A Study of Hyperbaric Oxygenation; In Reference with It's Effect on Hemodynamic Changes in Use of RISA

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In recent years, hyperbaric oxygenation has been disputed to be effective for cardiovascular disease, heart disease and bleeding shock as a new therapy in the anesthesiological field. Since two years, an attempt has been made on the fundamental study of hyperbaric oxygenation by the authors. The primary objective of this paper is to report the influence of hyperbaric oxygenation upon hemodynamic changes of experimental animals which were carried out lately.

The experiment was carried out on two groups; normal control group and acute coronary infarct group. RISA, 100μc was injected as soon as possible in the external jugular vein, which was exposed beforehand. Total circulatory blood volume, cardiac output, pulmonary circulatory time, appearance time and half time at the ventricles were recorded with a recorder combined with the rate meter before pressurization, in thirty minutes after pressurization at three atmospheric pressure in the chamber and after depressurization.

In both groups, peak to peak, appearance time and half time were prolonged on pressurization at three atmospheric pressure in the chamber. On the other hand, total circulatory blood volume and cardiac output were decreased in their values. These trends were remarkable in the group of acute myocardial infarct. As the results, the occurrence in the burden of the right heart was suggested from the radiocardiogram which was taken during pressurization of control group, while, the burden of both ventricles were presumed in the group of acute myocardial infarct.

Therefore, further examination is still required to determine the efficacy of hyperbaric oxygenation on cardiovascular or heart disease.

Elimination Rate of ^{133}Xe from the Lung and Pulmonary Arteriovenous Shunt Flow

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Both elimination rate from the expired air and pulmonary arteriovenous shunt flow was measured after intravenous injection of ^{133}Xe and dye in extreme condition of dogs, that is 1) in one lung ventilation, 2) in haemorrhagic shock. Moreover the relationship between two parameters, namely elimination rate of ^{133}Xe and pulmonary arteriovenous shunt flow was discussed.

Method

Mongoreal dogs weighting 9~13 kg were anesthetized by thiopentone and their spontaneous respiration was stopped by muscle relaxants. Pulmonary ventilation was maintained by piston respirator with solenoid valve which facilitated the sampling of expired air.

After intravenous injection of 1 mc of

dissolved ^{133}Xe together with commassie blue or indocyanine green into inferior vena cava, ^{133}Xe elimination was analysed separately breath by breath by scintillation counter and elimination pattern was plotted on ordinate against abscissa of breath number. Elimination sum for the first 1 minute to total injection dose was calculated. Simultaneously, following Fritts method (J. clin. Invest. 1960, 29, 1841) pulmonary arteriovenous shunt flow was estimated. In some case helium washout curve was obtained according to the open circuit method.

Results and Discussion

During control period, about 59% of injected ^{133}Xe appeared in expired air after 1 minute following administration, 3.9% in the systemic arteries. Calculated shunt flow expressed as percentage of the cardiac output, was 2.1%. Elimination pattern of ^{133}Xe from expired air was depicted as the exponential curve. When one lung ventilation was performed by Carlen's tube, other lung became atelectatic, and absolute elimination sum and shunt flow was different from the control. Decrease of elimination sum for 1 minute accompanied by the increase of shunt flow may be well understood theoretically, and reverse correlation was found between these two parameters. Elimination pattern showed similar form to the control. By the analysis of pattern, it is possible to make clear the distribution of ventilation.

In shock stage, the inclination of curve of elimination pattern became less steep and its tail was prolonged. Elimination sum of ^{133}Xe was not decreased. The factors, which influence the elimination pattern of ^{133}Xe can be thought as followes:

1. Prolongation of pulmonary circulation time.
2. Disturbance of distribution of perfusion in the lung.
3. Increase of pulmonary arteriovenous shunt flow.
4. Disturbance of distribution of ventilation, which causes the increase of slow space in the lung.
5. Decrease of tidal volume

Of these factors, shunt flow did not increase. Tidal volume was maintained by piston respirator. Helium washout curve was prolonged markedly. Maldistribution of ventilation, prolongation of circulation time, and disturbance of distribution of pulmonary circulation, these 3 factors may be responsible for the change of elimination pattern of ^{133}Xe.

Double Tracer Method for Determination of Pulmonary Circulation and Alveolar Diffusion

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Methode: Two scintillation counters were set on anterior and posterior chest wall to measure the same pulmonary area. These are connected pulse height analysers which were adjusted ^{131}I and ^{133}Xe.

Immediately after the oncet of breath holding, mixture of RISA (50uc) and ^{133}Xe (250uc) was injected rapidly into an antecubital vein. The breath holding was continued as long as possible.

Counts of ^{131}I and ^{133}Xe were recorded separately to four truck taperecorder.

Results: In normal case, RISA curve had one peak and ^{133}Xe curve had a plateau during the breath holding. In the case which had honey comb lung, ^{133}Xe curve was same as RISA curve.

Conclusion: It is considered that RISA circulates in the pulmonary capillary with circulatory blood, but ^{133}Xe is diffused to alveolus through the capillary wall. The result from honey comb lung case suggested that ^{133}Xe is not diffuse to alveoli from blood.