

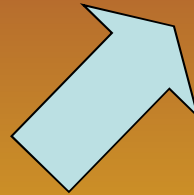
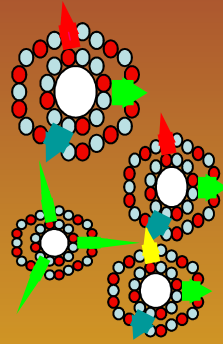
BUBBLES, MICROPARTICLES & NEUTROPHIL ACTIVATION: CHANGES WITH EXERCISE and BREATHING GAS DURING OPEN-WATER SCUBA DIVING

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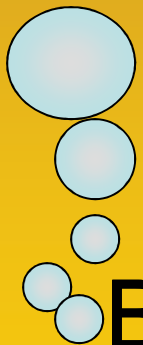
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HYPOTHESIS

INFLAMMATORY RESPONSES



MICROPARTICLES
(0.1 – 1 μm spheres)



BUBBLES



PREVIOUS MOUSE STUDIES

- 1. MICROPARTICLES INCREASE POST-DIVE**
- 2. MORE PROVOCATIVE DIVING YIELDS MORE MPs**
- 3. MPs (ESP. FROM PLATELETS) LINK TO PMN, CAUSE ACTIVATION & VASCULAR INJURY**

Hypothesis

Exertion underwater & gas with more O₂ and less N₂ (EAN) will alter MPs production and size, PMN activation and their relationships to intravascular bubble formation.

GOALS OF STUDY

EVALUATE INTRAVASCULAR CHANGES IN HUMAN DIVERS POST-DECOMPRESSION

Bubbles (Pre-cordial Doppler)

Microparticle number

MPs surface markers (indicate cells of origin)

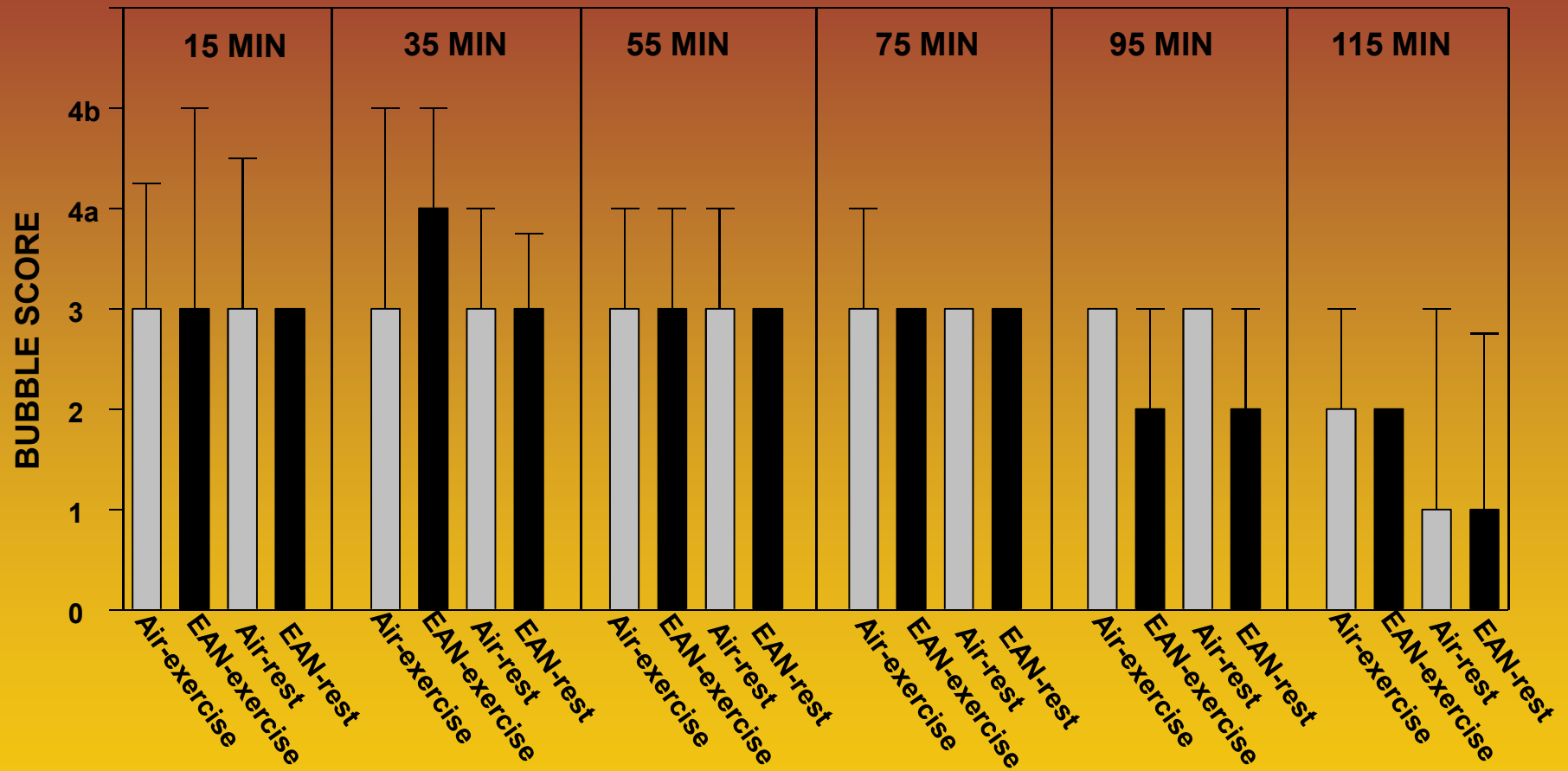
MPs size (enlarged MPs cause most injury)

Neutrophil activation & presence of MPs

FOUR DIVES, 4+ DAYS BETWEEN STUDIES

**24 divers: 18 msw for 47 minutes air or
22.5 msw 32% EAN, moderate exertion vs stationary**

Bubble scores did not differ among four dive conditions over 2 hr post-dive



MPs #/μl and diameters (no sig. differences pre-dive)

Group	Pre-dive			
	Total	<1	1-2	>2 μm
EAN Rest (n=8)	1448 ±146	1422 ±143	26 ±2	0.5 ±0.2
Air Rest (9)	1182 ±128	1147 ±123	34 ±6	0.5 ±0.3
EAN Ex (24)	1352 ±104	1314 ±101	37 ±3	0.8 ±0.2
Air Ex (23)	1609 ±147	1569 ±144	39 ±4	0.8 ±0.3

MPs #/ μ l and diameters (all sig. vs pre-dive)

Group	15 min-post			
	Total	<1	1-2	>2
EAN Rest (8)	3050 ± 329	2902 ± 317	132 ± 14	16 ± 3
Air Rest (9)	3741 ± 552	3579 ± 529	143 ± 20	19 ± 6
EAN Ex (24)	3915 ± 670	3709 ± 636	181 ± 32	25 ± 4
Air Ex (23)	3793 ± 453	3592 ± 428	173 ± 24	28 ± 4

MPs #/μl and diameters

Group	2 h post-			
	Total	<1	1-2	>2
EAN Rest (8)	3858 ± 622	3465 ± 555	323† ±63	70† ±11
Air Rest (9)	4692 ± 873	4270 ± 783	355 ± 82	67 ± 16
EAN Ex (24)	4540 ± 751	4092 ± 676	366† ± 62	82† ± 15
Air Ex (23)	8270*† ± 1109	7492*† ± 1012	638*† ± 85	140*† ± 17

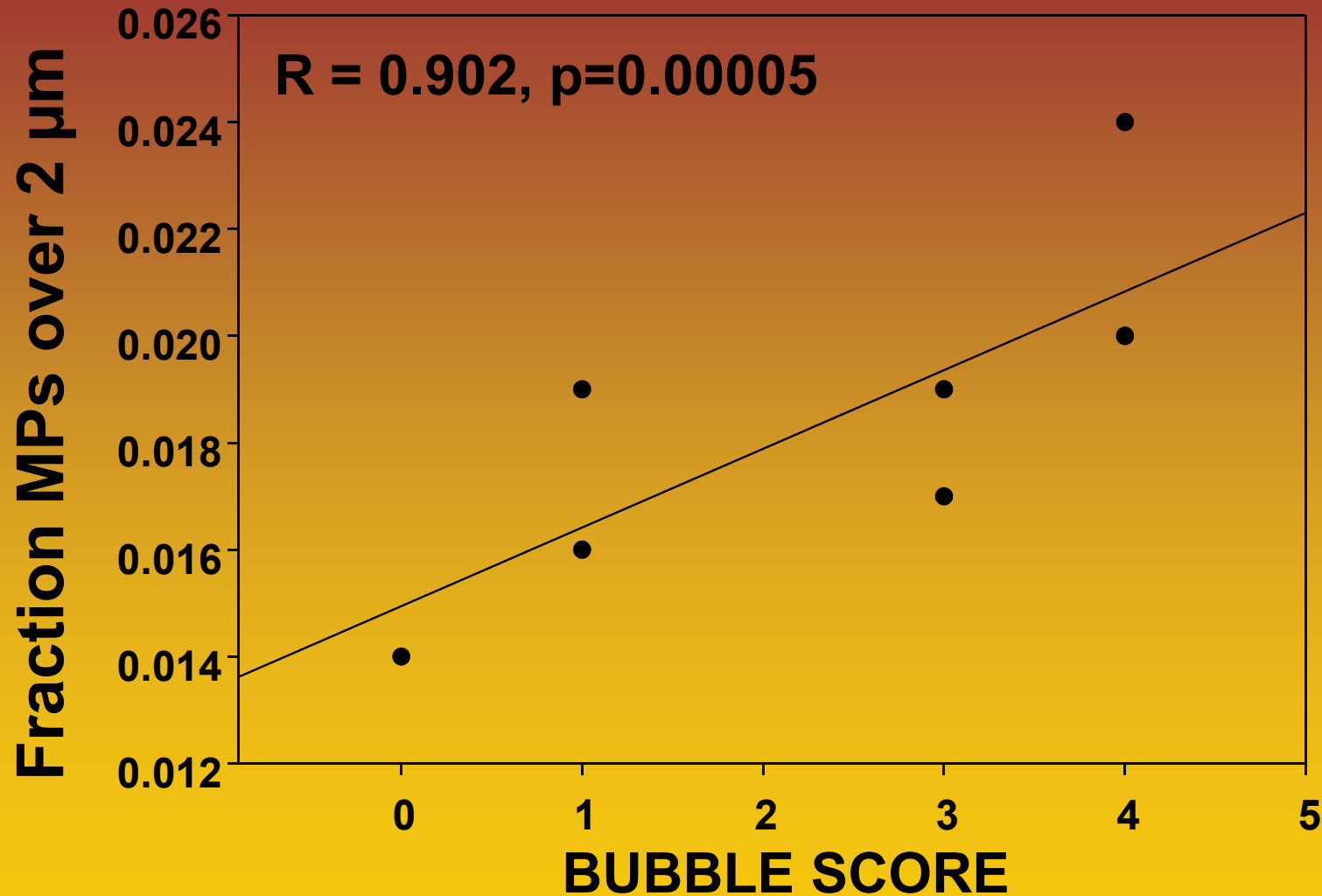
* p<0.05 versus others in the column (vertical)

† P<0.05 vs 15 minute value in same group

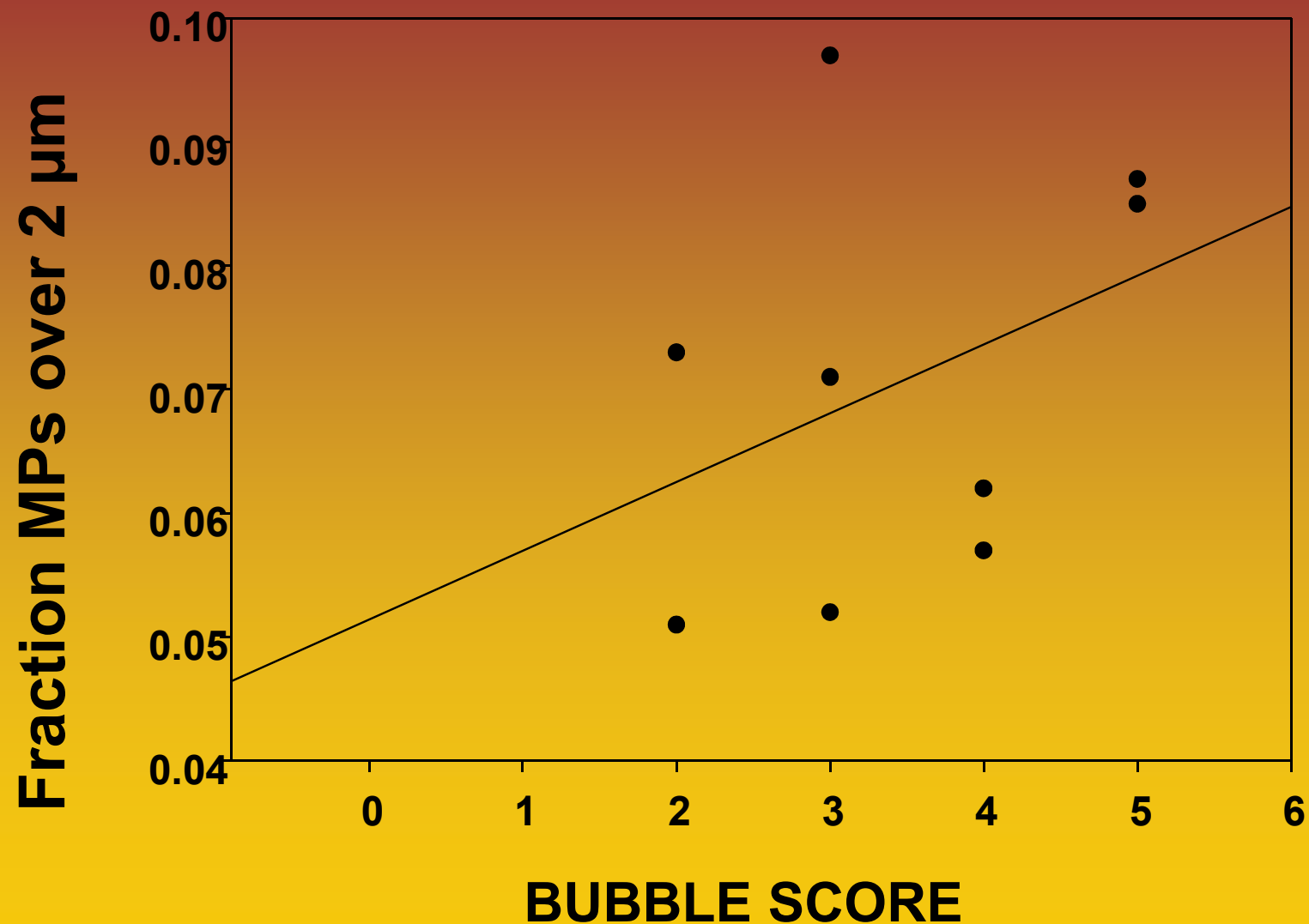
NEUTROPHIL ACTIVATION OCCURRED IN ALL GROUPS

MYELOPEROXIDASE on PMN surface						
Group	% above 10 units			Geometric Mean		
	Pre	15m	2 h	Pre	15m	2h
1. EAN (8) Rest	4.0 (0.4)	10.8 (1.1)	13.8† (1.0)	10.5 (0.8)	27.8 (1.0)	30.2 (2.1)
2. Air (9) Rest	4.6 (0.4)	10.9 (1.4)	15.3† (0.9)	12.1 (0.6)	26.1 (1.3)	30.2† (1.1)
3. EAN (24) Exercise	3.2 (0.3)	10.9 (0.6)	13.8 (1.1)	12.6 (0.5)	22.0 (0.6)	23.1 (0.7)
4. Air (23) Exercise	3.3 (0.4)	10.7 (0.7)	16.4† (1.3)	10.1 (0.5)	23.5 (1.5)	30.0† (1.3)
Groups Significantly different	1 v. 3 2 v. 3 2 v. 4	NS	1 v. 3 1 v. 4 2 v. 3 2 v. 4	1 v. 3 3 v. 4	1 v. 3	1 v. 3 2 v. 3 3 v. 4

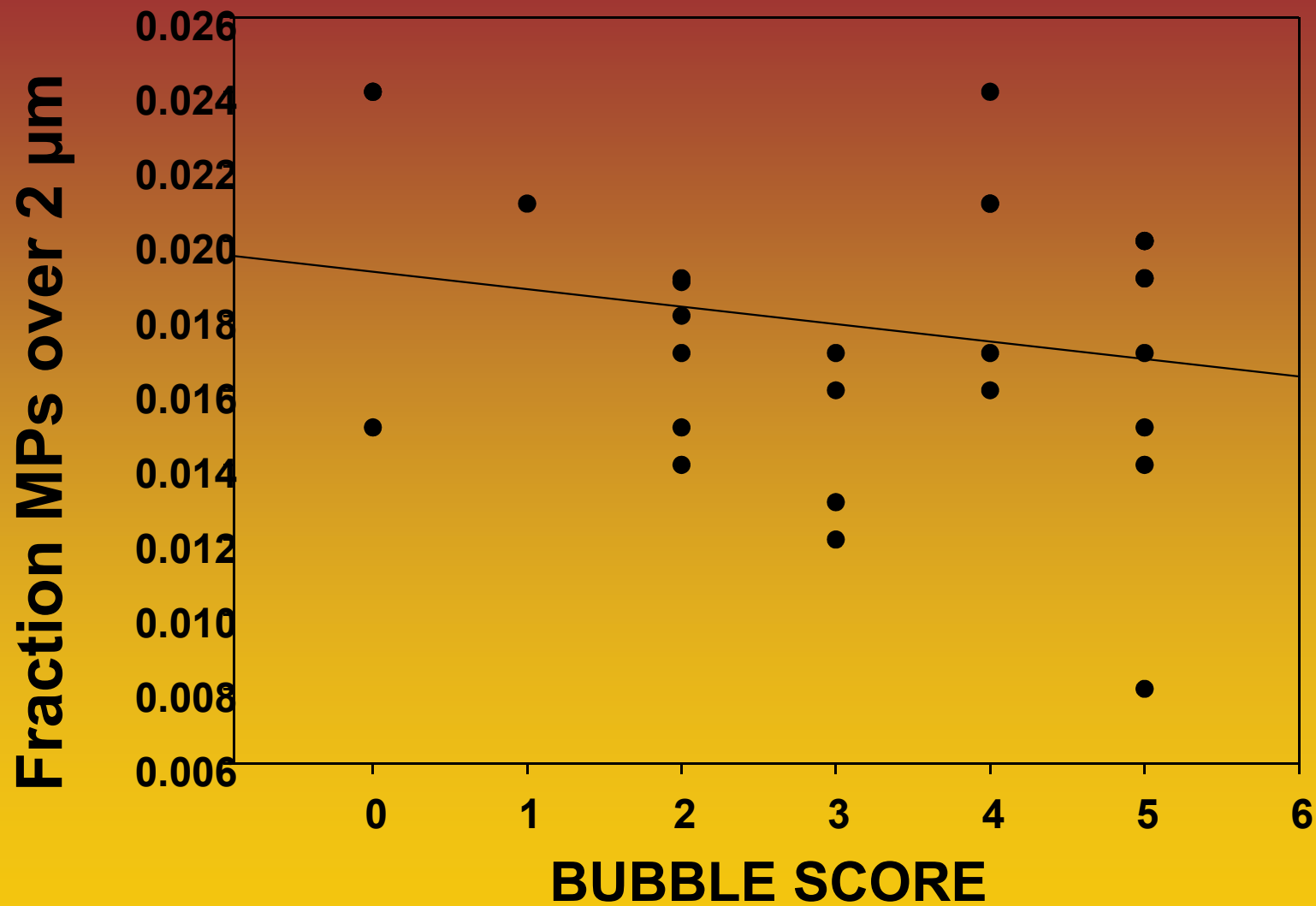
EAN-REST BS vs MPs >2 μm at 120 min (only groups showing tight correlation)



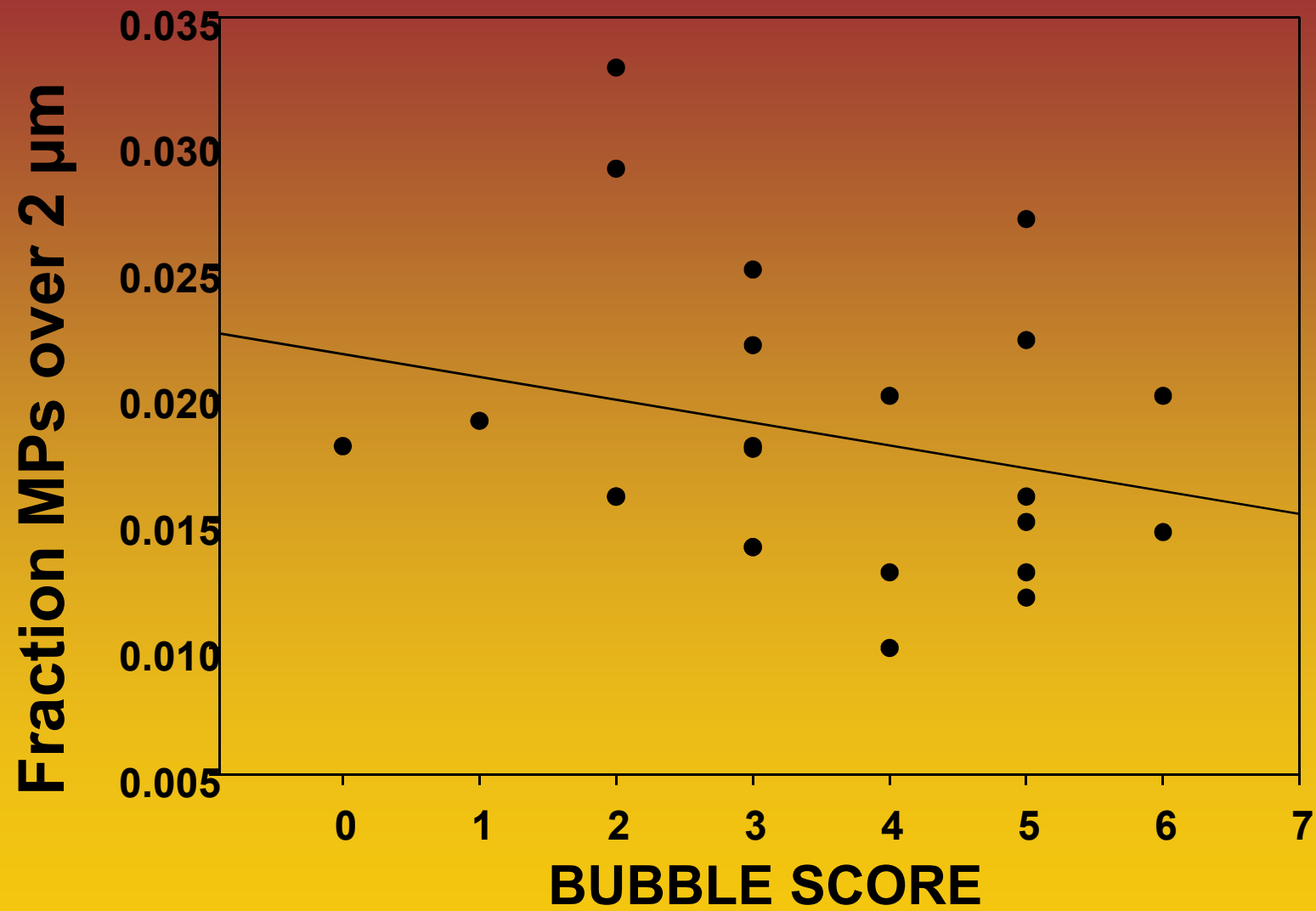
AIR -REST BS vs MPs >2 μm at 120 min



EAN-Exercise BS vs MPs >2 μm at 120 min



AIR-Exercise BS vs MPs >2 μm at 120 min



CONCLUSIONS

AFTER OPEN-WATER DECOMPRESSION:

Intravascular MPs increase 2.7X at 15 min (all dives)

Only Air-Ex, increase 5x at 2 hours

MPs 'size' increases

Neutrophil activation occurs

**EAN-Rest → bubbles correlated with enlarged MPs
(this also smallest group)**

Association between MPs & bubbles – maybe.

OBSERVATIONS:

SCUBA diving appears to cause MPs generation out of proportion to the level of exertion.

Differences for EAN-Rest? Lowest total MPs post-dive, among fewest changes for dual-positive MPs (antigen sharing) suggests the dive may have been less physiologically provocative.

Difference between Air-Rest and EAN-Rest may relate to O₂ partial (Air ~ 59 kPa; EAN - 105 kPa, 78 % higher and influence on NOS activity.

Other?: Pre-dive index platelet-neutrophil interactions

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