

VIII. Lung

Studies on the Regional Pulmonary Function by the Radioactive Xenon. Measurement for the Regional Residual Volume/Regional Total Lung Capacity Ratio and Its Clinical Application

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The regional residual volume/regional total lung capacity ratio (RVr/TLVr ratio) was measured in 9 normal subjects, 5 cases with chronic pulmonary emphysema and 7 cases with chronic bronchitis by ^{133}Xe and the following findings were obtained.

1) RVr/TLCr ratio was calculated by the following equation.

$$\frac{(VC_r - VD_r)F_1}{RV_r - VC_r} = F_{x2} \dots \dots \dots (1)$$

$$F_{x2} = F_4 \cdot \frac{U_{x2}}{U_4} \dots \dots \dots (2)$$

$$\frac{VC_r - VD_r}{TLC_r} = \frac{F_{x2}}{F_1} = C_{x2} \dots \dots \dots (3)$$

$$\frac{VC_r}{TLC_r} = C_{x2} + \frac{VD_r}{TLC_r} \div C_{x2} \dots \dots \dots (4)$$

$$\frac{RV_r}{TCL_r} = 1 - C_{x2} \dots \dots \dots (5)$$

Where, VC_r , VD_r , RV_r , and TLC_r are the regional vital capacity, dead space, residual volume and total lung capacity, respectively. F_{x2} is the calculated concentration of xenon within a zone after deep breath from the RV level and U_{x2} is the external counting rate over that zone. F_4 is the known concentration of xenon in the lungs after re-breathing and U_4 is the external counting rate during full inflation after re-breathing.

F_1 is the concentration of xenon in the inspired gas.

2) In the normal subjects, RVr/TLCr ratio was decreased from the upper region to the lower region in the sitting position, this finding means that the size of the alveoli is more increased in the upper region than in the lower region. The mean value and standard deviation of the upper, middle and lower region were 43–9%, 35–8%, and 28–9%, respectively. These differences disappeared in the supine position.

3) The size of the scintillation counter did not give any significant effect on the determination of the RVr/TLCr ratio between 1.5 inch and 0.5 inch scintillation counter.

4) The RVr/TLCr ratio was significantly increased over the lung, and the reversal of this distribution was found in some case in the case with chronic pulmonary emphysema.

5) In the case with chronic bronchitis, the RVr/TLCr ratio showed the similar distribution as the normal subjects and showed no significant regional overdistension.

6) This method is very useful to find the regional overdistension and the regional emphysematous changes.