Letter to the Editor

Effect of an air break on the occurrence of seizures in hyperbaric oxygen therapy may be predicted by the power equation for hyperoxia at rest

In their recent report in the September 2019 issue of *Diving and Hyperbaric Medicine*,[1] Costa, et al. summarized seizure frequency in hyperbaric oxygen treatment (HBOT). The frequency of central nervous system oxygen toxicity (CNS-OT) manifesting as seizures was reported to be 3.4 per 10,000 sessions before the introduction of a 5-min air break, and 1.2 per 10,000 sessions after air break introduction to the treatment protocol. Because exposures in the two groups were similar apart from the air break, its effect on seizure frequency should have been observed in the second part of the exposure (that which followed the air break). This in effect amounted to a reduction of 3.4–1.2 = 2.2 seizure events per 10,000 sessions.

We have proposed the power equation as a measure of pulmonary and CNS oxygen toxicity, and I believe it has the best predictive power of any approach suggested to date. The CNS-OT index K for exercise at 4 metabolic equivalents of task (METs) is given by the equation:

$$K = t^2 PO_2^{6.8} \quad [1]$$

where t is the time in min and PO_2 is the inspired oxygen pressure in bar.

Recovery of the index K (Krec) was calculated by the equation:

$$Krec = K \times e^{-0.079trec} \quad [2]$$

where trec is the recovery time in min. If we introduce a 5-min air break into the recovery equation, it will reduce the toxicity index to 67% of its value without the break. This explains the advantages of such a procedure, and using the power equation will also allow us to choose the appropriate time for the air break.

The value of the CNS-OT index enables us to calculate the risk of toxicity in active diving.[2–4] However, the power equation at rest (1 MET) has not yet been calibrated. A preliminary attempt has been presented,[4] however, still employing exercise parameters to derive values for resting CNS-OT. The wealth of data amassed by Costa, et al.[1] together with those from other hyperoxic exposures at rest, such as the German mandatory oxygen tolerance test described by Koch, et al.[5] may be used to calculate the resting power equation. In rats, we showed that the power of PO_2 increases as metabolic rate is reduced.[3]

I would encourage the authors of the cited paper[1] to compile the individual data (PO_2 and time for each session), and in accordance with the procedure we used,[2] to derive the power equation for resting conditions. They will thus obtain the power of PO_2 (time should remain as the square of the time) and the appropriate risk (Z) for resting conditions. This should be similar in form to the algorithm we derived for hyperoxic exercise from the normal distribution using the CNS-OT index, namely:

$$Z = [\ln(K^{0.5}) - 9.63] / 2.02 \quad [3]$$

Once this is done, the power expression obtained, together with the recovery function, should influence HBOT protocols, and any other hyperoxic exposures at rest (1 MET).

References

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