Significance of Ventilation and Perfusion Images for Evaluation of overall Gas Exchange Function of Lung

Y. ISHI, H. ITO and K. TORIZUKA

Department of Radiology, Kyoto University Medical School, Kyoto

T. MUKAI

The Central Clinical Isotope Division, Kyoto University Hospital, Kyoto

With recent availabilities of 133-Xe and a scintillation camera, the regional distribution of the ventilation (V) and the perfusion (Q) could be visualized simultaneously. Upon processing these images by computer, the ratio of ventilation to the perfusion (V/Q) and relation between V and Q were expressed as quantitative distributions.

Since the effectiveness of gas exchange function has been evaluated as the alveolar-arterial partial gas pressure difference, (A-a)•D, present attempt is concerned with these presentation of the camera data to be correlated with the (A-a)•D theoretically. It is speculated that constituent of gas content concerning PO2 and PCO2 can be determined solely by the V/Q value at a million of alveolar units, so the overall gas content both of V and Q can, therefore, be calculated by weighted averaging, if the distribution of the V for V/Q and Q for V/Q are known.

The normal distribution in an upright position of V for V/Q and Q for V/Q were shown to be a log normal distribution with a narrow standard deviation. There observed to be a slight dissociation between these distributions due to the difference of gravity effect on V and Q, and the dissociation was, then, calculated to be within normal range of (A-a)•D.

In term of V/Q inequalities, there exits a region of physiological dead space, where the V/Q is high, and a region of physiological shunt, where the V/Q is low. In case of the dead space, much of the V distribution was corresponded with high V/Q value, resulting a magnification of (A-a)•D•CO2 to be calculated. In case of the shunt, much of the Q distribution was corresponded with low V/Q value, resulting a magnification of (A-a)•D•CO2 to be calculated. These calculated values were well within the range of the laboratory blood gas findings.

Present attempt might provide a good insight in evaluating for the ventilation-perfusion inequalities of the camera data to be correlated with an overall gas exchange efficiency of lung in term of (A-a)•D.

Measurement of the Regional Pulmonary Function using 133Xe.

T. KATSURA, K. NARABAYASHI, S. YOSHIDA and T. MAEDA

Department of Radiology, Kobe University, School of Medicine, Kobe

We tried to obtain a quantitation of regional pulmonary ventilation and perfusion in various pulmonary diseases with 133Xe using a spirometer.

Samples and Methods: 3 cases of normal, 2
cases of interstitial pulmonary disease, 7 cases of chronic bronchitis, 5 cases of emphysema, 4 cases of bronchiectasis were examined.

The patient was studied in a sitting position with an Anger camera. Posterolateral view was obtained. The patient was held in deep inspiration during first 20 seconds after the injection of 5 mCi of $^{133}$Xe solution. Utilizing the ROI method with a scintillation camera, regional perfusion was studied.

Forced expiration into the spirometer was performed. In this phase regional F.V.C. and F.V.C. 1.0% were studied by the same R.O.I method. After that patient breathed during sufficient time for the complete disappearance of radioactivities in the lung.

Regional washout $T_{1/2}$ was calculated in this phase using the same method. Breathing in the closed circuit spirometer systems, which contained $^{133}$Xe expired from the patient and O2, inhalation scintiphotos were obtained from the breathing.

Result
1) Regional F.V.C. is moderately impaired in emphysema and severely in bronchiectasis.
2) Regional F.V.C 1.0% is moderately impaired in both chronic bronchitis and bronchiectasis, severely in emphysema.
3) The prolongation of the regional washout $T_{1/2}$ from residual volume was moderate in bronchiectasis and severe in emphysema.
4) This examination technique is not so useful for the interstitial pulmonary diseases.

Abnormal Pulmonary Circulation in Aged Patient Studied by Lung Scintigraphy

Department of Nuclear Medicine & Radiological Science, Tokyo Metropolitan Geriatric Hospital, Tokyo

One hundred and nine cases with 59 male (64 y.o.–98 y.o.) and 50 female cases (56 y.o.–91 y.o.) with mean ages of 75.3 and 75.8 y.o. were studied by lung scintigraphy.

High incidence of major fissure sign and decreased effective volume of lower lobes were found among aged cases.

The former represent the band-like decrease in pulmonary arterial perfusion along with major fissure of the lung. And the latter represent the decrease in effectively perfused lung volume.

Major fissure sign was found in 62% in right lung and 60% in left lung. Decreased lower lung volume was found in 20% in right lung and 28% in left lung.

No significant correlation was found between these findings and the types of pulmonary disorders or types of pathologic findings studied by 15 autopsied cases.

However significant correlation was found between these findings and the process of aging.

Authors concluded that diffuse aging process in smaller arteries might be responsible for the high incidence of major fissure sign and predominant aging process of the lung might be initiated from the lower lung-lobes.