

Fluid Loading Before Immersed Exercise and Changes in Spirometry as a Screening Test for Susceptibility to Swimming-Induced Pulmonary Edema (SIPE)

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Immersion Pulmonary Edema

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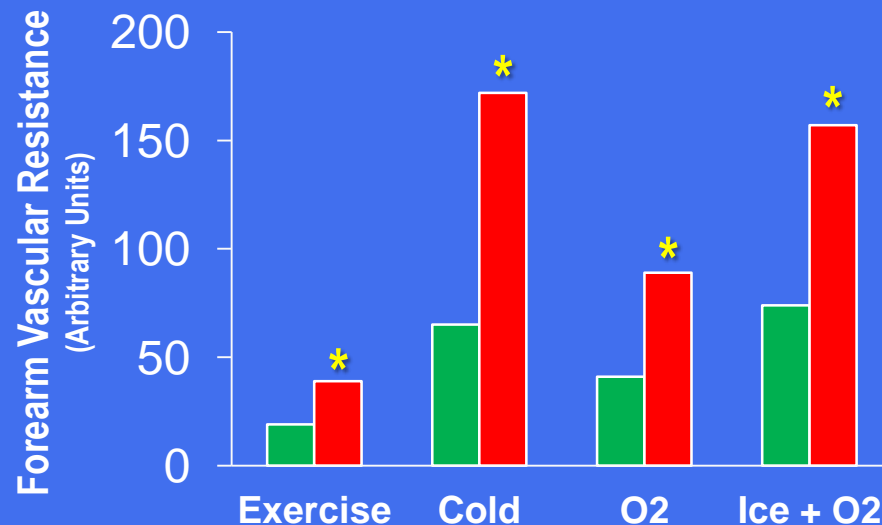
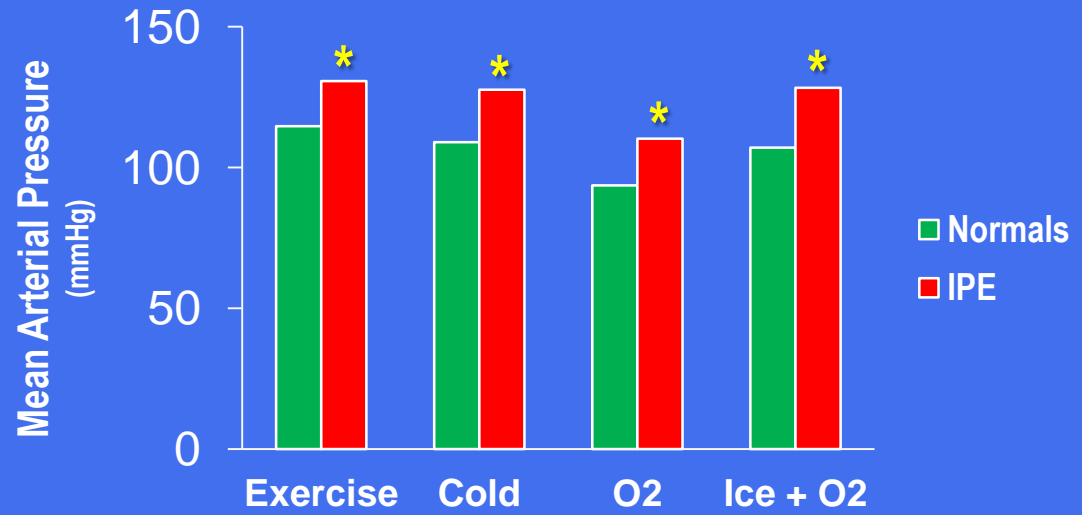
COLD-INDUCED PULMONARY OEDEMA IN SCUBA DIVERS AND SWIMMERS AND SUBSEQUENT DEVELOPMENT OF HYPERTENSION

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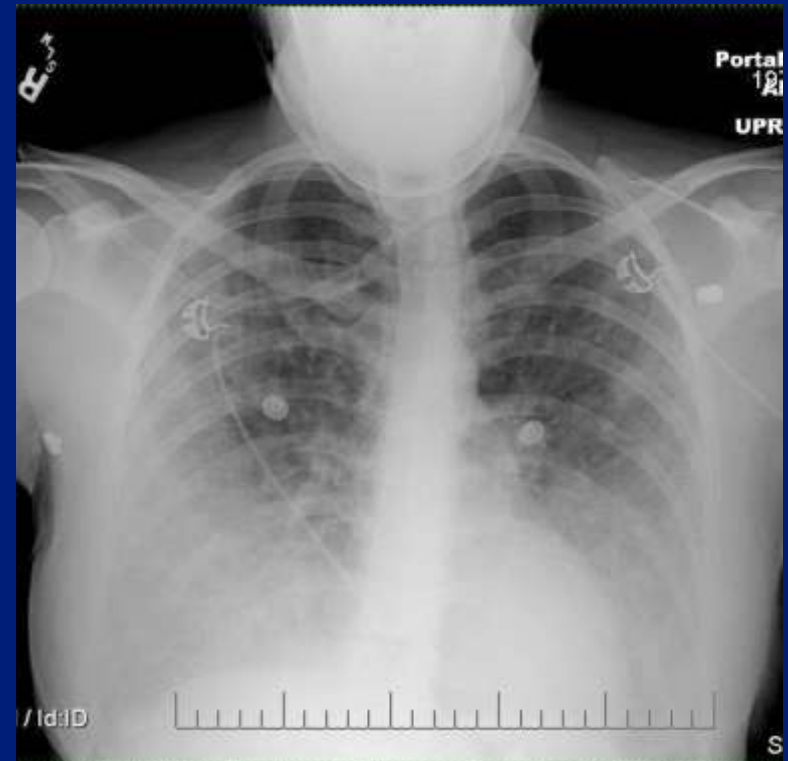
Summary The effect of cold and/or a raised partial pressure of oxygen was examined in eleven people with no demonstrable cardiac abnormality but who had pulmonary oedema when scuba diving or surface swimming, and in ten normal divers. These stimuli induced pathological vasoconstriction in the pulmonary oedema group, nine of whom also showed signs of cardiac decompensation when so stimulated. The pulmonary oedema patients have been followed-up for an average of 8 years. Seven have become hypertensive. Except for the onset of lone atrial fibrillation in one normotensive female diver and development of Raynaud's phenomenon in a normotensive man, there have been no cardiovascular events and no deaths.



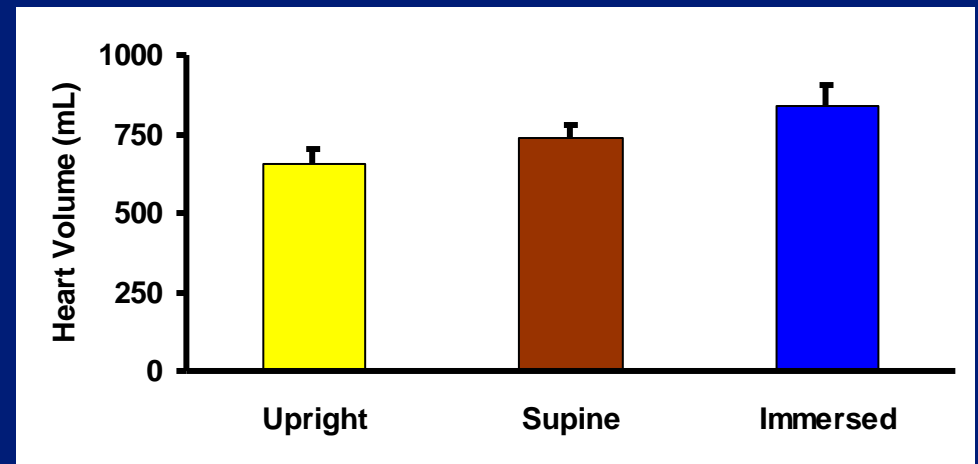
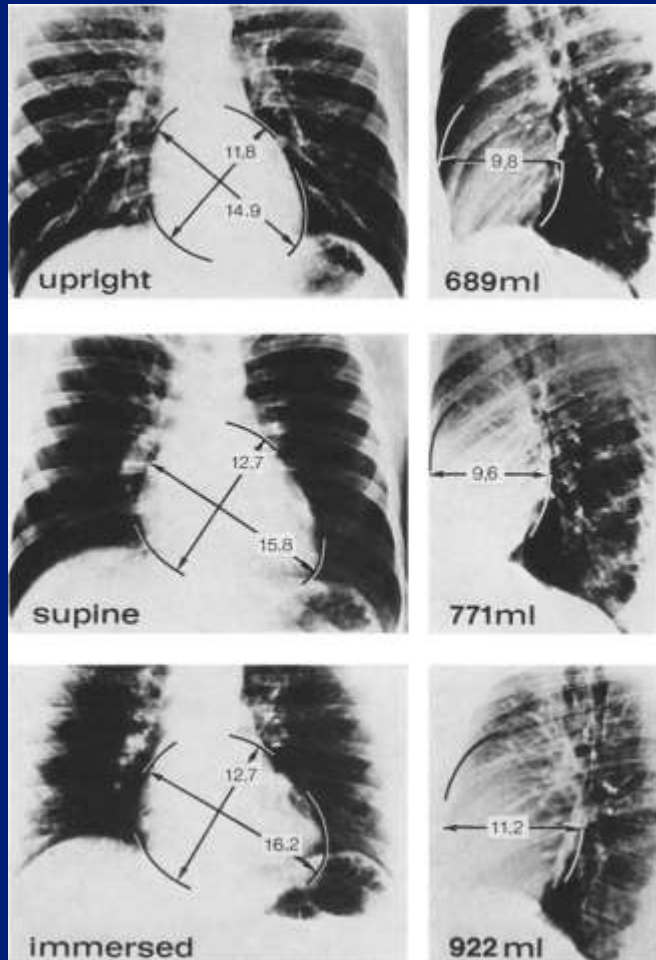
* $P < 0.05$ vs. Normals

Swimming-Induced Pulmonary Edema (SIPE)

- 39 year old healthy female. Training for triathlon: had difficulty in open water swim with fatigue and cough
- Second open water swim in 68°F water. After 200 meters had difficulty breathing, called for help and was rescued. Coughed up copious amounts of blood, EMT called
- SpO₂ 55%, HR 200 bpm
- Admitted to ICU. Slight increase in troponin. Coronary artery CT normal



Heart Volume During Immersion



Lange L, et al. *Pflügers Arch* 352:219, 1974

Introduction

- Prevalence of SIPE in 2.4-3.6 km open sea swimming trials reported as 1.8-60%, depending upon severity (Shupak A. *Respir Physiol* 2000;121:25; Adir Y. *Chest* 2004;126:394)
- Reductions in FVC, FEV₁ and FEF₂₅₋₇₅ have been observed in SIPE-susceptible individuals after a 2.4 km swim (Shupak A. *Respir Physiol* 2000;121:25)
- Risk factors: cold water, heavy exertion, fluid loading (Weiler-Ravell D. *Br Med J* 1995;311:361)
- **Hypothesis:** SIPE-susceptibility can be identified by measuring spirometric values before and after 40 minutes of head-out immersed exercise in cold water with or without fluid loading

Methods

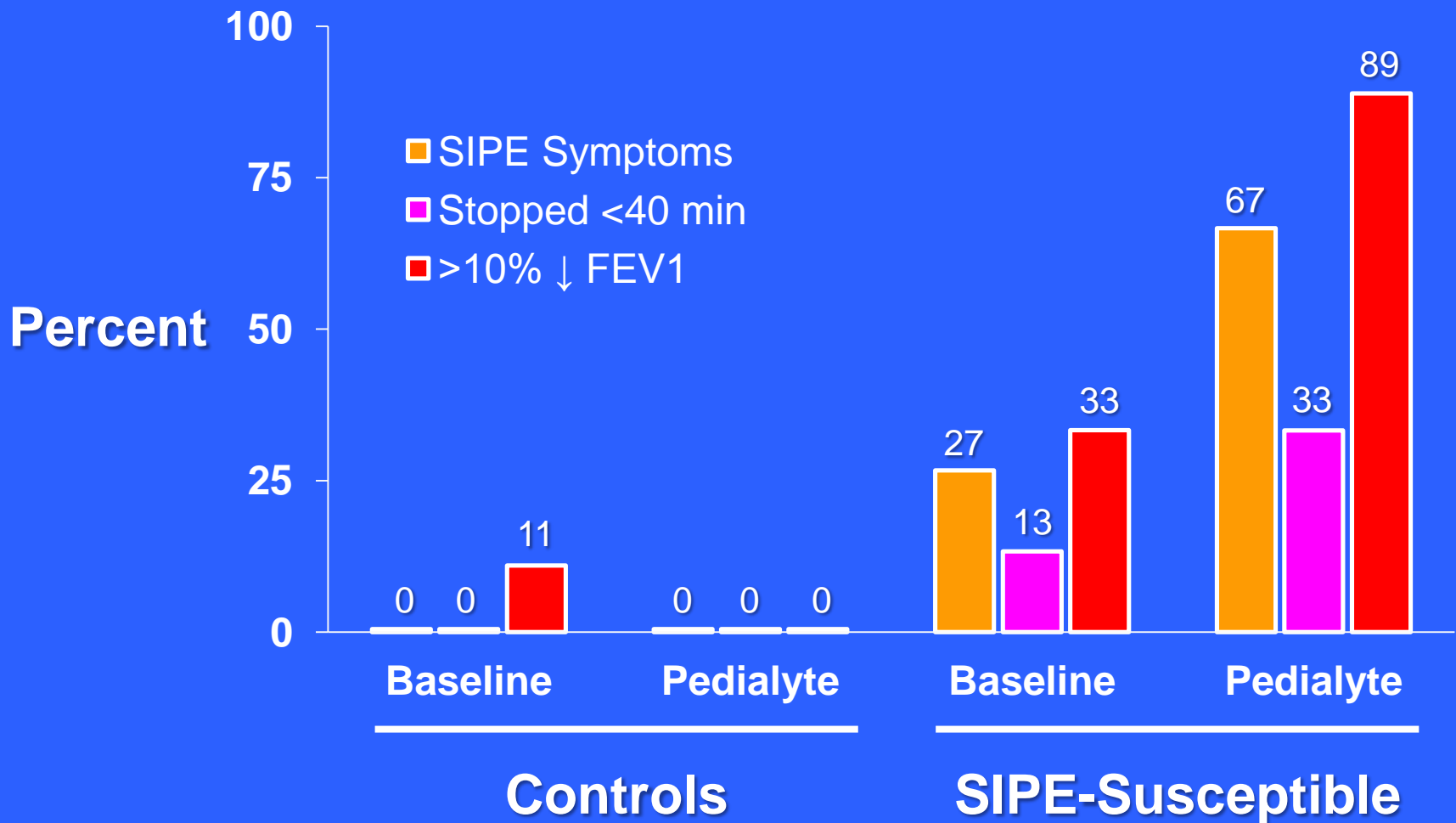
- After institutional approval and informed consent spirometry before and after 40 minutes moderate exercise without thermal protection in 20°C water
- 15 individuals who had experienced one or more SIPE episodes, 45 controls
- Subset of 9 SIPE-susceptible and 12 controls studied on another day after 2 L Pedialyte™ (Na⁺ 45 mEq/L, K⁺ 20 mEq/L, Cl⁻ 35 mEq/L, citrate 30 mEq/L, glucose 139 mM/L, 250 mOsm/kg)
- Fisher's exact test

Demographics

	SIPE-Susceptible	Controls
N	15	46
Age (mean \pm SD, range)	41.9 \pm 8.9, 23-53	26.0 \pm 6.4, 19-50
M/F	2/13	24/22

Activity Precipitating SIPE	N
Triathlon	7
Diving	6
Windsurfing	1
SEAL Training	1
TOTAL	15

Results



Conclusions

Fluid loading with an electrolyte solution increases the risk of developing SIPE. It is therefore recommended that vigorous hydration should be avoided before a competitive swim, e.g. for triathletes and SEAL trainees who may be SIPE-susceptible

A 10% or greater reduction in FEV_1 after a 40 minute exercise and/or SIPE symptoms during exercise in 20°C water after ingesting 2 L of Pedialyte™ is a possible screening test for SIPE susceptibility





Owen Doar



Aaron Walker



Dionne Peacher



Eric Schinazi



Mike Natoli



Ivy Forkner



Anne Cherry



Claire Otteni



Jennifer Fraser



Marty Lynch



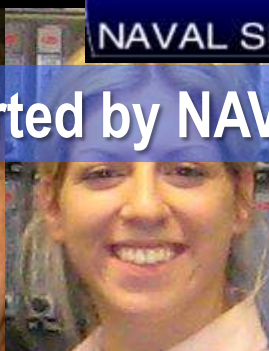
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Rick Roller



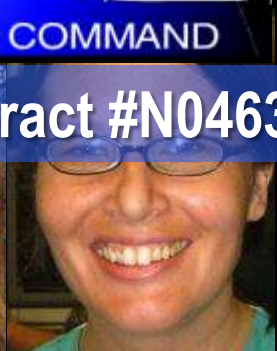
Sonny Boso



**Stefanie
Martina**



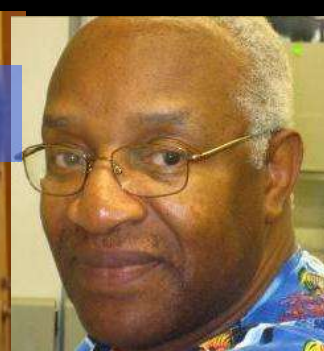
Jenna Wiley



**Dawn
Kernagis**



Shelly Pecorella



Eric Alford