寄　　稿

高圧下ならびに減圧下におけるマウスの血液ガス値ならびに麻酔導入時間ならびに覚醒時間に及ぼす影響

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＜ はじめに ＞

高圧ならびに減圧環境下における生体への影響については、宇宙実験、高圧酸素療法、潜函病治療、気象病等からも、われわれの生活に非常に関係が深いにもかかわらず、今までにこの種の実験報告は多いとは言えない。実験動物界でもこの種の異常環境圧力研究を行うことが生態にとって重要であるということから奨励してゆくべきである。日本実験動物学会にもこの種のセッションから出来たと伺っている。それからこの種の実験はエビデンスが得られていないという事実もあり、この種の実験の真理はどこにあるかを突き止めなければならないこともこの種の実験に課せられた問題でもある。また、この種の実験をこれから継続してゆく必要があることも含められていると思われるのである。そこで現在私がこの種の実験に携わっていなかったことから、私が常に行っている麻酔実験でこの種の実験ができないかを考え、「高圧環境下ならびに減圧環境下にてマウスの麻酔導入時間ならびに覚醒時間への影響」について検討しようと実験を企てた。

＜実験材料・方法＞

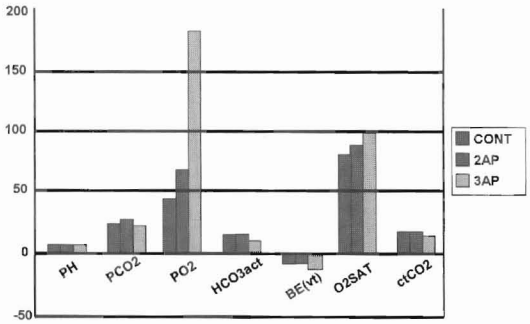
- ＜第一実験＞動物実験タンク（P―5100S、内容量15.2L、最高圧力:0.1962MPa,バロテックニューダ・株社製）。Wistar系ラット♂:30匹、タンク内圧力0.64,1.00,2.00,3.00atm、30分維持、尾動脈血80マイクロメーター採取、血液ガス値を測定。
- ＜第二実験＞C57BL系マウス50匹使用、タンク内へ酸素ガスを流入させ、圧力を0.64、1.00、2.00、3.00atmを維持、5%セボフルレン麻酔ガスをタンク内へ流入させ、体動停止までの麻酔導入時間測定。10分間維持後、タンク開放し室内空気を吸入させ、歩行するまでの時間を覚醒時間とした。
- 統計処理は、Turkey HSDにて有意差検定した。

動物用加圧タンク
（バロテックニューダ・株社製）

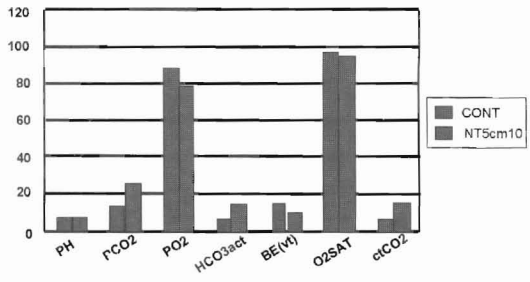
＜ 成　績 ＞

- ＜第一実験の成績＞1）加圧時の血液ガス値は、加圧段階に応じてPO2値が増加、PCO2値は微増、O2SAT値は増加、HCO3値・BE値は著変がなかった。2）減圧時の血液ガス値は、PCO2値が増加、O2SAT値の減少、HCO3act値の微増、ctCO2値の微増、ctCO2値の微増、PH,BE値は著変はなかった。
- ＜第二実験の成績＞麻酔導入時間は、各圧力が増加に反比例した。覚醒時間は、1.00と3.00atmおよび3.00と1.00atmのみ5%危険率で有意差があった。また、他の圧力での優意差は認められなかった。

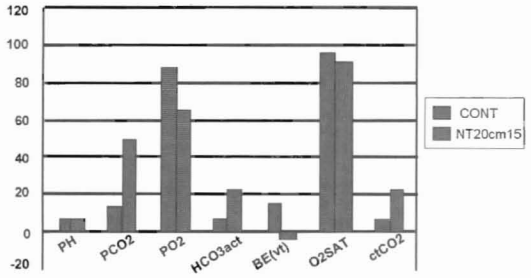
加圧による血液ガス値（CONT,2AP,3AP）



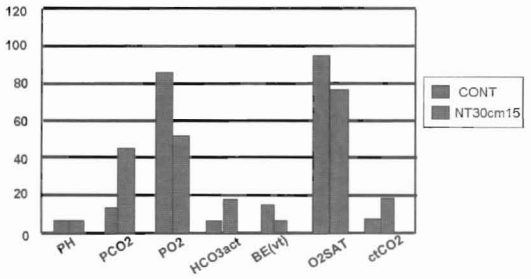
減圧による血液ガス値（5cm10分）



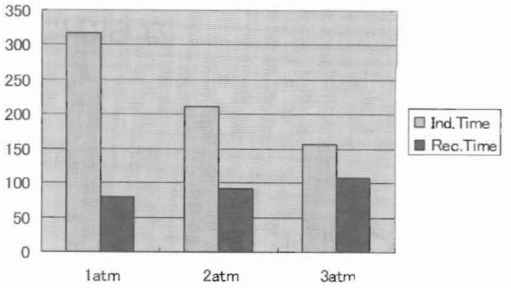
減圧による血液ガス値(20cm15分)



減圧による血液ガス値(30cm15分)



加圧時における麻酔導入・覚醒時間
(1atm,2atm,3atm)



＜考察ならびに結論＞

- 1)圧力の増加による血液ガス値は、PO2値の増加、PCO2値の微減が認められたが、減圧時の血液ガス値は、PCO2値が増加、PO2値の減少が得られた。
- 2)麻酔導入時間は、加圧により短時間になり、いずれの圧力とも5%の危険率で有意差があった。このことは加圧により空気の粒子と麻酔ガス粒子の密度が濃厚になり、麻酔導入時間が短縮し、減圧により麻酔ガス粒子の密度が疎になり、血液ガス値の減少や麻酔導入時間の延長が認められた。

Effect of Blood Gas Value, Anesthesia Induction Time, and Arousal Time of the Mouse Under High and Reduced Pressures

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I. Introduction

The effect on the biological body exposed to high pressure and reduced pressure environments is very closely related to our everyday life, as seen in space experiments, hyperbaric oxygen therapy, compression illness therapy, and meteoropathy etc., but there are relatively few reports on this topic for experiments. In the world of animal experiments, it is important to research our ecology. I have heard that there is a new session called "Consider the variation of air pressure," intended to encourage research. There is also the fact that although this type of experiment is continuing, no evidence has yet been revealed. We are left with the homework of figuring out where the truth of this experiment comes from. It also seems that this experiment must continue. Since I have not yet been engaged in this type of experiment, I started thinking how to conduct it and came up with an idea. Why not conduct this experiment just like I always did my anesthetic experiments? With this in mind, I made a plan to examine whether there would be any effect on the blood gas value, anesthesia induction time, and arousal time of the mouse, exposed to high and reduced pressures respectively.

II. Experimental Material and Process

For this type of animal experiment, a convenient animal experiment tank (Type : P-5100S, Capacity: 15.2L, Maximum Pressure 0.1962MPa, made by BAROTEC HANYUDA Co., Ltd.)is on the market. We placed 30 male Wister rats in the tank for our first experiment, keeping the pressure at 0.64, 1.00, 2.00, 3.00atm. After half an hour, we removed the rats to take a blood sample from their tail arteries onto a 80mm-dose capillary, and measured the blood gas value of PH, PCO2, PO2, HCO3act, BE, O2SAT, and ctCO2 etc., using the CIBA-CORNING blood gas value measuring equipment (248 type). For our second experiment, we had 50 C57/BL male mice in the tank, sending oxygen gas as a carrier, and keeping the pressure at 0.64, 1.00, 2.00, and 3.00atm. We then pumped sevoflurane anesthetic gas and 5% of that gas for anesthesia induction into the tank using a pressure pump. We recorded the time until the mice stopped moving, known as the anesthesia induction time. After the anesthesia induction, we took 10 minutes to maintain the anesthesia time. We then opened the tank and allowed room air in, waiting for the mice to wake up and start walking. We called this the arousal time and recorded it. For statistical processing reasons, we used the average value, standard deviation, standard error, 95% average confidence interval (supremum, infimum), minimum value, maximum value etc., and searched for any significant difference in each pressure using Turkey HSD.

III. Result

The result of our first experiment showed that, according to the pressurization level, there was an increase in the PO2 value, a slight increase in the PCO2 value, and an increase in the O2SAT value when the blood gas value was pressurized. No significant change was found, however, in the HCO3 and BE values. When depressurized, the blood gas value showed an increase in PCO2 values, a reduction in the PO2 and O2SAT values, a slight increase in the HCO3act and ctCO2 values, and no change in the PH and BE values.

The results of our second experiment were, when compared by the anesthesia induction time average of each pressure, 310.97 seconds at 0.64atm, 316 seconds at 1.00atm, 210.84 seconds at 2.00atm, and 156.9 seconds at 3.00atm. They all showed a 5% risk rate with a significant difference. As for the arousal time, only 1.00atm and 3.00atm, 3.00atm and 1.00atm showed a 5% risk rate with a significant difference, but not at other pressures.

IV. Consideration and Conclusion

By increasing the pressure to 0.64, 1.00, 2.00, 3.00atm, the blood gas value caused an increase in the PO2 value and a small reduction in the PCO2 value. When under reduced pressure, the blood gas value showed an increase in the PCO2 value and a reduction in the PO2 value, etc. When we compare the average value of the anesthesia induction time at each pressure, the result was 310.97 seconds at 0.64atm, 316 seconds at 1.00atm, 210.84 seconds at 2.00atm, and 156.9 seconds at 3.00atm. They all showed a 5% risk rate with a significant difference, which means that the density of air and anesthetic gas particles became dense due to pressurization, along with the increase in blood gas value and the reduction in the anesthesia induction time. Furthermore, the density of air particles became non-dense with depressurization, along with the decrease in blood gas value and the extension in the anesthesia induction time.

V. References

The 53th Annual Meeting of the Japanese Association for Laboratory Animal Science, 107.