mal contraction of the myocardium by the serial gated scintigraphy. This finding suggests the possibility that the scintigraphy will demonstrate degenerative changes in the myocardium such as fibrosis and disclose even slight decreases in the coronary blood flow. Some of the patients with hypertension, presented slight abnormalities in their scintigraphy of the myocardium.

The left ventricular ejection fraction was not less than 60 % in all control patients, while the rate was slightly reduced in many patients with hypertension, the data being distributed widely. The ejection fraction was markedly decreased in many patients with myocardial infarction, but remained within normal range in a rather few patients. This finding suggests the necessity of restricting the stress on the heart even of the patients who have been rehabilitated.

Factors in the Regulation of Regional Pulmonary Perfusion

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The purpose of the present study is to clarify factors which control the distribution of regional perfusion.

The right upper lobe (RUL) of an anesthetized dog was isolated in vivo by a balloon catheter under fiberoptic bronchoscopic guidance. The RUL was artificially ventilated by the following gases, while the rest of the right lung and the entire left lung were breathing air spontaneously; pure nitrogen (N_2), 10 % oxygen (O_2) in N_2, air, 40 % O_2 in N_2, 60 % O_2 in N_2, 100 % O_2 and 10 % CO_2 in air, each mixed with a trace amount of helium (He). Because preliminary studies indicated that, after 5th through 7th artificial gas exchange of the RUL, alveolar gas concentration of He, O_2 and CO_2 became nearly constant, either ^{99m}Tc-MAA or ^{99m}Tc-albumin microsphere was injected intravenously at the end of the 7th gas exchange. Radioactivity of the RUL, the remainder of the right lung and the right whole lung was measured with a scintillation camera at each injection of the tracer material.Radioactivity from the previous injection was subtracted as background, and perfusion distribution of each region was calculated. Alveolar gas was obtained from the RUL through the balloon catheter prior to the 1st gas exchange and at the end of the 5th, 6th and 7th exchange of each gas and was analyzed for He, O_2 and CO_2 concentration. The RUL was ventilated by either N_2 or air at various alveolar expansion monitored by alveolar pressure levels to learn the effect of alveolar expansion on regional perfusion distribution.

When the RUL was inflated to its maximal volume or to what we call the TLC of the RUL, perfusion distribution in the RUL was the least, while it was the greatest at the alveolar volume of tidal ventilation. Thus all studies were made at the alveolar expansion of tidal pressure range unless otherwise indicated. Regional perfusion decreased in the RUL when N_2, 10 % O_2 in N_2 or 10 % CO_2 in air was given as an inspired gas as compared with perfusion distribution when air was used as an exchange gas through the catheter. On the contrary, regional perfusion in the RUL increased when 40 % O_2 in N_2, 60 % O_2 in N_2 and 100 % O_2 were artificilly inhaled to that lobe as compared with when air was artificially given. The degree of perfusion increase was almost proportional to the degree of oxygen concentration in the exchanging gas. The amount of regional perfusion when 100 % O_2 was artificially given to the RUL through the catheter was almost equivalent to that when air was spontaneously inhaled into the same lobe without the catheter in place. Helium concentration in the alveolar gas was diluted when N_2 or 10 % O_2 in N_2 was used as an inspired gas, while it was concentrated in case of 40 % O_2 in N_2, 60 % O_2 in N_2 or 100 % O_2, indicating excretion of gas into the alveoli under hypoxia and absorption of the alveolar gas under hyperoxia. When the right lung-reimplanted dogs were studied in a similar fashion, regional perfusion in the denervated RUL decreased under hypoxia of N_2 and 10 % O_2 in N_2 and hypercarbia of 10 % CO_2 in air, while it increased under hyperoxia of 40 % O_2 in N_2, 60 % O_2 in N_2 and 100 % O_2. Regional perfusion responses of the denervated lung to various gases used in this study were similar to those observed in the normal lung. Even when the study was made at the maximal expansion of the RUL, the so-called TLC of the RUL, regional perfusion decreased under hypoxia and hypercarbia, while it increased under alveolar hyperoxia. Generally administered aminophylline did not affect regional perfusion.

In summary regional alveolar hypoxia, hypercarbia and hyperinflation induce regional pulmonary vasoconstriction, resulting in reduced regional perfusion, while regional alveolar hyperoxia induces regional pulmonary vasodilation and increases regional perfusion distribution. No nervous integrity is required for this vascular response.

High Resolution Analysis of Left Ventricular Functions

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Using γ-camera computer system, approximately 30 to 50 frames of images of left ventricular pool (^{99m}-Tc alb.) & left myocardium (201-T1C1) per cardiac cycle were acquisited at 20 msec interval by LIST mode. After digitized x-y scintillation coordinates and R-markers from the ECG were rerecorded on magnetic tape over 1500 to 2000 cardiac cycles, these data were sorted into a sequence of images.

Analysis of sequential cardiac pool & myocardial images gave; (1) contraction pattern, (2) relative volume curve, (3) ejection fraction, (4) relative volume velocity & (5) relative muscle volume.

(1) Contraction pattern of left ventricle was generated at 80 msec interval. Uniform contraction pattern was noted in normal control. However, in the case of myocardial infarction, the contraction pattern revealed distorted motion and asynergy corresponding to nonviable myocardium. Myocardial infarction associated with congestive heart failure was characterized by the enlargement of the cardiac pool.

(2) Relative volume curve of left ventricle was generated from change in counts of left ventricle after subtraction of background. Several dynamic parameters of left ventricular function were derived from this curve.

(3) Ejection fraction of normal left ventricle was 55 to 88 %. The myocardial infarction indicated 47 % in the mean ejection fraction. In the case of myocardial infarction associated with CHF, the ejection fraction decreased to 21 %. The ejection fraction of the mitral insufficiency was 57.6 %. After replacement of mitral valve, this value increased to 68.4 % which was within normal limits.

(4) Relative volume velocity of left ventricle was calculated by differentiation of the volume curve. The maximum values of the systolic & diastolic relative volume velocity were compared in cardiac diseases. In normal case the value of the maximum systolic volume velocity (MSVV) ranged 2.74 to 4.72/sec and the value of the maximum diastolic volume velocity (MDVV) ranged 2.22 to 5.2/sec. In hyperthyroidism the value of MSVV were 4.46 & 4.6/sec, showing the upper limits of normal values, while the value of MDVV were 5.55 & 5.5/sec, resulting in an increases. In myocardial infarction the value of MSVV and MDVV ranged 1.22 to 2.69/sec and 0.73 to 2.72/sec, respectively. Three groups, normal, myocardial infarction & hyperthyroidism, could be separated better by this parameter than ejection fraction.

(5) Relative muscle volume curve was generated from change in counts of three regions of interest, that is, free wall, apex and septum of left ventricular wall. The contraction fraction as an indicator of myocardial thickness was the ratio of the difference between the maximum & minimum muscle volume to the maximum muscle volume. The contraction fraction (CF) of hyperthyroidism was about 40 %, while CF of myocardial infarction & myocardosis was 20 %. The periods between R wave and the