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Use of Helium as a New Therapeutic Gas.

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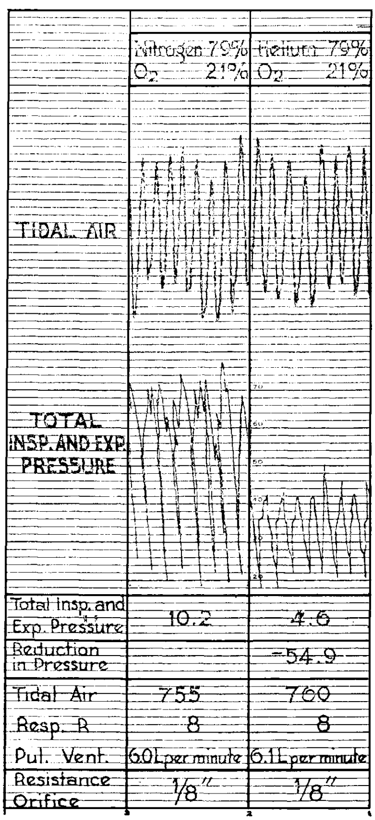
With an atomic weight of 4 and a density of 0.138, helium is the lightest of all the gases except hydrogen. The explosive possibilities of the latter render it too dangerous for clinical use. When helium is substituted for nitrogen in the air, the specific gravity of the mixture (21% oxygen and 79% helium) is 0.341, as compared to that of air. 1. The helium-oxygen mixture is 66% lighter. Since *work* is in general proportional to the density, the pressure required to move helium-oxygen mixtures in and out of the lung should be decidedly less than nitrogen-oxygen mixtures.



GRAPH 1.

An "artificial lung" was constructed by using a spirometer in which the bell was moved up by a motor running at constant speed and pressure, and lowered by constant weights. The spirometer "breather" (was filled by) different mixtures of gases from a Douglas bag or from another spirometer. The volume of air entering and leaving the spirometer (the tidal air) was graphically recorded on a kymographic drum. The pressure of the air within the spirometer, corresponding to a theoretical intra-pulmonary pressure, was obtained by making a leak-tight connection into the spirometer bell and connecting it to a water manometer, which then recorded the lifting or inspiratory pressure and the compressing or expiratory pressure. When the helium-oxygen mixture was "respired", the tidal air was increased from 23% to 50%, with a reduction in pressure of from 2% to 21%.

The effect on patients with compensated heart disease of breathing through a slightly narrowed orifice was measured. The inspiratory and expiratory pressures in the pulmonary air-ways were obtained by connecting a water manometer to the tube which came from the patient's mouth. They were then graphically recorded. Twenty observations on 10 such patients showed a consistent decrease in the pressure necessary to move a helium-oxygen mixture than to move air. The reduction of the total inspiratory and expiratory pressures was between 20% and 45%.

When a still smaller orifice was employed, there was a reduction in the total inspiratory and expiratory pressure of 54%. Observations were also made on patients breathing helium-oxygen mixtures without any narrowed orifice but simply against the resistance imposed by the spirometer bell and flutter valves. When mild dyspnea was produced in 4 compensated cardiac patients, a reduction in pressure in the pulmonary air-ways of 25 to 50% was obtained. In one cardiac patient who was slightly dyspneic at rest, the same phenomenon was recorded as in the patients who were made dyspneic by mild exercise, namely, a marked reduction (40%) in the pressure used in moving the helium-oxygen mixture in and out of the lung. In all the cardiac patients, there was observed corresponding to the decrease in pressure, a decrease in the total pulmonary ventilation when helium-oxygen mixtures were inhaled.

In a previous study,[1] helium as well as other rare gases were excluded from air atmospheres for periods as long as 6 weeks without apparent harm to animals (mice) living in these rare gas-free atmospheres. The biologic inertness of helium was further con-

[1] Barach, A. L., *Science*, December, 1934.

firmed by the fact that mice lived in an atmosphere of 21% oxygen and 79% helium without apparent injury for periods as long as 2½ months.

Sayers and Yant[2] exposed animals to 10 atmospheres of helium-oxygen mixtures and then decompressed them in ⅓ of the time necessary for animals exposed to similar nitrogen-oxygen mixtures. They suggested the use of helium and oxygen for caisson workers and divers exposed to excessively high barometric pressures because helium has a lower solubility and a greater diffusivity than nitrogen. The physical basis for the use of helium in clinical disease is its decreased specific gravity in comparison to nitrogen. According to the formula $F = Ma$, in which F is force, M mass and A acceleration, the movement of air requires a force three times that of a mixture of 20% oxygen and 80% helium. The velocity of gas mixtures diffusing through small orifices is proportional to the square root of the molecular weights, approximately twice as fast in the helium-oxygen mixtures than air. In conditions in which there is resistance to the movement of an adequate volume of air to and from the lungs in any part of the respiratory system from the pharynx to the alveoli, helium-oxygen mixtures may be transported with less effort. When large pulmonary ventilations are maintained over long periods of time, the saving of pulmonary effort is relatively great. Clinical studies in asthma, pneumonia and cardiac failure are in progress.

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Types of Specific Carbohydrates in the Cholera and Cholera-Like Vibrios.*

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We reported the finding of 2 types of specific carbohydrate in the vibrios.[1] Both types contained an aldobionic acid from which on prolonged hydrolysis galactose and glucuronic acid could be

[2] Sayers, R. R., and Yant, W. P., *Anesthesia and Analgesia*, 1926, **5**, 127.

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[1] Linton, Richard W., and Shrivastava, D. L., PROC. SOC. EXP. BIOL. AND MED., 1933, **30**, 600; 1933, **31**, 406.