

### 29 Physiological reactions of the Rhesus monkey under high density gas hyperbaric environment (51 Bar, He-N<sub>2</sub>-O<sub>2</sub> p=27g/l. BTPS)

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in 1981, Seki et.al. succeeded in bringing back cats alive to the surface after having exposed them for 72 hours to the high density He-N<sub>2</sub>-O<sub>2</sub> environment of 27 g/l BTPS which is equivalent to the depth of 500 m. in 1981 and 1983, within the framework of Franco-Japanese cooperation on oceanic development, Seki et. al. carried out further experiments at the Laboratory of hyperbaric physiology of CNRS - GIS in France to see the effects on cats of their exposure to the hyperbaric high density gas environment, and succeeded in making them survive in the environment of 67 g/l BTPS which is equivalent to the depth of 1200m. The results thus obtained turned out to be different from those of our past experiments.

The experiment at 51 bar with He-N<sub>2</sub>-O<sub>2</sub> was conducted under the following conditions: the ratio of He and N<sub>2</sub> was 32; P<sub>4</sub> = 0.21 bar; ambient temperature at 34°C ± 1°C. On the first day of compression, due to the effects of N<sub>2</sub> narcosis, the behaviour of the cats was considerably restrained, but in time, their behavior became normal. The improvement of this ambient pressure diving method, which is tentatively named High Density Gas Hyperbaric Environment Diving Method will be rewarded with the following results: alleviation of high pressure nervous syndrome (HPNS); economy helium gas; the possibility of diving beyond the depths of 2,000m.

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The aim of the present experiment was to obtain more detailed results than the ones already obtained from the experiments with cats. For that purpose, rhesus monkeys were used because their physiology is similar to man's.

The 4 male rhesus monkeys used in the experiments, weighed between 5.6 kg and 8.6 kg and were presumed to be 4-6 years old. One month prior to each experiment, the selected monkeys were put under ketamine hydrochloride anesthesia and electrodes and sensors for the recording of electroencephalogram, electrooculogram, electromyogram, electrocardiogram and brain temperature were implanted. During the experiment, various physiological information was recorded 24 hours a day without interruption.

The physical conditions of the experiments are as follows: after 26 hours of prior observation in the atmospheric pressure environment of air, from 1 bar to 31 bars compression was made with **He** introduction, and from 31 bars to 51 bars.

Decompression was effected in 66 hours and 45 minutes for GENIUS-V. 69 hours 15 minutes for GENIUS-II and 74 hours 47 minutes for GENIUS-III. During decompression, PO<sub>2</sub> value was kept at 0.8 bar. However, in the case of GENIUS-V, from 51 bars to 31 bars decompression was effected with **PO<sub>2</sub>=0.21** bar, and after 31 bars was reached, PO<sub>2</sub> value was brought up to **0.8** bar.

The four monkeys successfully survived the exposure to high density gas hyperbaric environment of the experiments. By the visual observation, it was witnessed that the behavior performance of all the monkeys decreased extremely on the first day at 51 bars, but from ON second day their behavior performance began to return to normal, and behaviors witnessed previously at atmospheric pressure were resumed. During the duration of the experiments, all the monkeys drank water, ate food, defecated and urinated everyday.

Recording by the polysomnography of heart frequency during the sleep and awake stages shows that at 51 bars tachycardia occurred more frequently than at 1 bar in normal air environment. The respiratory frequency showed the same tendency with significant increase at 51 bars. As to the narcosis effects included by the partial pressure of **N<sub>2</sub> at** PN<sub>2</sub>-20 bars, the monkeys showed less effects than the cats.

Concerning sleep stages, all the monkeys registered SWS and PS. As to the change

of weight before and after each experiment, 5 cases out of 6 registered decrease of 4-11%. and only one registered increase of 6% (GENIUS-V). During decompression, one monkey showed signs of decompression disorders at the depth of 5m, but after recompression treatment, he was brought back to the surface safely.

In the present series of experiments, all the 4 resus monkeys lived at least 2 days and the 2 monkeys 4 days in the high density gas hyperbaric environment of 51 bars, He-N<sub>2</sub>-O<sub>2</sub> environment and p-27gli BTPS. Maintaining the homeostasis of their bodies, they endured the vely sever decompression stress resulting from the transition from hyperbaric environment to atmospheric pressure environment, and came back to the suriae succeeded in keeping alive monkeys for 4 days in the high density gas hyperbaric environment and in bringing them back to the atmospheric pressure environment.