HYPERBARIC OXYGEN PRETREATMENT REDUCES DECOMPRESSION SICKNESS INCIDENCE IN RATS

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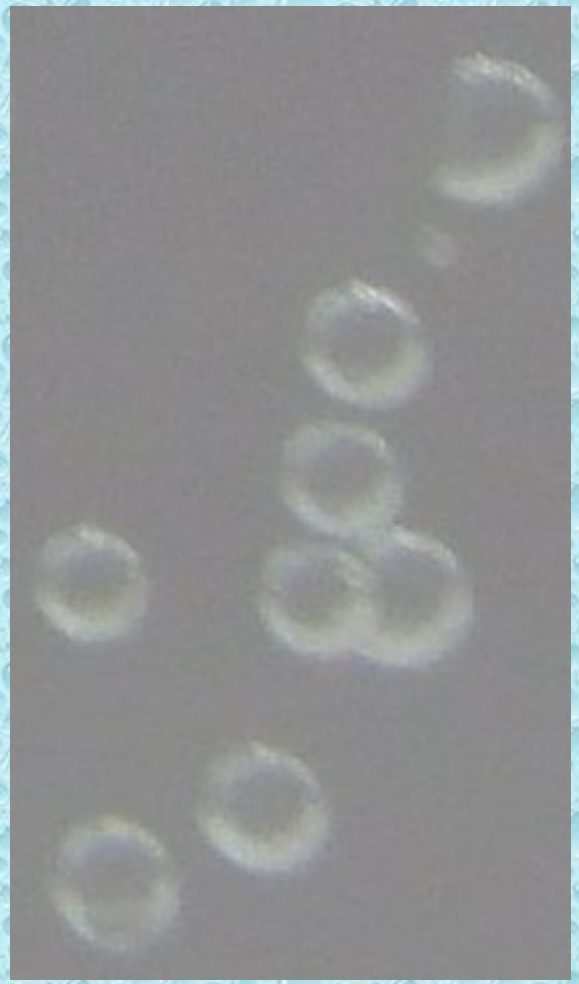
INTRODUCTION

It is widely accepted that bubbles which grow during decompression originate from pre-existing gas micronuclei in tissue.

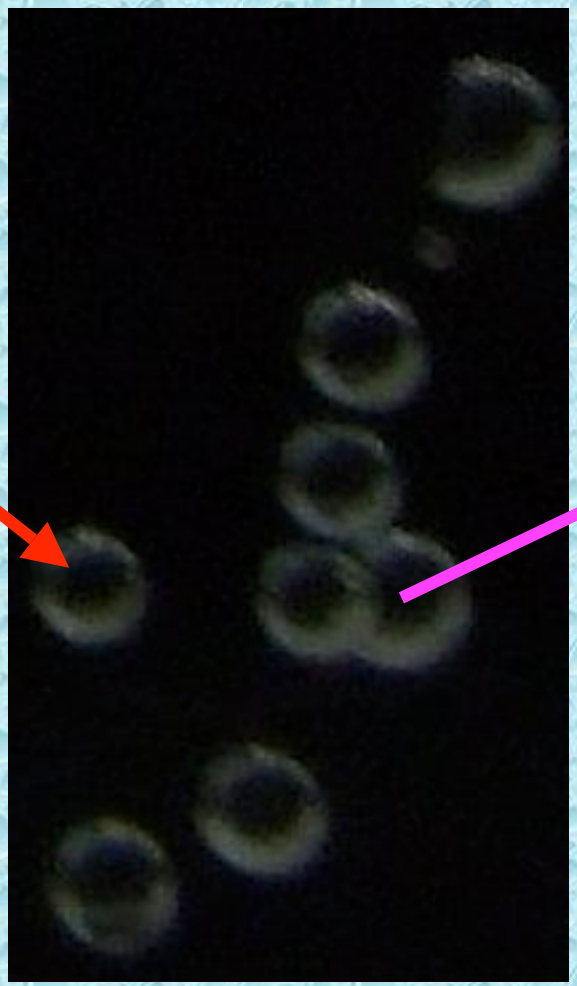
HYPOTHESIS

We hypothesized that pretreatment with hyperbaric O_2 will shrink some of the gas micronuclei, and thus reduce the number of bubbles emerging on decompression.

MYSTERIOUS MICRONUCLEI ARE WAITING FOR DECOMPRESSION



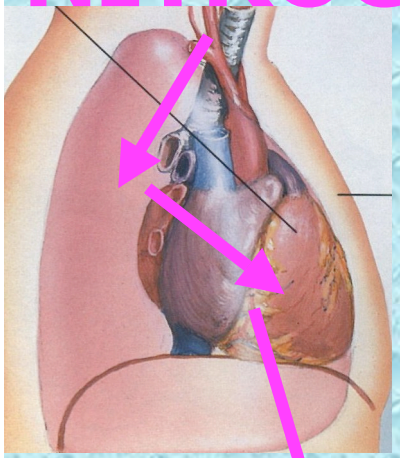
WHILE BREATHING HYPERBARIC OXYGEN, OXYGEN REPLACES THE RESIDENT GAS IN THE MICRONUCLEI

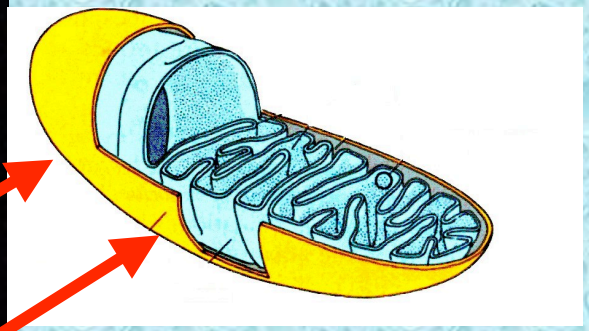


After cessation of oxygen breathing, oxygen from the micronuclei is drawn into the "mitochondrial sink", and is partially replaced by nitrogen.

NITROGEN

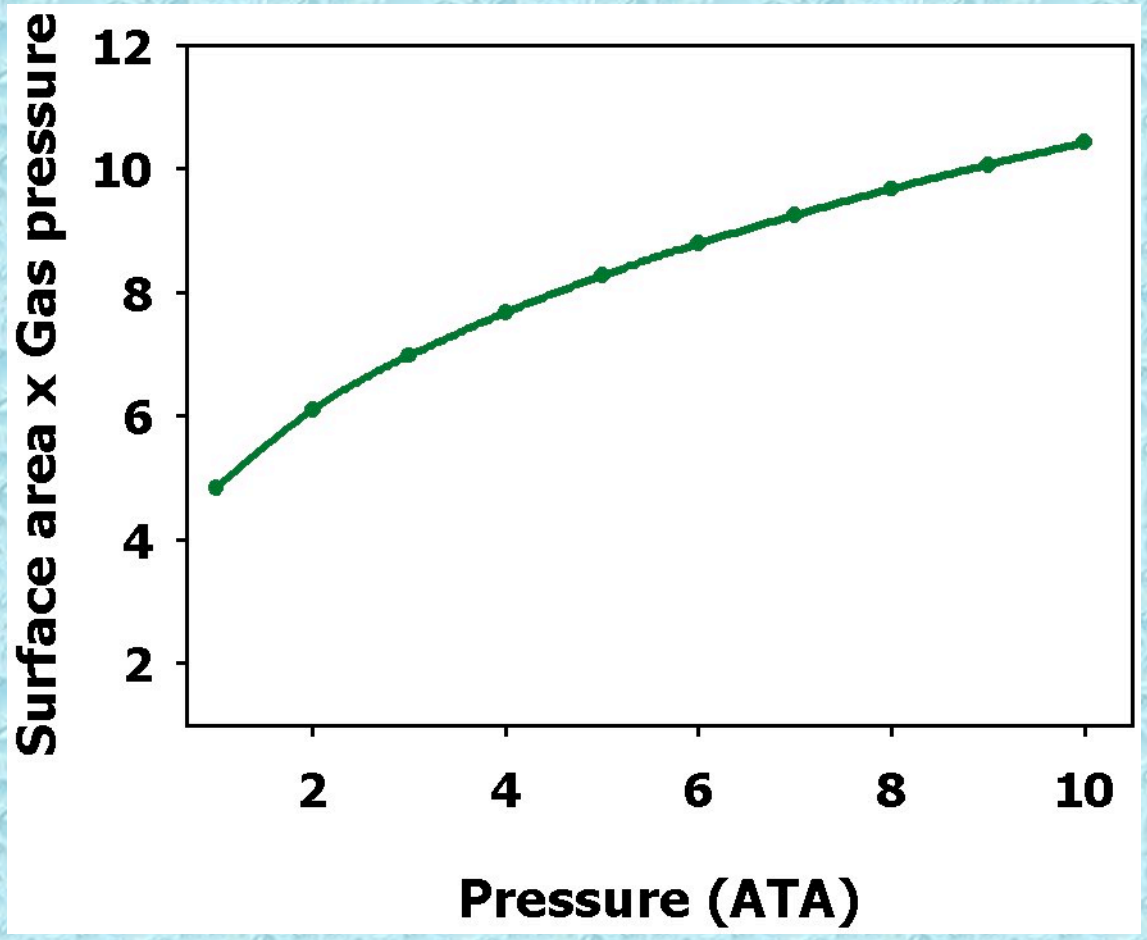
The proximity of mitochondria and faster diffusion rate result in oxygen leaving faster than nitrogen enters.





OXYGEN

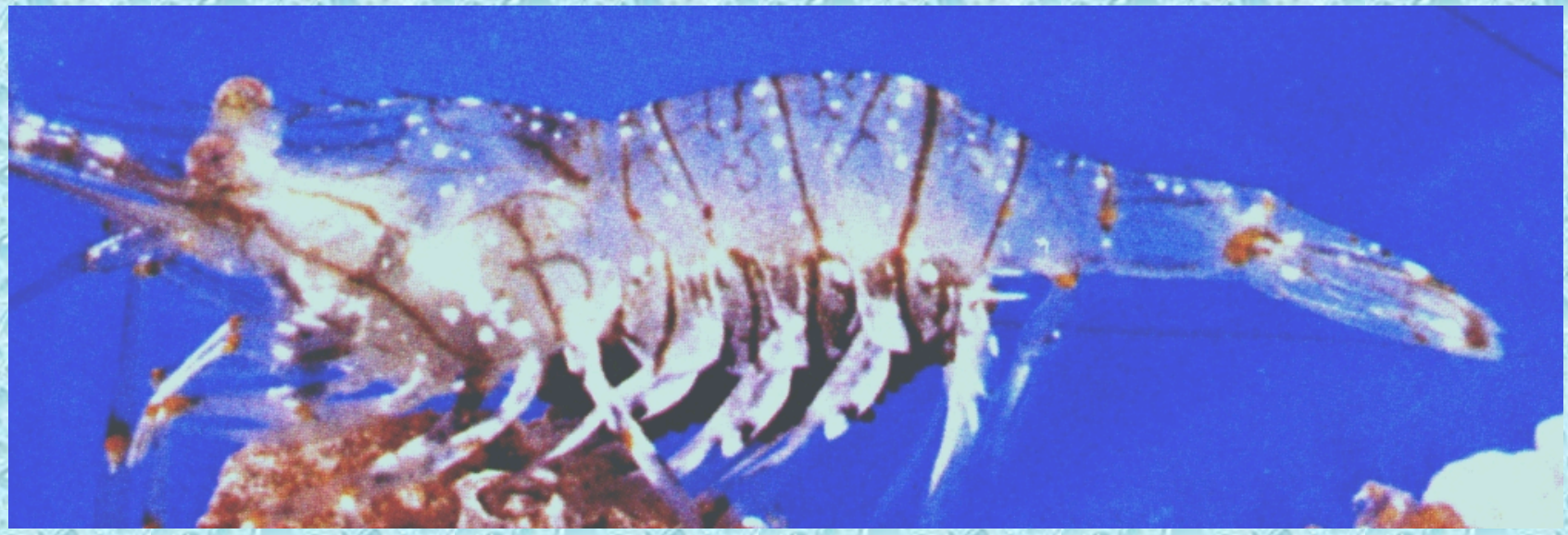
Rate of gas exchange from a spherical micronucleus of unit radius.



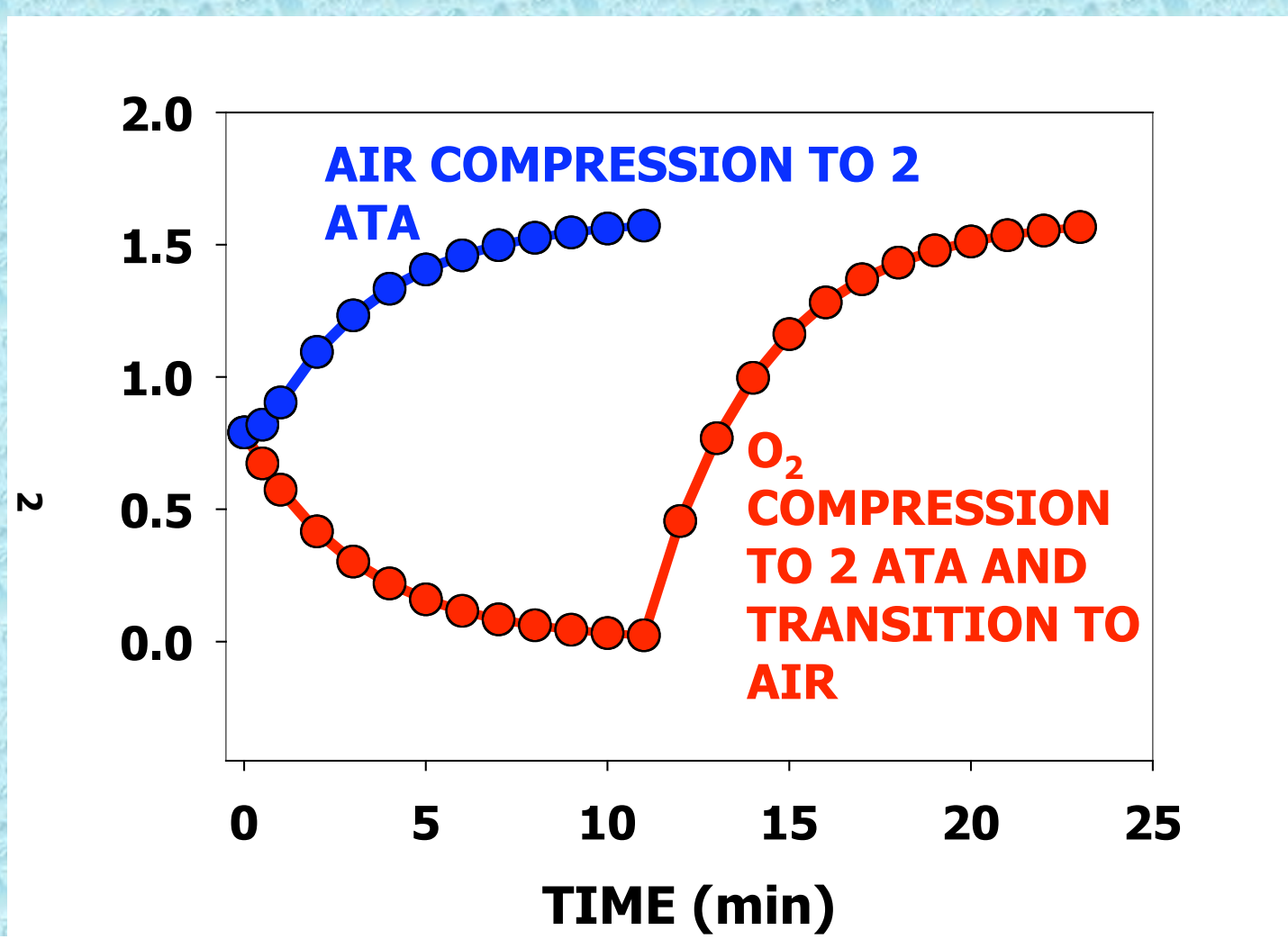
Model calculation suggests faster gas replacement using hyprbaric oxygen.

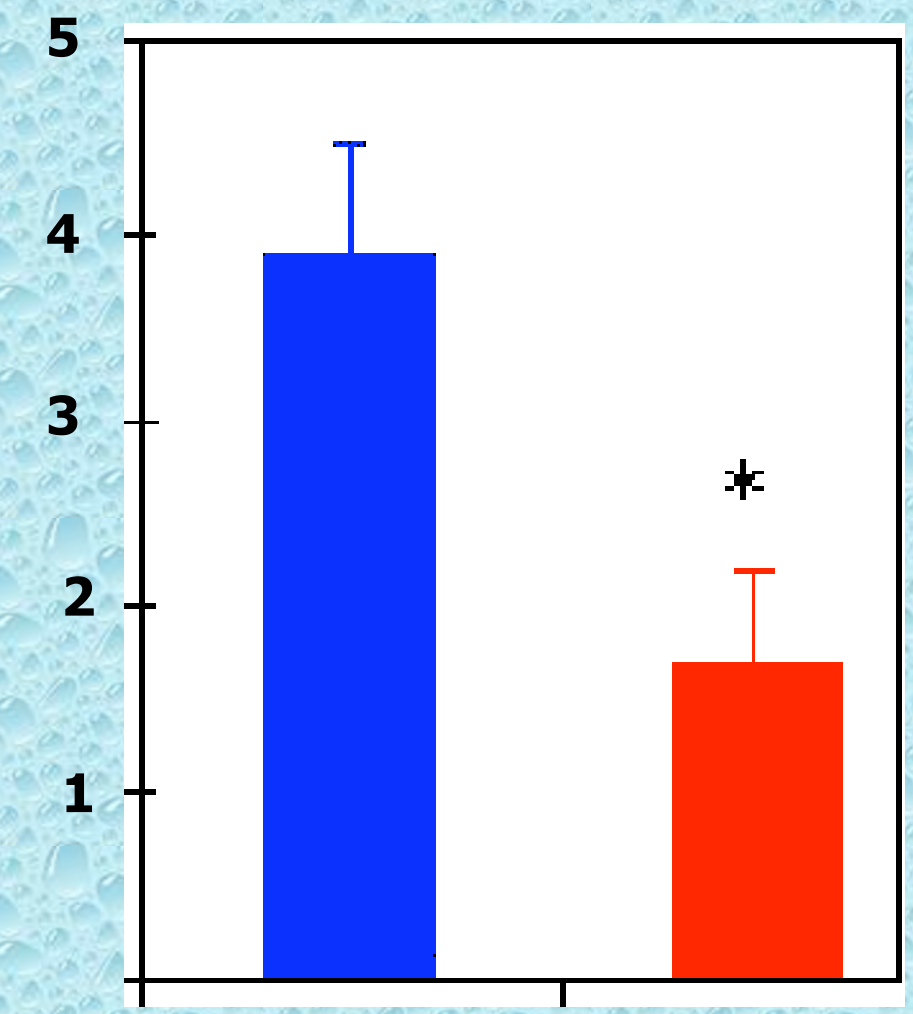
Previous findings

Initially, we tested our hypothesis on the transparent prawn.



Before explosive decompression, tissue PN_2 was the same in the O_2-pretreated prawn and the control prawn

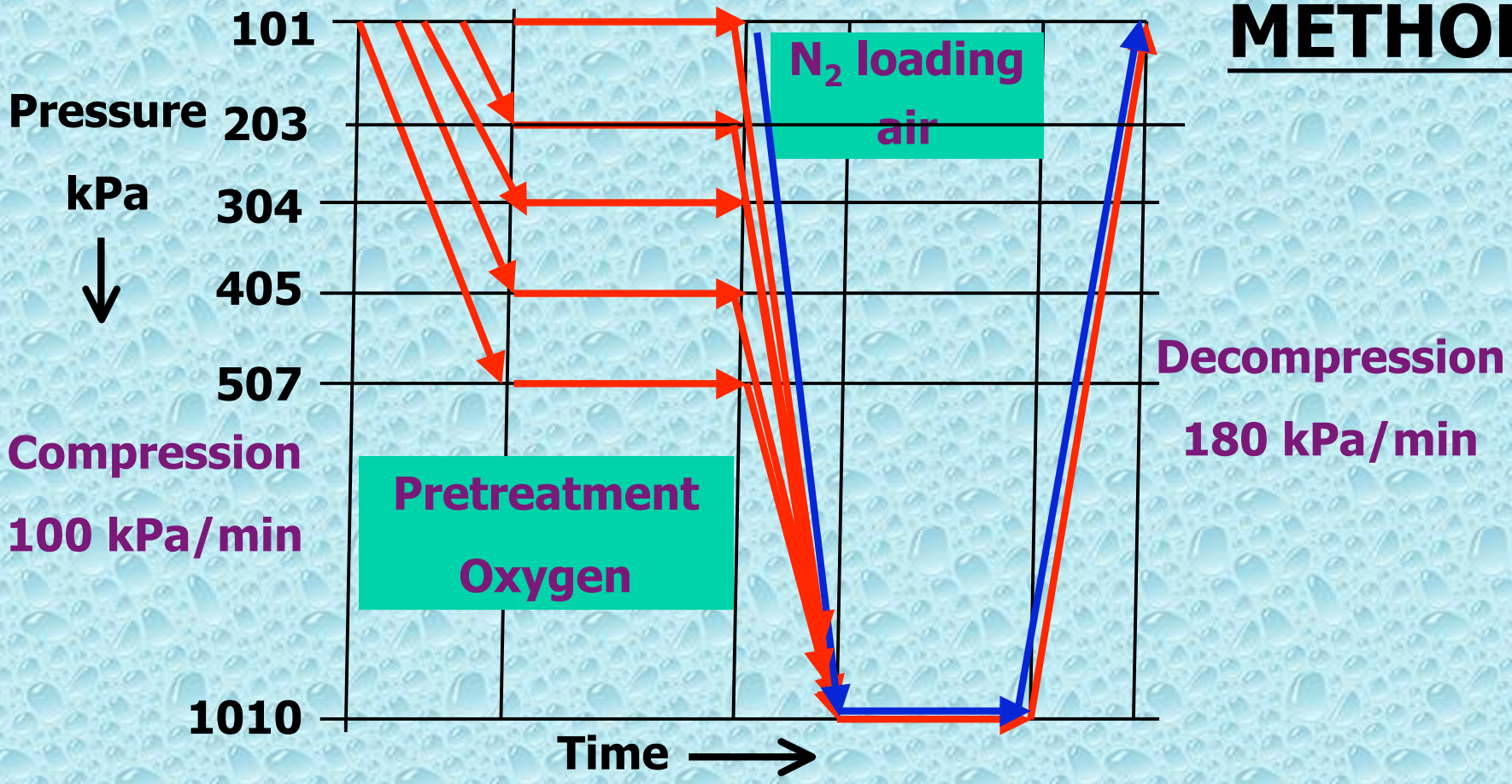




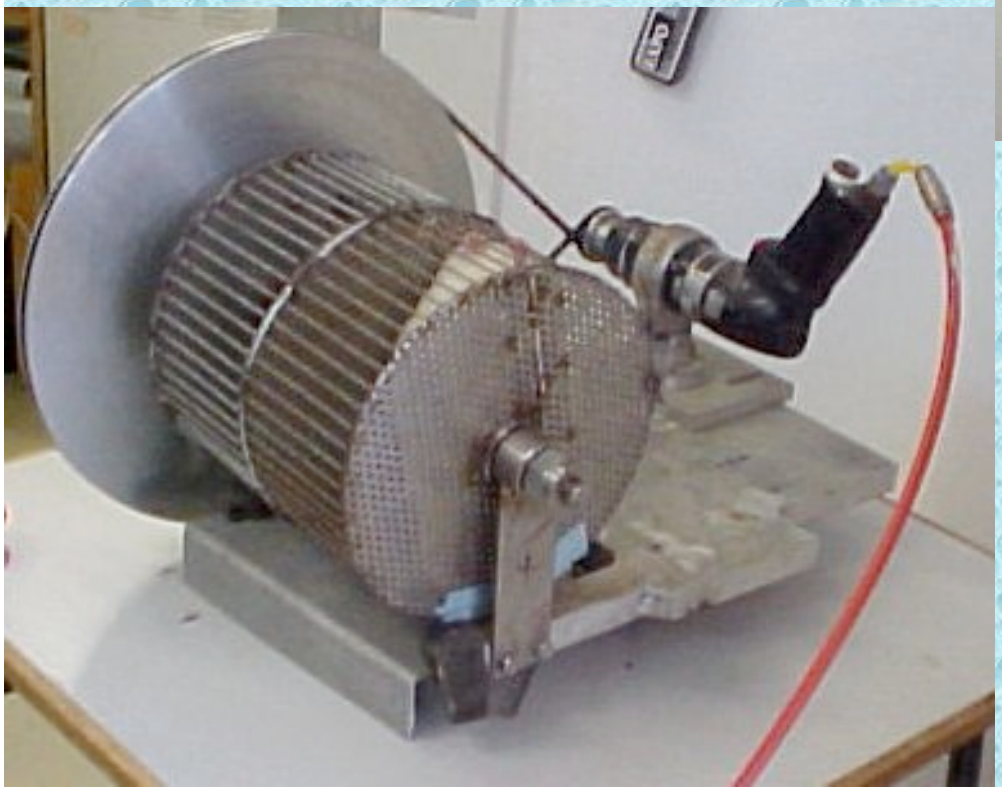
The number of bubbles was less in the O_2-pretreated prawn compared with the control.

The experimental rat was exposed to hyperoxia for 20 min, compressed to 1010 kPa air for 33 min and decompressed. The Control rat was exposed to air for 32 min at 1010 kPa and decompressed.

METHODS



Rotating wheel for DCS assessment



After decompression the rat was observed for 30 min in the rotating wheel, and at 2 and 24 hr after decompression.

RESULTS

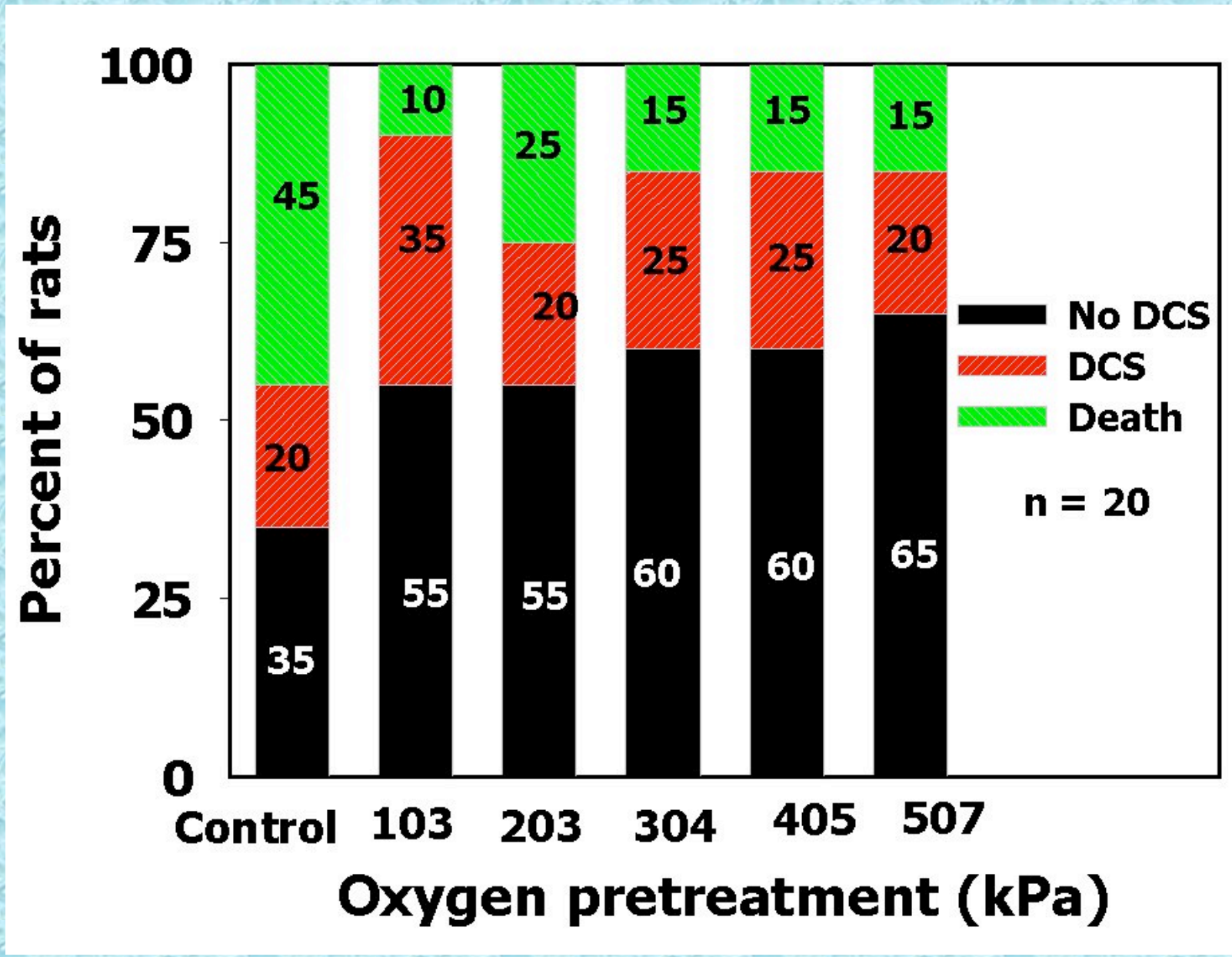
Three categories were used:

No DCS – No symptom of DCS

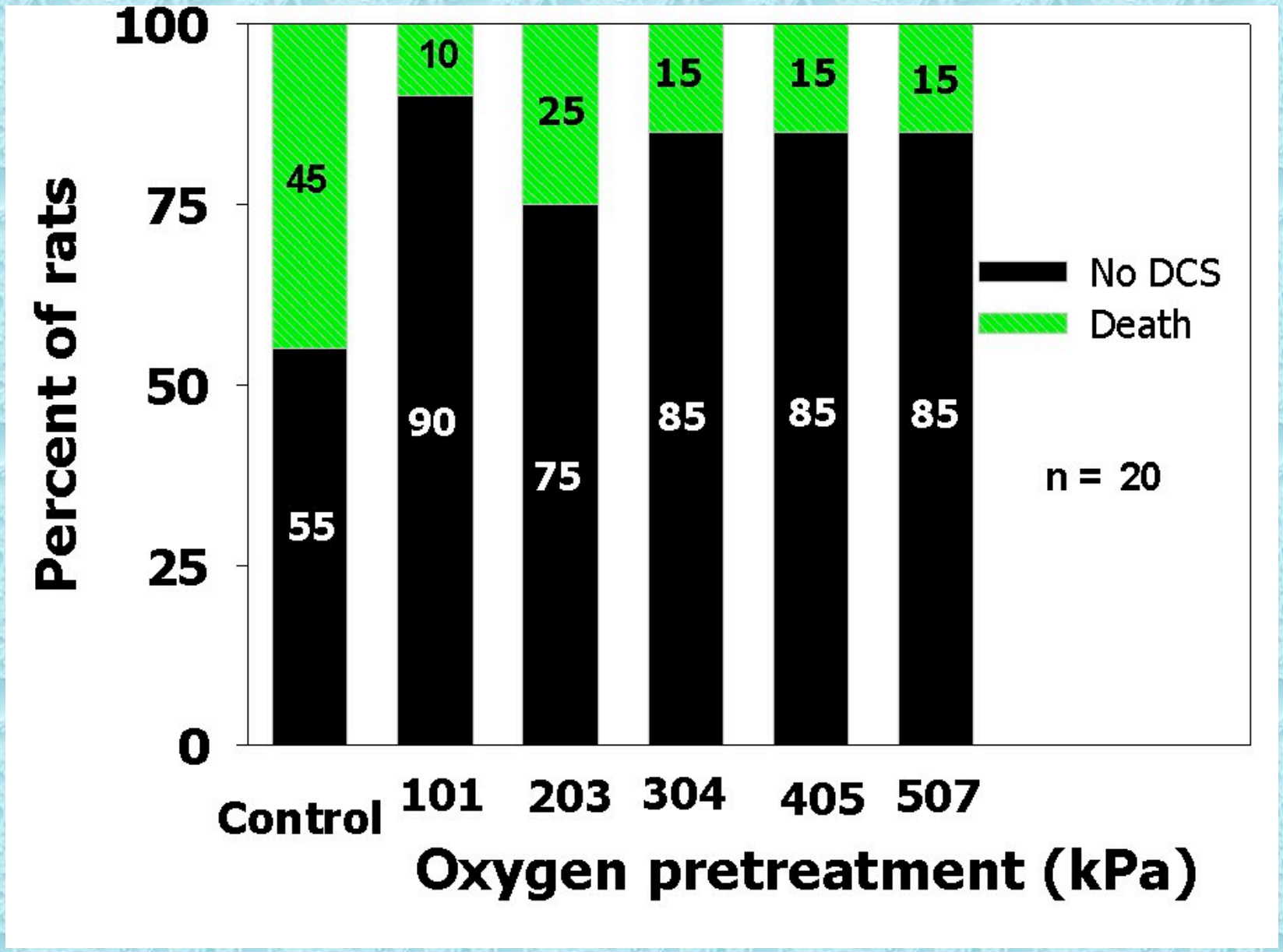
DCS – Any symptom of DCS which did not terminate in death

Death – DCS that culminated in death

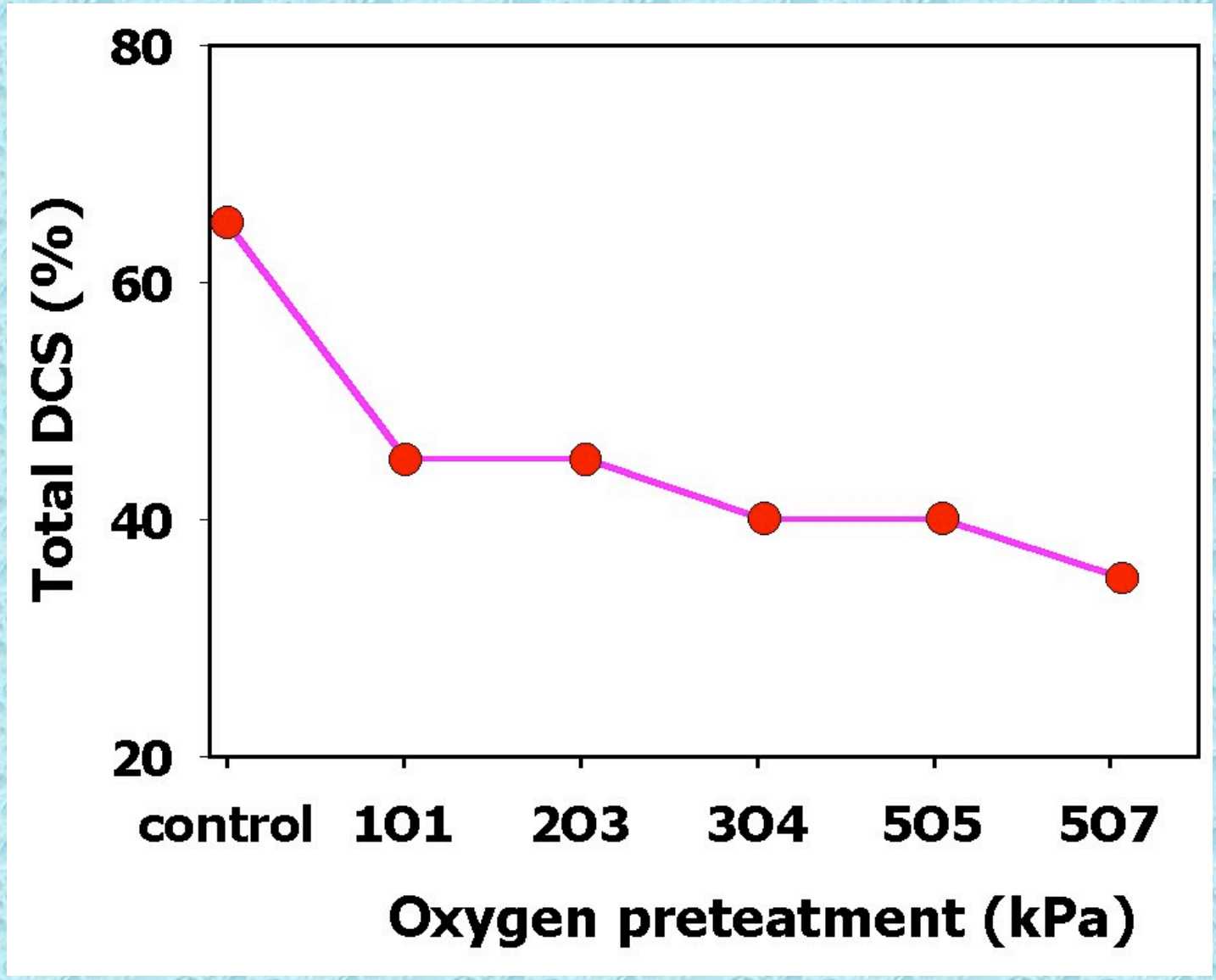
2 h post-decompression



24 h post-decompression



Total decompression sickness as a function of HBO pretreatment



CONCLUSIONS

The reduction of effective micronuclei by hyperbaric oxygen has a huge potential as a means of protection against DCS in man.

Some of this potential has already been assessed by Landolfi et al. (2005), who demonstrated a reduction in bubble score after oxygen pretreatment in man. Human experimentation is being planned with DAN (Diving Alert Network).