

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

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HYPOTHESIS:

We hypothesize that circulating microparticles (MPs) generated by a variety of cell types are the proximal cause for vascular and neurological insults following decompression stress because they initiate an inflammatory response. MPs, or so-called ‘cell dust’, are shed into the blood stream under normal physiological conditions and release is increased from platelets, leukocytes, erythrocytes and endothelial cells in association with a variety of thrombotic and inflammatory processes

GOALS OF STUDY

To assess whether 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.

METHODS

24 divers: 18 msw for 47 minutes on air or 22.5 msw breathing 32% EAN (equivalent air depth), Performing moderate exertion vs stationary

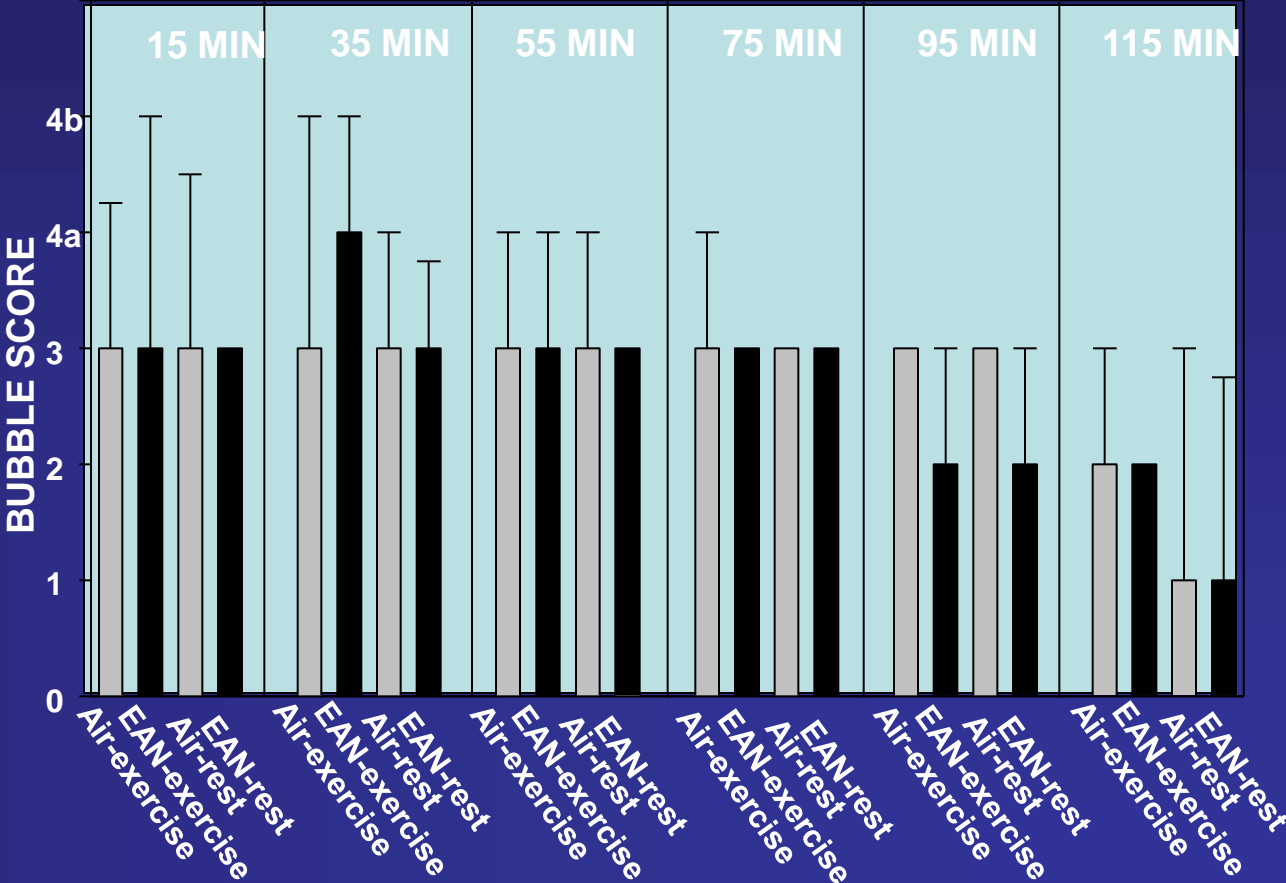
THEREFORE - FOUR DIVES, 4+ DAYS BETWEEN STUDIES

MEASUREMENTS:

Bubbles (Pre-cordial Doppler) for 2 hrs post-dive
Microparticle number
MPs surface markers (indicate cells of origin)
MPs size (enlarged MPs cause most injury)
Neutrophil activation & presence of MPs

WE GRATEFULLY ACKNOWLEDGE
SUPPORT FROM:
OFFICE OF NAVAL RESEARCH,
DIVERS ALERT NETWORK,
UNITY THROUGH KNOWLEDGE FUND,
CROATIAN MINISTRY OF
SCIENCE, EDUCATION & SPORTS

Bubble scores - no differences



NEUTROPHIL ACTIVATION IN ALL GROUPS

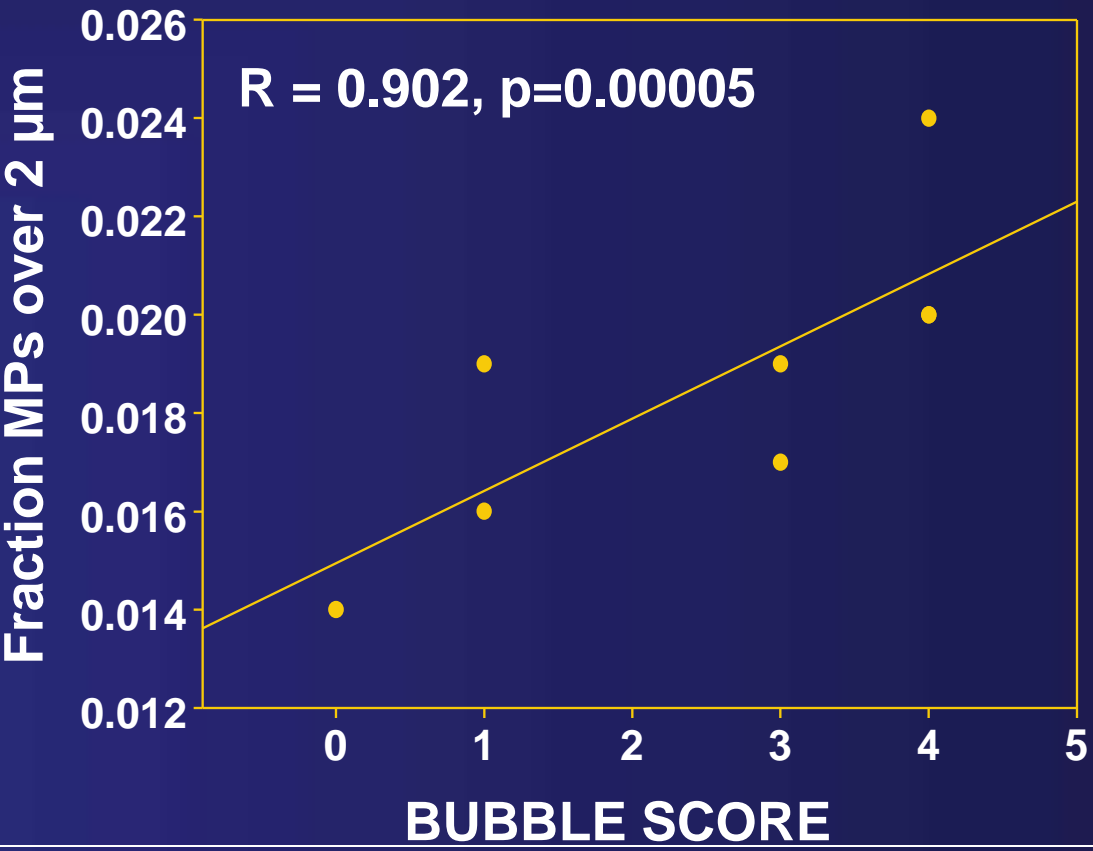
MYELOPEROXIDASE on PMN surface						
Group	% above 10 units			Geometric Mean		
	Pre	15m	2 h	Pre	15m	2h
1. EAN (8) Rest	4.0 (0.4)	10.8 (1.1)	13.8† (1.0)	10.5 (0.8)	27.8 (1.0)	30.2 (2.1)
2. Air (9) Rest	4.6 (0.4)	10.9 (1.4)	15.3† (0.9)	12.1 (0.6)	26.1 (1.3)	30.2† (1.1)
3. EAN (24) Exercise	3.2 (0.3)	10.9 (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 Significant 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. 4	1 v. 3 2 v. 3 3 v. 4

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

Group Pre-dive	Pre-dive			
	Total	<1	1-2	>2 µm
EAN Rest (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
15 mni post--dive				
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
2 hour post--dive				
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

In only EAN-REST BS correlated with MPs
e.g. BS vs MPs >2 µm at 120 min



CONCLUSIONS

AFTER OPEN-WATER DECOMPRESSION:

1. Intravascular MPs increase 2.7X at 15 min (all dives)
2. Only Air-Ex, increase 5x at 2 hours
3. MPs ‘size’ increases
4. Neutrophil activation occurs
5. EAN-Rest → bubbles correlated with enlarged MPs (this also group with smallest # divers)
6. Association between MPs & bubbles – maybe.

OBSERVATIONS:

1. SCUBA diving appears to cause MPs generation out of proportion to the level of exertion.
2. 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.
3. Difference between Air-Rest and EAN-Rest may relate to O₂ partial (Air ~ 59 kPa; EAN - 105 kPa, 78 % higher) and influence on nitric oxide synthase activity.
4. Other?: Pre-dive index platelet-neutrophil interactions