Effect of Body Position and Inhalation Levels on Distribution of Ventilation

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We reported in the previous communication on a pulmonary function study using Kr-81m gas. In this presentation, we report on the effect of body positions and inhalation levels on distribution of ventilation.

METHOD

Ten healthy volunteers with normal pulmonary function were selected for this study. Subjects were kept in sitting, supine and both decubitus positions successively.

In each position, they were asked to (1) breathe Kr-81m gas at a normal, resting tidal volume (SP), (2) inspire from residual volume level to total lung capacity (VC), (3) inhale a bolus of Kr-81m gas (10 m*l*) at levels of FRC (Functional Residual Capacity) and (4) RV (Residual Volume).

Radioactivity was measured with scintillation camera posteriorly placed over the thorax.

Regions of interest (ROI) were set up in two large areas covering each lung, six small areas for upper, middle and lower lung fields of each lung and four rectangular areas placed over each lung laterally.

Counts from each ROI were accumulated for 10 sec. during breath holding in VC, FRC, RV inhalation and for 30 sec. during tidal breathing in SP method.

RESULTS

In the sitting position, in SP, VC and FRC inhalation methods, activity was higher in lower lung field than in upper. In RV inhalation, activity was lesser in lower than in upper as reported by previous investigators.

In the left decubitus position, radioactive gas was inhaled in larger volume to the dependent lung than to the upper lung in SP, VC and FRC inhalation.

In RV inhalation, distribution of activity was reversed, that is to say, activity was lesser in dependent lung.

This result suggests that uneven distribution of ventilation is caused by gravity in the decubitus as wellas in the upright position.

Clinical Application of ^{81}Rb-^{81m}Kr Generator

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Clinical application of ^{81m}Kr eluted from ^{81}Rb-81mKr generator is described in 34 patients with lung diseases including pulmonary embolism, pulmonary emphsema and bronical asthma ^{81}Rb-^{81m}Kr-generator used in this study was produced by Nihon Medi-Physics Co. Japan.

Data for lung images were taken in four projection, ANT, POST, R-lat and L-lat view, using Picker Dyna Camera 3C with 1900 holes parallel collimator.

The foloowing results was obtained by this studies.

1) There is no radionculide except ^{81m}Kr in the solution eluted from ^{81m}Kr-generator by 5% dextrose.
2) Resolution of 1900 holes collimator for 190 Kev γ energies of 81mKr is better than 25,800, 10,000 holes collimator by measurement of Line Spread Function.
3) Radioactivity of ^{81m}Kr eluted from ^{81}Rb-

^{81m}Kr-generator is high in proportion to eluting speed at 1.94～19.7 m*l* per minute, but is almost same at 1～41 per minute.

4) Effect of ^{81}Rb on lung images using Scintillation Camera is not observed, when generator is located at the side of detector.
5) Perfusion images obtained with ^{81m}Kr is less apparent than ones obtained with ^{99m}Tc-MAA in the same patients.
6) Rebreathing method is more stable than single breath holding method for ventilation lung images.
7) The method, that performs perfusion study using ^{99m}Tc-MAA and ventilation study using ^{81m}Kr at the same time, is most available for clinical application.
8) Inhalation washout study using ^{81m}Kr is no significant for clincal application.

Pulmonary Ventilation Studies of Asthmatic Children with Kr-81m

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Krypton-81m gas was eluted from the ^{81}Rb—^{81m}Kr generator by using compressed air as an eluting agent. The continuous inhalation of mixed gas of ^{81m}Kr and air with a scintillation camera produced the pulmonary image of which activity was proportional to regional ventilation. Because of short half life of ^{81m}Kr (13 seconds), the exhaled gas was not necessary to be trapped by the charcoal filter, and the several pulmonary views of a patient could readily be available in a short period of time. The great advantage of ^{81m}Kr generator was found in use for the studies of small children who were not usually cooperative to the medical examination. Thrity two patients with bronchial asthma of any state were so far studied. Their ages ranged from 3 to 13 years old. Studies revealed the definite ventilation defects in the scans of patients with asthmatic attack. Re-scans right after the medications such as the use of bronchodilators showed marked improvement of the ventilation defects. Exercise induced asthma (EIA) can be easily identified by the ^{81m}Kr ventilation study. After the medicines for EIA such as a disodium cromoglicate was administered to the patients, next exercise did not produce the ventilation defects, and the preventive effect can be objectively examined for each patient.

The ^{81m}Kr ventilation study is now being used for identifying the provokative substances of bronchial asthma. The house dust of several densities were inhaled with ^{81m}Kr gas by the patient.

The threshold dose of disclosing the ventilation defects in the scans was remarkably less than that of provokating the symptom of asthmatic attack. The sensitive ^{81m}Kr ventilation study could be another provokative test which does not induce the real asthmatic attack.

Studies on the Spirometry and Regional Ventilatory Function in Patients with Bronchial Asthma

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Comparison between spirometry and regional pulmonary ventilatory function at an asthmatic condition and at a clinically symptom-free condition was studied in thirteen patients with bronchial asthma.

In order to estimate the regional ventilatory