



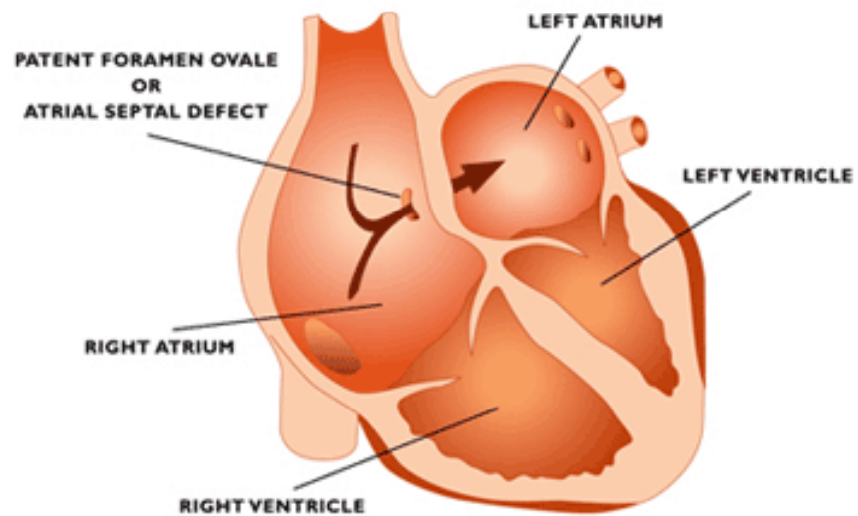
HISTORY OF DIVING AND DECOMPRESSION SICKNESS IN SCUBA DIVERS TESTED FOR PATENT FORAMEN OVALE (PFO) AND PURSUING CLOSURE

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Background

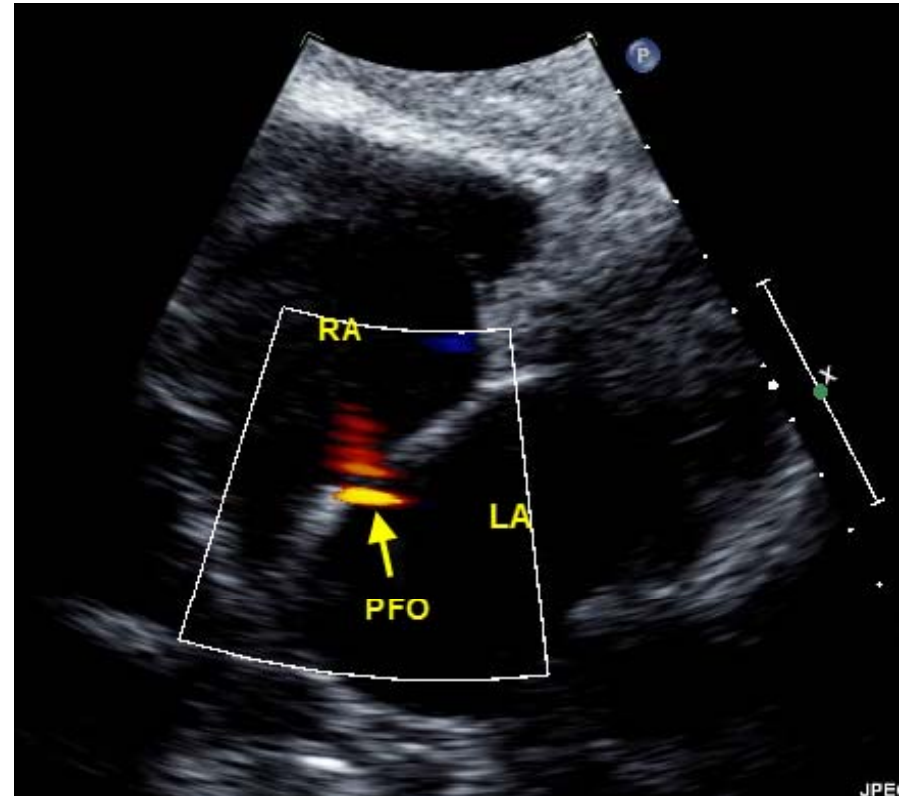
- Patent foramen ovale (PFO) is suspected contributing factor for decompression sickness (DCS).



- There are no formally established indications for either PFO testing or PFO closure for diving.

Purpose of the study

- To explore dive histories of divers tested positive for PFO
- To look for possible reasons for testing and
- To compare divers who underwent closure PFO to those who did not.



Methods

- Retrospective survey of 30 scuba divers diagnosed with PFO in various clinical centers.
- We explored their diving practices , the number of episodes of DCS, manifestations of DCS, and the magnitude of right-to-left shunt.
- Differences between divers who underwent closure and those who did not were tested with Fisher Exact test. Significance was accepted at $p < 0.05$.

Results

PFO test positive divers (all)

- Aggressive dive practice
 - 20 divers practiced frequent deep (>101 fsw) and decompression diving
 - 1 professional diver
 - 8 dove within typical recreational no-decompression limits.

- *“I was diving within non-decompression limits and would have DCS symptoms (about 60x), especially when my tanks were 34% EAN vs. 36% EAN. After a severe bout with skin bends, chokes, and a golf ball sized lump on my left breast, which ultimately receded and left a nasty bruise, I decided I had to have a PFO.”*

— Participant in DAN PFO study

“I often felt completely shuttered--a combination of being incredibly tired, not being able to move, feeling pretty heavy, feeling sick, rough. And, all this often in combination with a headache. I also had quite a few skin bends and other DCI incidents.”

— Participant in DAN PFO study

History of DCS

➤ Repeated episodes of DCS (n=30)

- Repeated episodes - 19
 - 2x to 60x + , median 3
- Single episode - 8
- No previous DCS - 3

DCS Manifestations

➤ Symptoms (n= 30 divers)

• Fatigue	16	• Vision disturbances	10
• Balance	16	• Choking	8
• Vertigo	15	• Skin swelling	7
• Skin itch	14	• Breast pain	7
• Headache	13	• Abdominal pain	6
• N & T	13	• Muscular weakness	5
• Skin mottling	12	• Confusion	5
• Joint pain	12	• Bladder disfunction	4
• Migraine w. aura	11		

DCS Manifestations

➤ Symptom Bundles

- Multi-organ symptoms (skin, cerebral, pulmonary and/or vestibular) – 16
- Single organ symptoms (vestibular [2], skin [2] or spinal cord [2]) - 6
- Ambiguous symptoms (headache, fatigue) – 5

R-S Shunt

- The magnitude of the right-to-left shunt could not be compared due to variation in measurement methods.
- Six divers had either atrial septal defect (ASD [4]) and/or atrial septal aneurysm (ASA [3]).

Closure vs Non-Closure

- 19 out of 30 study participants underwent PFO closure;
 - 14 out of 24 divers with PFO
 - 5 out of 6 divers with ASD or ASA

- Dive practices (eg. depth, time) were *not* significantly different between the two groups.

- Repetitive, multi-organ DCS was more common in the closure group than in the non-closure group (18/19 vs. 4/11, respectively)

Summary

- Study participants dove more aggressively than the average recreational diver.
- The burden of previous DCS in study participants both regarding the nature and frequency of symptoms was significant.
- The most defining characteristic of participants in the closure group vs the non-closure group was a history of repetitive, multi-organ DCS.

What's next?

- We plan to enroll 100 more participants who have been diagnosed with a PFO
- Determine risk-benefit of PFO closure vs just diving more conservatively