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QUANTITATIVE ANALYSIS OF PULMONARY VENTILATION SCANS WITH N-13 NITROGEN GAS AND POSITRON EMISSION TOMOGRAPHY: (2) EFFECT OF ANATOMICAL DEAD SPACE AND A MODEL TO DESCRIBE IT.

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If single compartment model holds, the simultaneous exponential equation method (SEE) we developed yields accurate value of regional lung volume (V) and ventilatory time constant (T). However due to the anatomical dead space some errors occur in the estimated value of T and V. Expired gas remaining in the dead space is re-inspired at the nest breath, which delays the clearance. When uneven distribution of ventilation exists, the expired gas from poorly ventilated regions is also re-inspired by the well ventilated regions, which further worsen the turnover of the latter. We have introduced a new model to investigate the effect of the dead space. We assumed synchronized breathing of all the alveoli and expressed the activity concentration of the dead space gas as the average of all alveoli weighted with the alveolar tidal volume. Our simulation studies suggested that significant overestimation occurred in the T value of well ventilated regions in cases with chronic obstructive lung disease. Also large overestimation occurred in the V values in poorly ventilated regions.

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THE PREDOMINANT SITES OF AIRWAY CONSTRICITON DURING METHACHOLINE CHALLENGE TEST AND THE EFFECT OF BRONCHODILATER INHALATION ON BRONCHIAL RESPONSIVENESS.

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Ten patients with bronchial asthma received bronchial provocation test with methacholine. The pulmonary impedance (Zrs), transcutaneous Po_2 ($tcPo_2$) and ventilation scintigram with krypton-81m ware obtained during methacholine challenge test. The predominant sites of airway constriction during methacholine challenge test were divied into central type and peripheral type by aerosol inhalation using $Tc\text{-}99mO_4^-$.
Four patients showed central type and six patients showed peripheral type. In peripheral type, $tcPo_2$ was lower than in central type after methacholine induced asthmatic attack.
The abrupt decrease of impedance following bronchodilater inhalation was observed in many cases of central type but in a few cases of peripheral type. The correlation cofficient of bronchial reactivity between Zrs and $tcPo_2$ was not significant, but the correlation between bronchial reactivity of Zrs and uneveness of Kr-81m ventilation was good.

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EVALUATION OF DRUG EFFECT BY RADIOAEROSOL INHALATION LUNG CINE-SCINTIGRAPHY--- BROMHEXINE AND SALBUTAMOL.

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An evaluation of a drug effect has become possible by means of radioaerosol inhalation lung cine-scintigraphy. The effects of bromhexine, a mucolytic agent, and salbutamol, a beta stimulator, were evaluated. Each drug was given singly to 10 and 9 patients , respectively, and the latter, also combined with other medications, to 10 other patients. All patients studied had various chest diseases in stable stage. Each drug was orally administered 8 mg and 4 mg t.i.d. for 7 days, respectively. Radioaerosol inhalation lung cine-scintigraphy, lung function test and chest x-rays were performed before and after the administration of the respective drug for 7 days. Bromhexine significantly improved airway clearance efficiency ($p<0.05$), but salbutamol did not, whether the latter was administered singly or in combination with other medications. Salbutamol, however, improved lung function data.Chest x-rays remained unchanged with either drug.

In summary, mucociliary clearance mechanisms are influenced by oral bromhexine but not by oral salbutamol.

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UNEVENNESS ON LUNG PERFUSION IMAGES AND LUNG FUNCTION

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We have previously reported our approach to quantitatively analyse the unevenness of deposition patterns on radioaerosol inhalation lung images in relation to the actual lung function data. The purpose of this study was to derive multiple regression models to estimate lung function data from analysis of lung perfusion images.

Twenty-one indexes of unevenness in the lungs were calculated from the count-profile of each row and column of the lungs in the matrixes of 64 x 64. Several most suitable indexes were selected out of the 21 by using the method of selection of variables in a multiple regression equation. The multiple regression models for each item of pulmonary function data established from analysis of 106 subjects appeared usable as a predictor of the actual lung function; for example, VC could be estimated by using 9 indexes out of 21 with a coefficient of multiple correlation (R) of 0.83 and FEV1.0, by different 9 indexes with R=0.83. FRC, TLC, MBC and DLCO were also estimated with R's of 0.74, 0.76, 0.83, and 0.70, respectively, but those for %VC and FEV1.0% were less good with R=0.53 and 0.44, respectively. They were ,however, all statistically significant with $p < 0.001$.

We expect that a better correlation would be obtained if a similar analysis has been made based on disease entities.