, L, CMAX, and HW all seemed to serve as guides 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.


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 enriched gas, and washout with air. Three different clearance time indexes were calculated from 133-Xe activity time curve in a divided lung matrix; real half time (T1/2R), half time estimated from exponential curve fitting (T1/2exp), and the area under the clearance curve divided by the difference in the count rate between the tidal ventilation and 120 seconds (TAH/M) after washout with air started. When the 3 indexes were calculated in a single matrix out of 16 × 16 matrices, there was a good correlation between T1/2R and TAH/M (r=0.92), but the correlation between T1/2R and T1/2exp 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 TAxH. Correlation between the presence TAH/M and the previous TAxH and that between T1/2exp'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.


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 ms 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 (B1/2) was calculated from the Xe activity-breath number curve as the half clearance time (T1/2) from the Xe activity-time curve, and a functional image was made. Furthermore, a histogram was made to estimate the distribution of B1/2 or T1/2 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 inspiratory 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 N2 concentration-breath number curve. So we think B1/2 is clinically a better index than T1/2 to estimate the regional ventilation.