

Exercise-induced Microbubble Formation After Oxygen Prebreathe



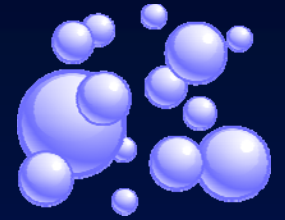
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¹Dartmouth Medical School, Hanover NH

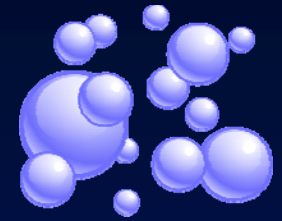
²Creare, Inc., Hanover NH

Funding provided by the ONR



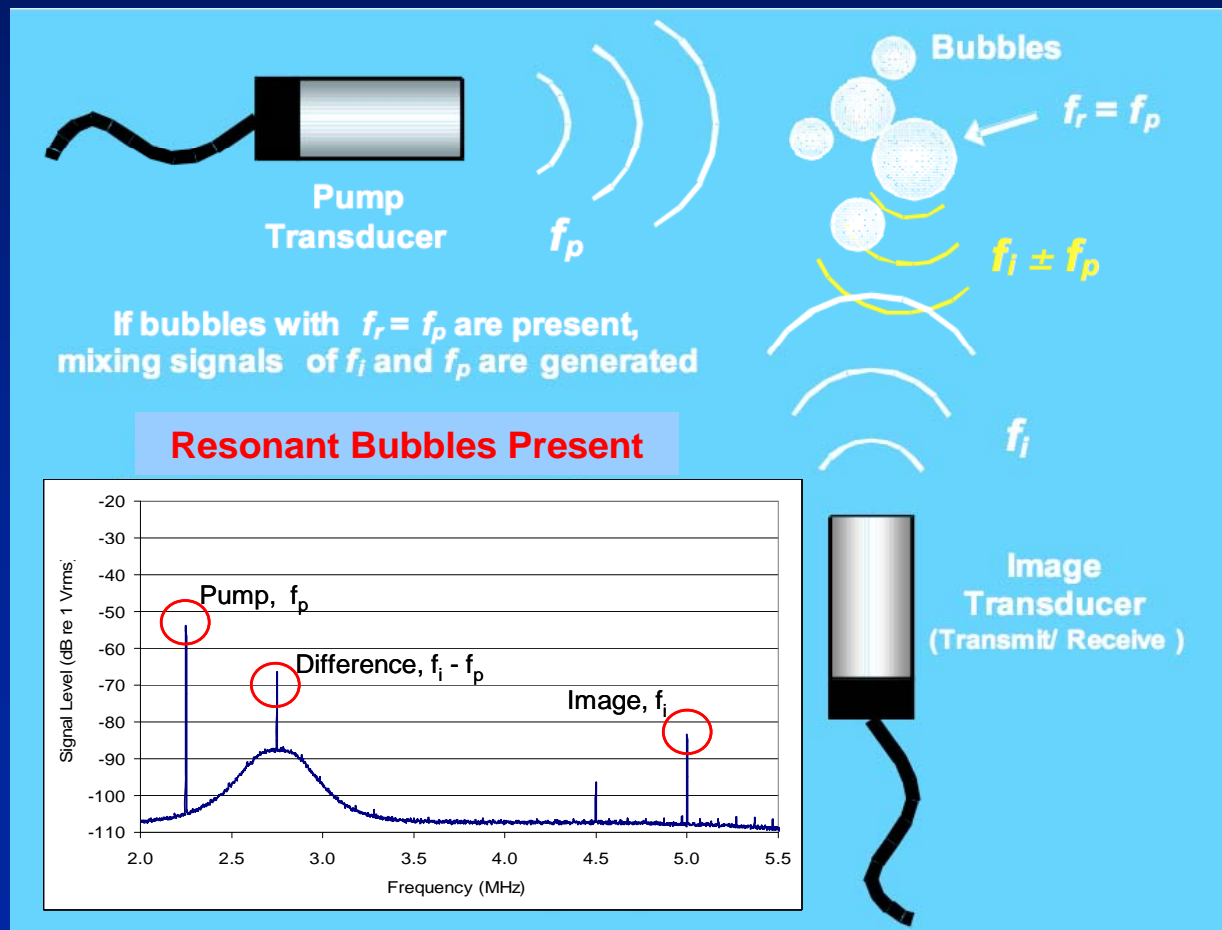
Bubble Detection-*Background*

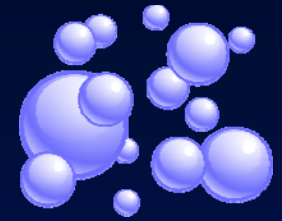
- Exercise produces microbubbles
- Composition of microbubbles not known
- If microbubbles disappear after de-nitrogenation via 100% O₂ prebreathe, this would indicate that microbubbles are nitrogen based
- If there is no decrease in microbubbles following O₂ prebreathe, this would suggest that bubbles are composed of available gases



Bubble Detection-*Methods*

- **Dual Frequency Ultrasound**
 - Based on non-linear behavior of resonating bubbles
 - Can detect and size stationary microbubbles in tissue

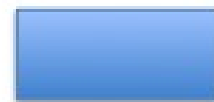




Bubble Detection-*Methods*

- 7 male human subjects breathed 100% O₂ for 240 minutes before and during cycle ergometry
- Exercised again after breathing room air for 120 minutes

Study Protocol

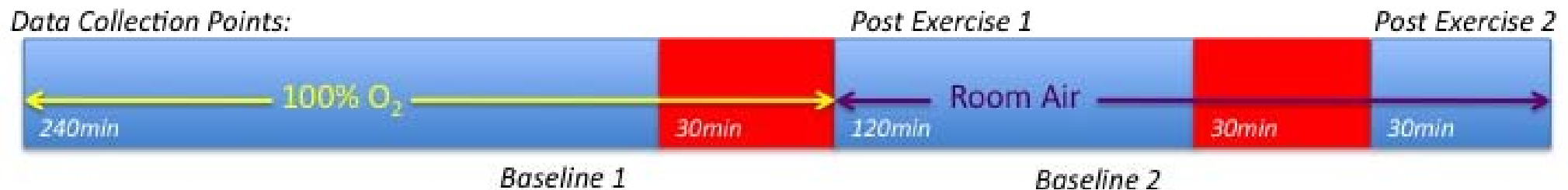


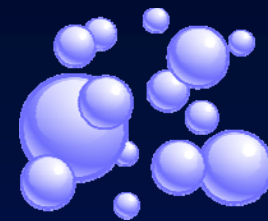
= Rest



= Cycle Ergometry; 80% age-predicted HR_{max}

Data Collection Points:

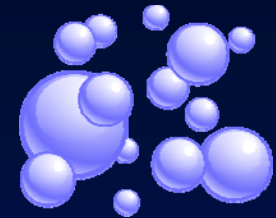




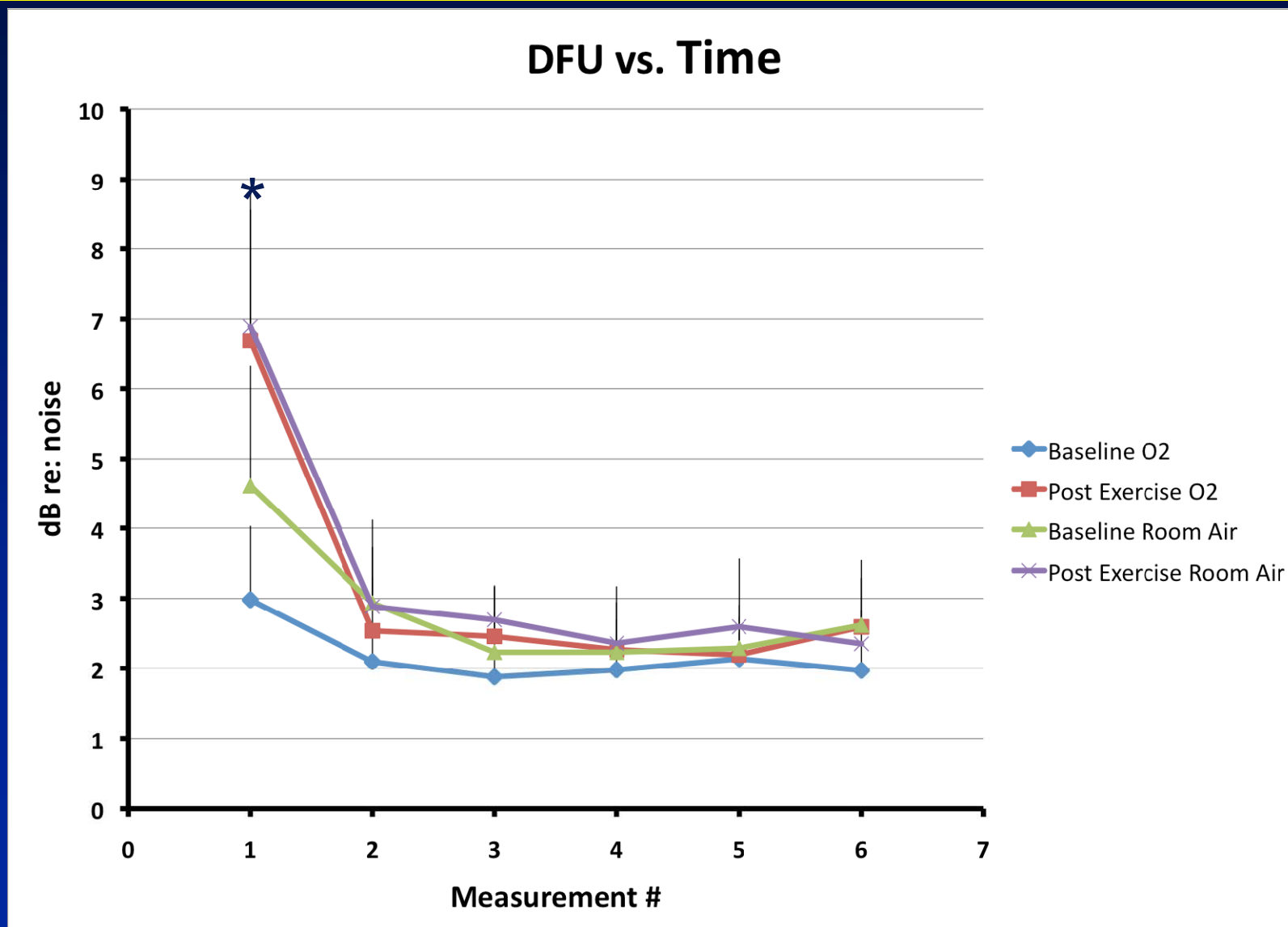
Bubble Detection-*Methods*

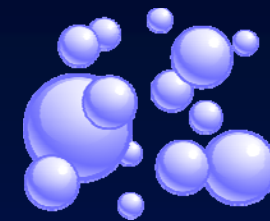
Measured microbubbles at 11 sites on leg (quadriceps, tibialis anterior and gastrocnemius)





Bubble Detection-Results

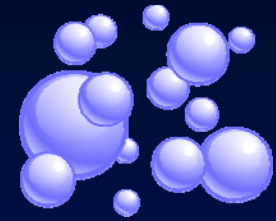




Bubble Detection-Results

TABLE II. RESULTS OF EXPOSURE TO A DECOMPRESSION TO 4.3 PSI SIMULATING EXTRAVEHICULAR ACTIVITY.

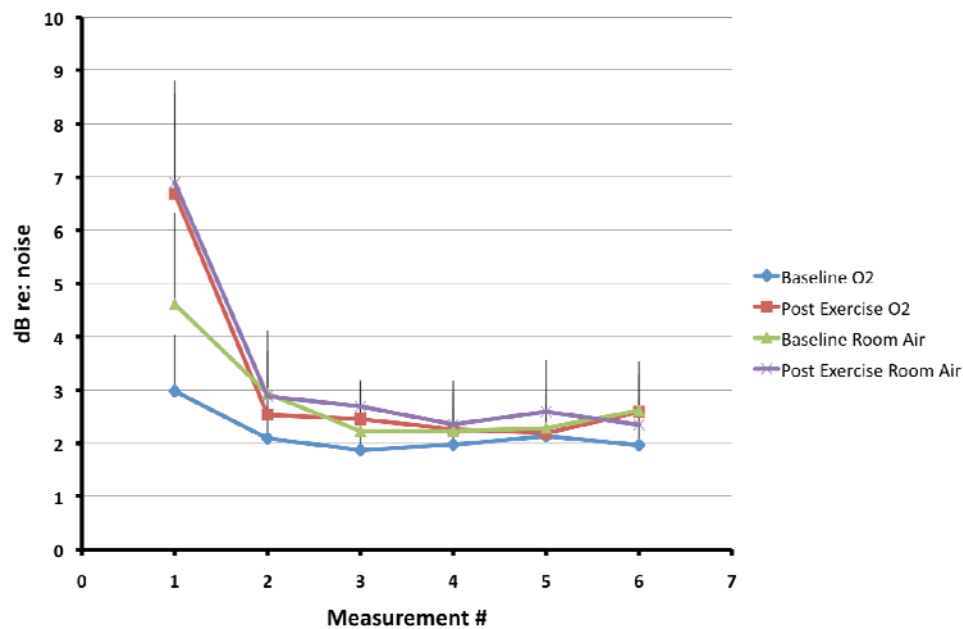
Hours of O ₂ Prebreath- ing	N	% Symp- toms	% Venous Bubbles	Source
3.5	23	30	65	(9)
4.0	28	21	46	(9)
6.0	38	10	29	Current Study
8.0	8	0	0	Current Study



Bubble Detection-Results

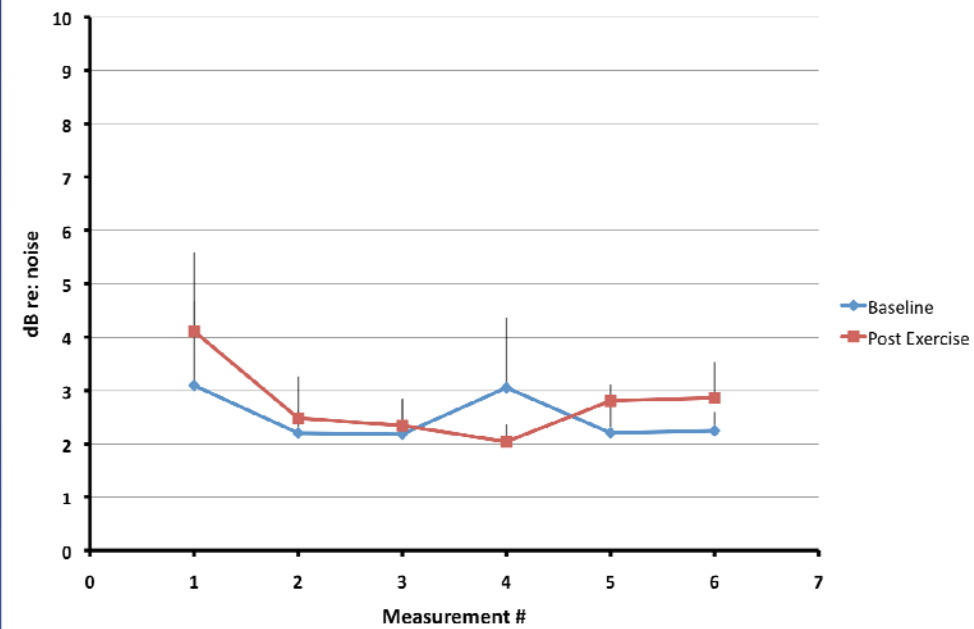
4 hour prebreathe

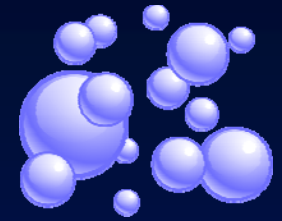
DFU vs. Time



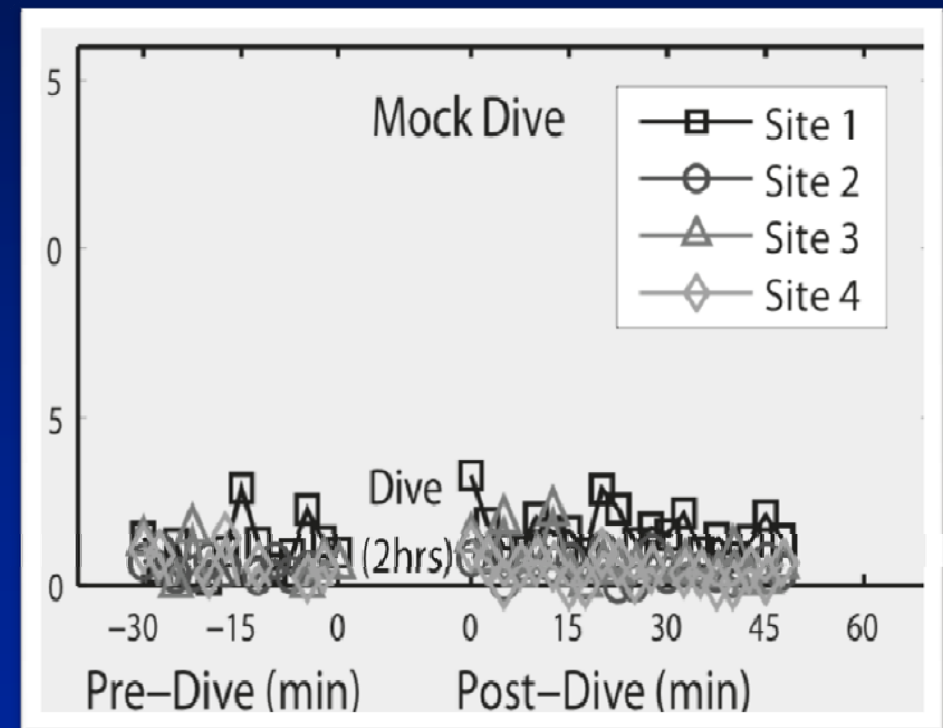
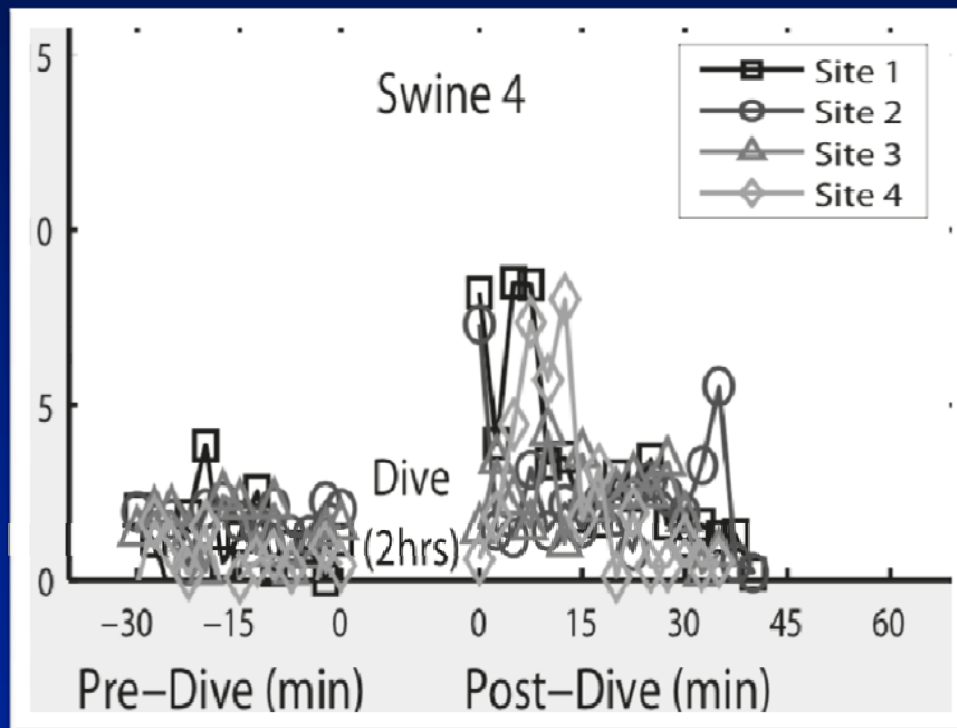
8 hour prebreathe

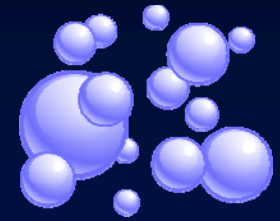
DFU vs. Time





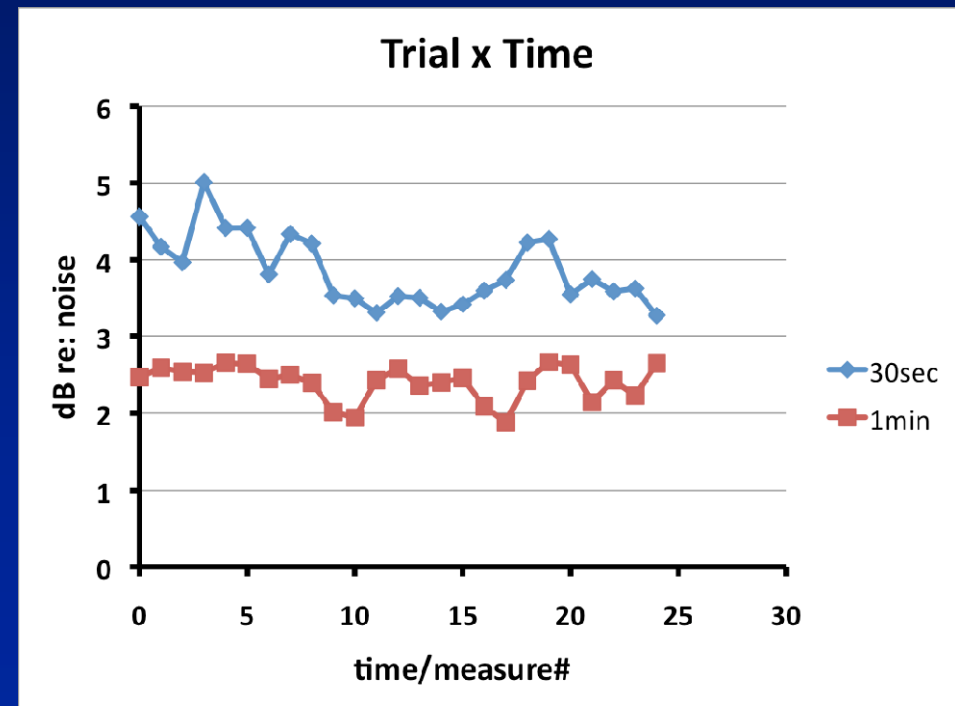
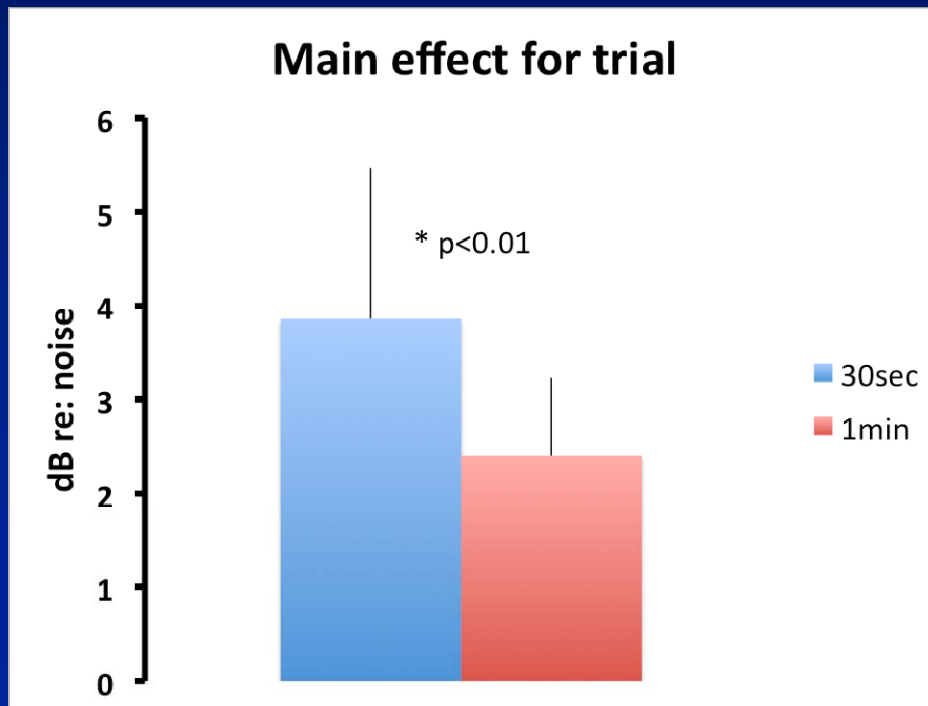
Bubble Detection-*Previous Swine Study*

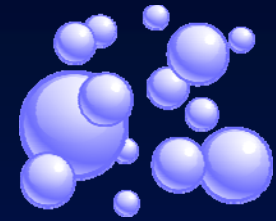




Bubble Detection-Results

First measurement high diminished by increasing pregel time to 1min

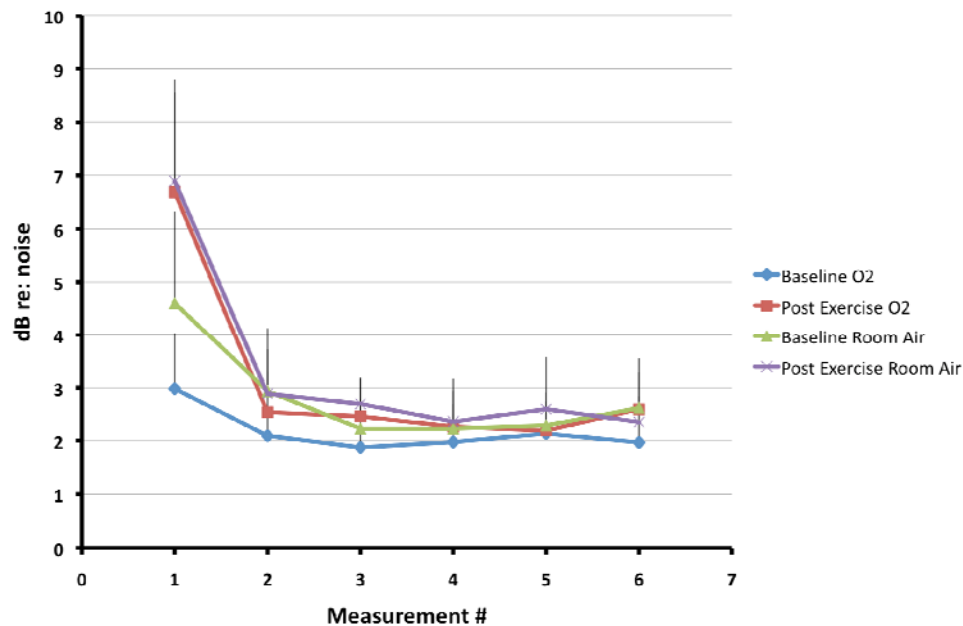




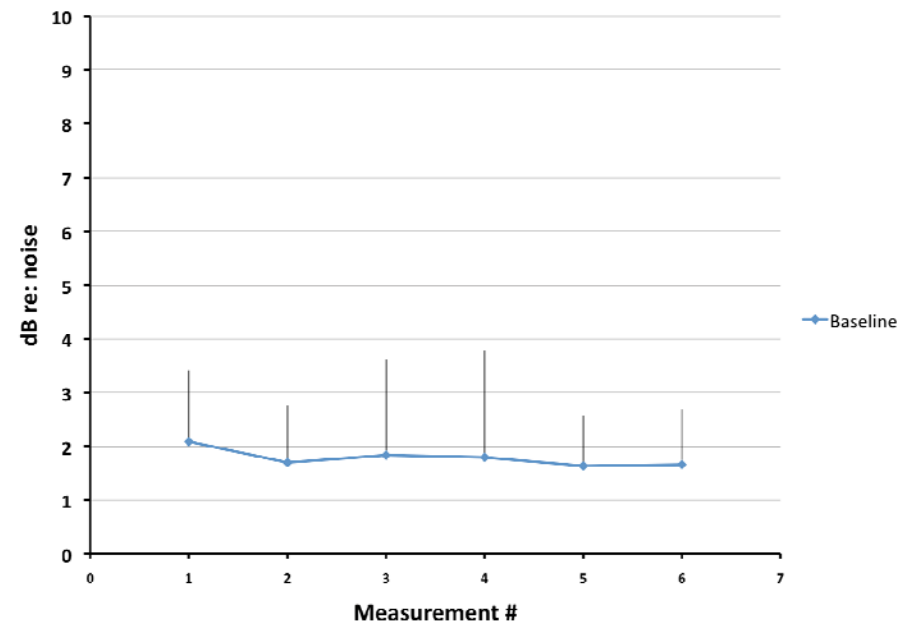
Bubble Detection

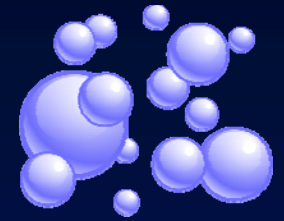
Currently collecting baseline data with 1 minute of pregel at 11 sites

DFU vs. Time



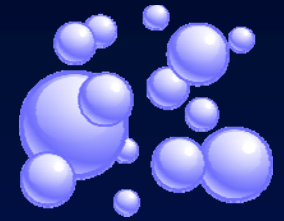
Baseline





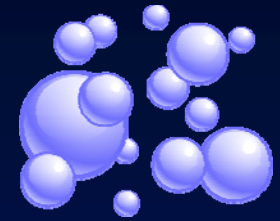
Bubble Detection-*Conclusions*

- **Prebreathing 100% O₂ for 4 hours did not reduce detected microbubbles but interpretation complicated by first measurement high (FMH) phenomenon**
- **FMH can be reduced using pregel suggesting surface phenomenon**
- **Currently developing hypotheses for FMH**



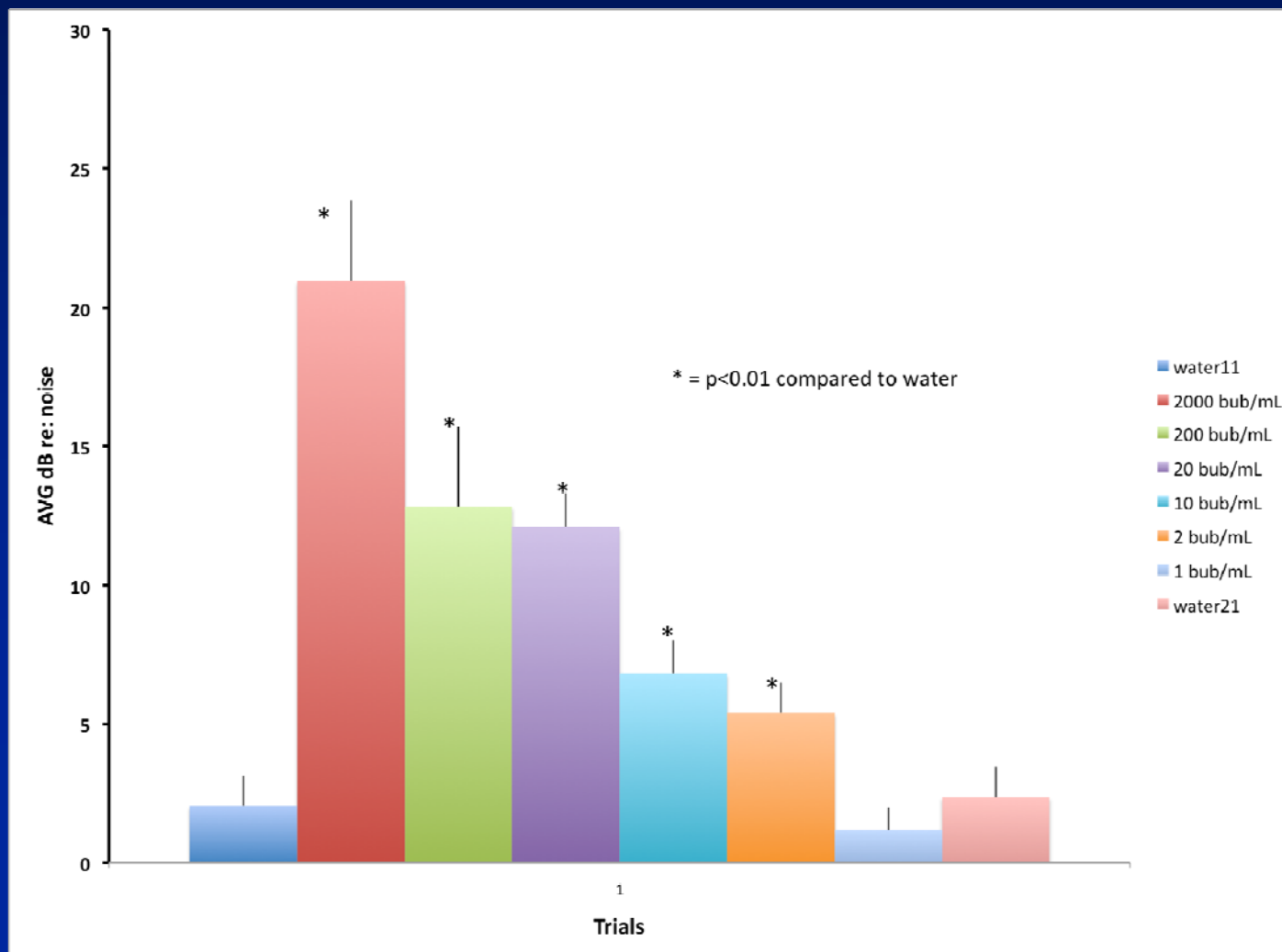
Bubble Detection-*Next steps*

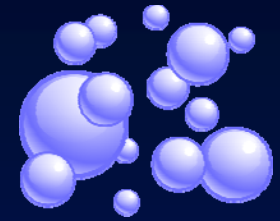
- Repeat exercise data using pregel technique to diminish first measurement high
- Need to assess following a decompression protocol



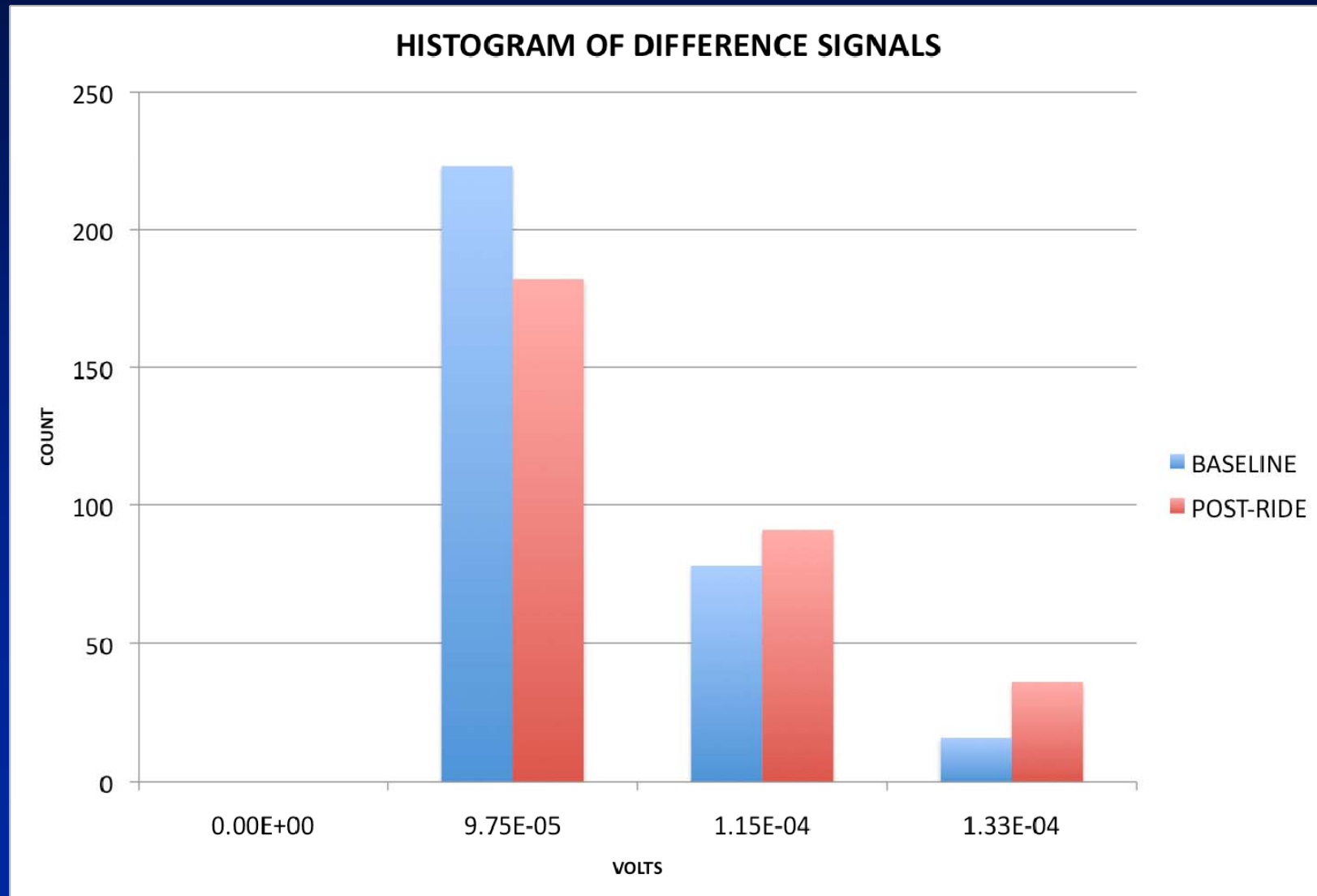
Bubble Detection

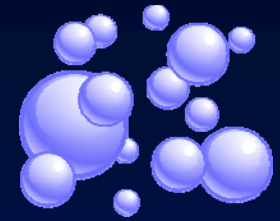
Sensitivity of DFU





Bubble Detection-*Backup Data*





Bubble Detection-Backup Data

