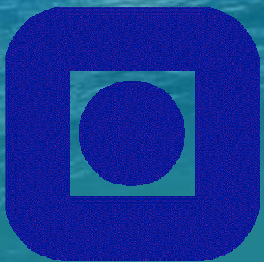


# GENERAL ANESTHESIA INCREASES MORTALITY AND BUBBLE FORMATION DURING DECOMPRESSION

**Jørgensen A, Gaustad SE, Møllerløkken A, Brubakk AO**

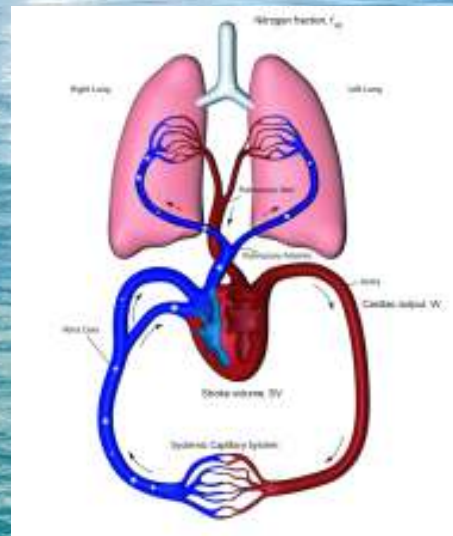
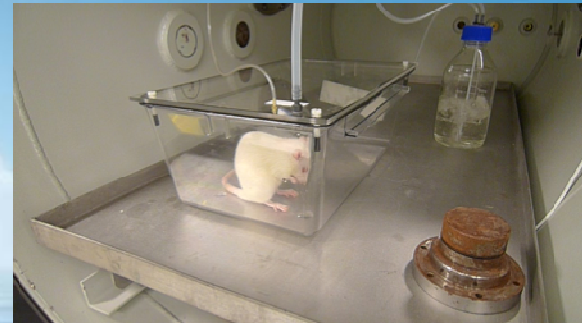


Department of Circulation and Medical Imaging, Medical Faculty,  
NTNU, Trondheim, Norway



**NTNU**  
**Norwegian University of  
Science and Technology**

# Background





# Background

VS

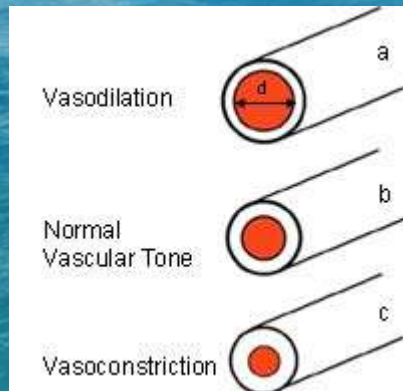


# Background

General Anesthesia is Commonly Used in Animal Experiments Studying DCS and Bubble Formation (Møllerlækken et al., 2006)



1st Phase During Induction



→ Rapid Heat Loss

*Sessler DI, 2008*

2nd Phase, Reemergence

→ Preventing Heat Loss

**HYPOTHERMIA**

*Mack and Lin, 1986*

Decreased Nitrogen elimination from the body.



# Background

General Anesthesia is Commonly Used in Animal Experiments Studying DCS and Bubble Formation (Møllerløkken et al., 2006)



Immobile

*Dujic Z et al.,  
2005*

VS



Active



No  
Shivering

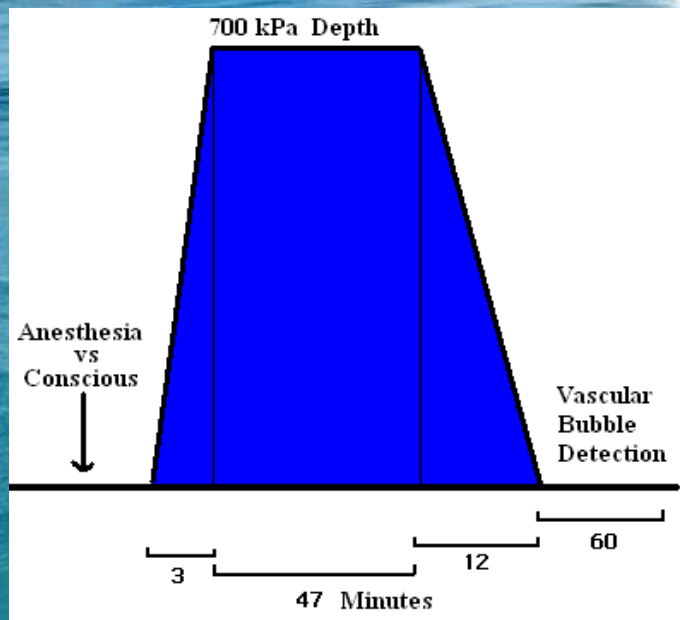
# Hypothesis

- **General anesthesia during a saturation dive in a hyperbaric chamber increase bubble formation and mortality.**
- **This by decreasing the rate of nitrogen elimination during decompression, due to an effect of a decreased core temperature and immobility.**



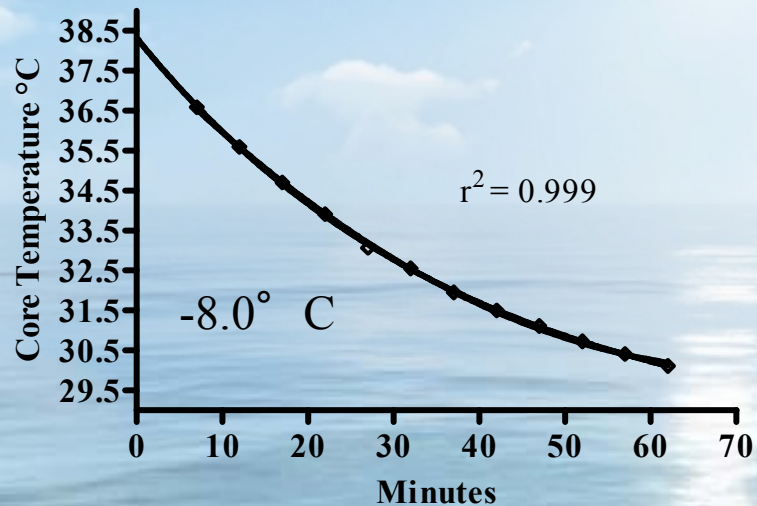
# Method

- Female Sprague Dawley rats, 266g  $\pm$  8SD
- Group I: General anesthesia during the dive, n=21
- Group II: Conscious during the dive, n=15
- Ambient temperature 22° C
- Core temperature, heart rate, resp.rate
- Near saturation dive, 700 kPa, 50 min, deco 50 kPa/min

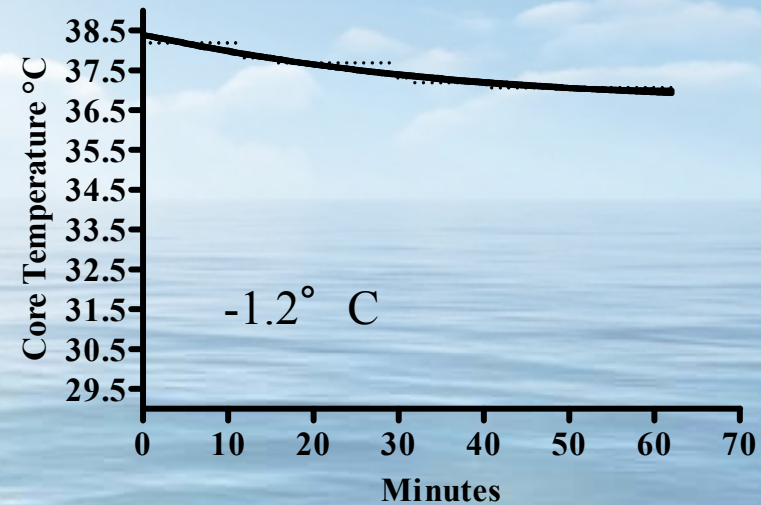


# Results

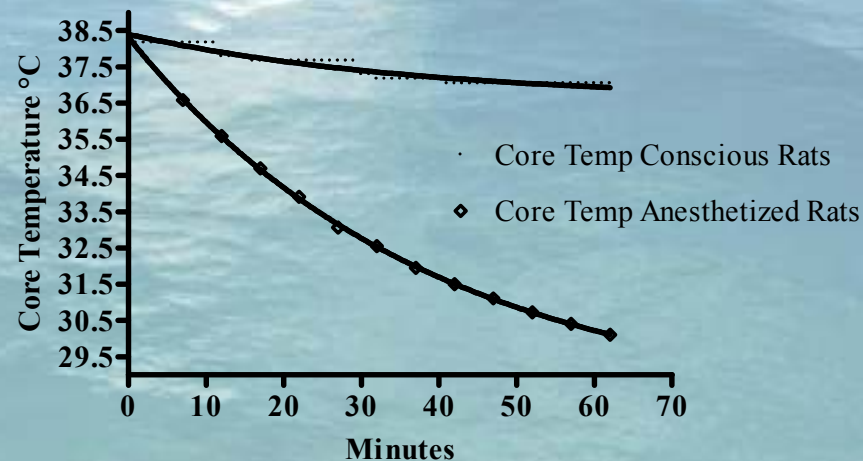
Core Temperature in Rats During Anesthesia



Core Temperature in Conscious Rats During Diving



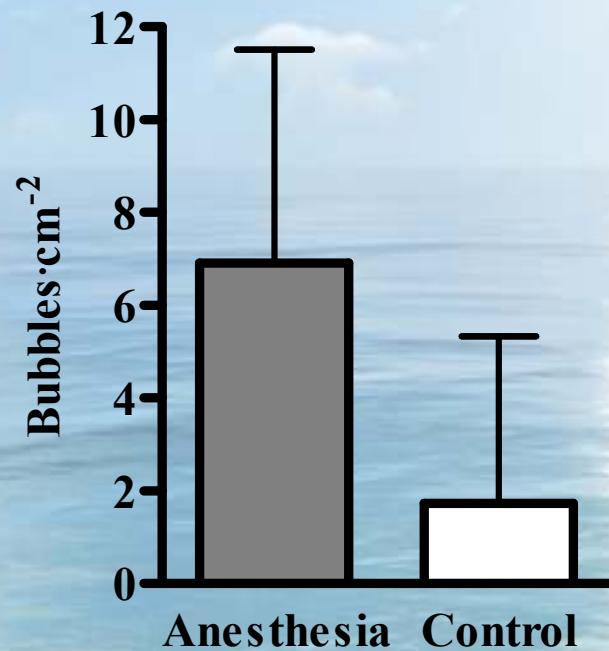
Core Temperature in Rats During Anesthesia and Diving





# Results

## A Bubble formation

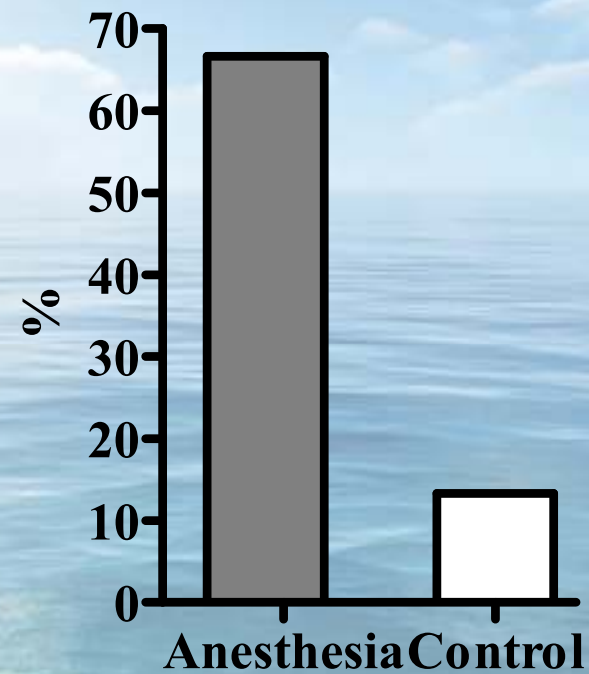


Bubbles·cm<sup>-2</sup> =

6.9 ± 4.6 vs 1.7 ± 3.6 SD

$p < 0.001$

## B Mortality



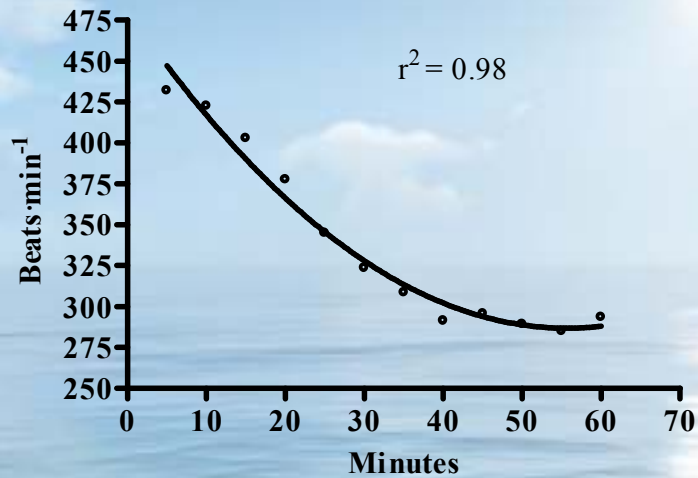
Mortality 67 vs 13%

$p < 0.001$

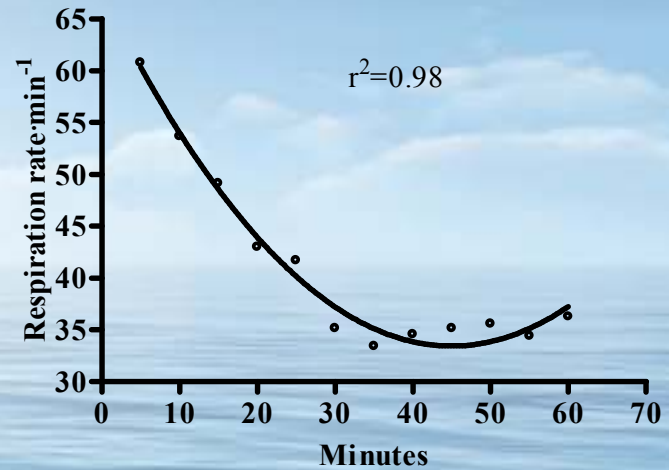
*Statistics: two tailed  
independent sample t-test*

# Results

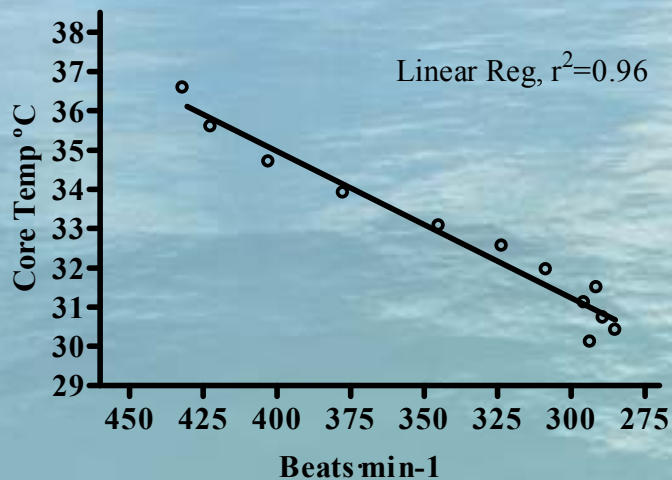
Heart Rate During One Hour in General Anesthesia



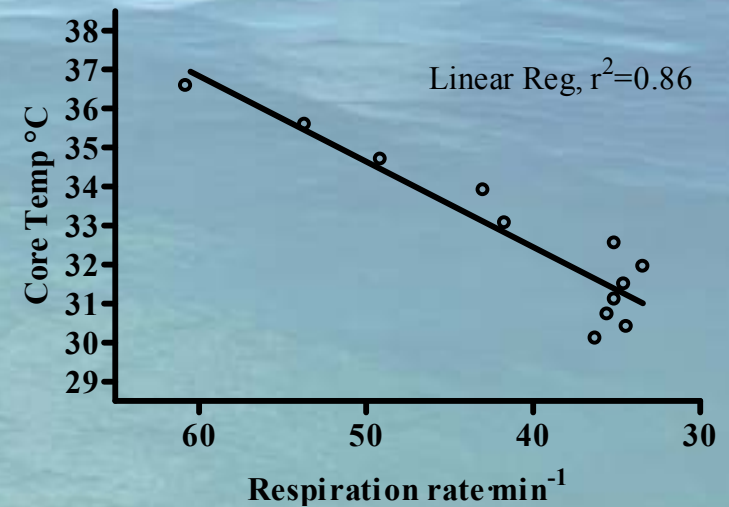
Respiration Rate During One Hour in General Anesthesia



Core Temperature and Heart Rate During General Anesthesia in Rats



Core Temperature and Respiration Rate During General Anesthesia in Rats





# Conclusion

- Rats in general anesthesia have significantly more detectable bubbles and higher mortality after a dry chamber dive compared to conscious rats at same ambient temperature.
- Might be an effect of
  - Decreased core temperature → decreased heart rate, respiration rate → decreased N<sub>2</sub> elimination?
  - General anesthesia → no shivering, no movements → no activity during decompression → decreased N<sub>2</sub> elimination?
  - Hypothermia → altered biochemistry → increased bubble formation and/or increased mortality?
  - Anesthetics used → altered biochemistry/physiology → increased bubble formation?
- This study addresses the importance of strict ambient and core temperature control when performing diving and altitude experiments studying bubble formation and DCS in anesthetized animals.

# Acknowledgements

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- The assistance of statistical calculations by Astrid Hjelde is gratefully acknowledged.
- THANK YOU!!!