Postural Effects on Perfusion and Ventilation in the Lungs

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Postural effects on perfusion and ventilation in normal subjects and patients with unilateral pulmonary tuberculosis were studied. Radioisotope perfusion scanning using ^{131}I-MAA was applied to clarify the perfusion aspects in the lungs, and inhalation techniques of radioactive xenon gas from closed circuit respirometer to study regional ventilation.

Scanning of the lungs was performed on 9 normal subjects and 31 patients with unilateral pulmonary tuberculosis in the supine position. At least two scannings were performed in the supine position after injecting ^{131}I-MAA either in the supine or in the lateral decubitus position. The partition ratios of the pulmonary arterial blood flow were compared in the supine and lateral dependent lung.

On the average, the pulmonary arterial blood flow increased by 1.17 times more in the dependent right lung than in the supine right lung in normal subjects, 1.16 times in patients with right pulmonary tuberculosis of minimal lesion, and 1.20 times in the patients with right moderately advanced pulmonary tuberculosis. In the left dependent lung, the increased ratios were averagely 1.13 in normal subjects, 1.19 in patients with left pulmonary tuberculosis of minimal lesion and 1.17 in patients with moderately advanced pulmonary tuberculosis of the left lung in comparison with the partition ratio in the supine left lung. Therefore, it was concluded that the dependent lung was perfused by the pulmonary arterial blood flow by 1.1 to 1.2 times more than the supine lung.

In order to study the regional ventilation, two scintillation detectors were placed on the 4th intercostal spaces on the mid-clavicular line on the right and left anterior chest wall and radioactive xenon gas was inhaled from the closed circuit respirometer of Knipping through a mouth-piece with a clip on the nose. When the radioactivity from the underlying lung came into equilibrium with that of the inspired gas, the subject was instructed to expire fully to the level of residual volume and then inspiration was made stepwise up to the maximal inspiration. The radioactivity of each step was recorded. After the radioactivity in the lung was washed out by air, the same procedure was repeated from the level of residual volume. The obtained informations were calculated for regional total lung capacity (TLC), functional residual capacity (FRC) and Tidal Volume (VT). Under the present condition, it was revealed that the two detectors measured radioactivity from almost identical volumes of TLC in both lungs in the supine position.

When lateral decubitus positions were assumed, regional TLC generally increased, FRC invariably decreased and regional turn-over rate (VT/FRC+VT) increased in the dependent lung. At the same time, clearance time of radioactive xenon gas was faster in the dependent lung than in the upper lung, although there were no appreciable difference in the right and left lungs in normal subjects in the supine position. The same tendencies were also recognized in the tuberculous patients studied to variable degrees.

From the above findings, it was concluded that both perfusion and effective ventilation increased in the dependent lung by change of postures from supine to lateral decubitus positions.