MICROPARTICLE PRODUCTION, NEUTROPHIL ACTIVATION & INTRAVASCULAR BUBBLES FOLLOWING OPEN-WATER SCUBA DIVING

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BACKGROUND:

MICROPARTICLES (MPs) are 0.1 to 1 μm diameter membrane vesicles shed from the surface of a variety of cells by what appear to be well regulated processes (1). As MPs bud from their parent cells negatively charged phosphatidylserine residues are exposed, which often leads to secondary binding of Annexin V. MPs can directly stimulate release of pro-inflammatory cytokines and platelet-derived MPs stimulate leukocyte activation and aggregation (2-4). Annexin V-positive platelet MPs exhibit pro-coagulant activity (5). MPs increase in mice after decompression stress and cause vascular injuries (6,7). Circulating MPs are increased in humans subjected to simulated scuba diving (8,9).

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GOALS & OBJECTIVES:

Evaluate bubbles, MPs and neutrophil activation in humans after open water scuba diving.

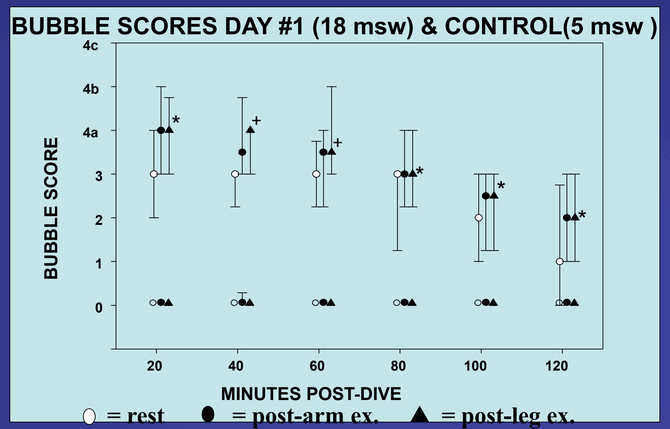
METHODS:

16 male divers performed dives to 18 msw for 47 minutes daily for 4 days. Bubbles were monitored after each dive, blood was obtained before and 80 minutes after dives on day 1 and 4. A control drive to 5 msw for 47 minutes with similar exertion was also performed.

HYPOTHESIS:

Decompression stress from open-water diving will cause elevations in circulating MPs and neutrophil activation.

Fig 1. Bubbles occurred after each dive



Modified Brubakk Scale: 0 – no bubbles; 1 – occasional bubbles; 2 – at least 1 bubble every four cardiac cycles; 3 – at least 1 bubble every cardiac cycle; 4 – continuous bubbling with modifiers [(a = at least one bubble per cm2 in all frames), (b = at least three bubbles per cm2 in all frames), or (c = almost complete whiteout but individual bubbles can still be discerned)] and 5 – 'whiteout'.

Fig 2. MPs increased 3.4-fold after each experimental dive

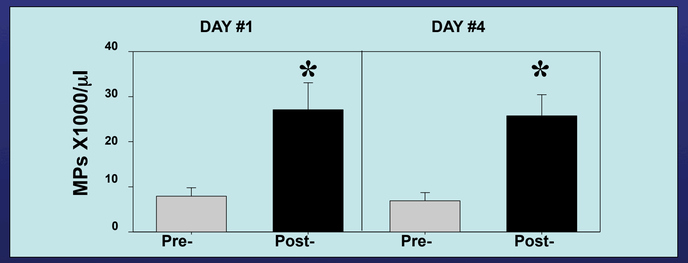


Fig 3. MPs diameter increases after each dive (larger particles are associated with more damage)

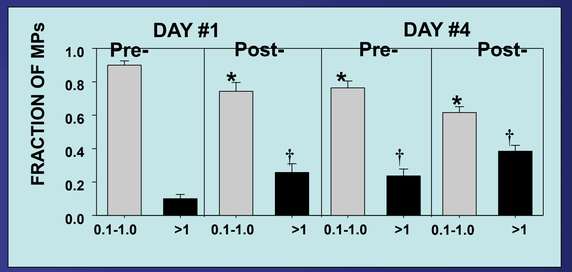


Fig 4. Neutrophil activation occurs after each dive (with nominal changes after control 5 msw dive)

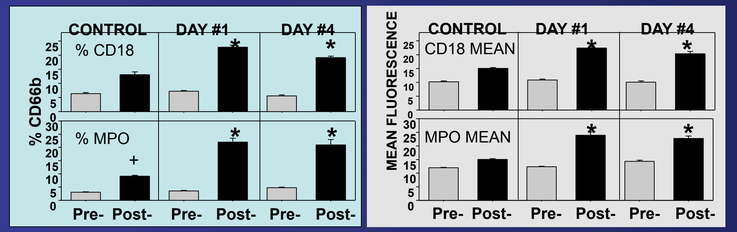
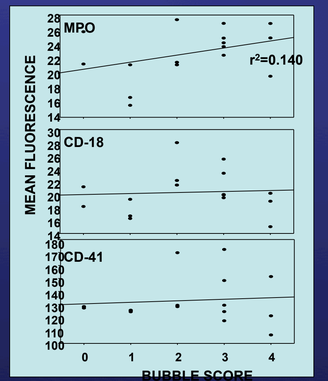


Fig 5. Post-dive 4 bubble scores relation to neutrophil activation.



CONCLUSIONS:

Intravascular MPs increase 3.4X
MPs 'size' increases
Neutrophil activation occurs
PMN-Platelet (or MPs) interactions occur

Changes occur with each dive, little evidence for lasting effects between dives

Association between bubbles and other Intravascular changes?