

Arterial Gas Embolism in Scuba Divers : A narrative review of mechanisms, risk factors and outcomes

Siddarth Subramaniam, University of Bristol, email – siddarthsubra@gmail.com

Introduction

- Arterial Gas Embolism (AGE) is a rare complication of diving and the 2nd highest contributor to diving fatalities.¹
- Emboli from barotrauma can enter arterial circulation, cause ischaemia through obstruction and cause stroke-like symptoms.
- The evidence is often limited by grouping AGE with Decompression Sickness in measuring risks and outcomes.

Aim

To evaluate the pathophysiology, risk factors and management outcomes specific to diving-related Arterial Gas Embolism.

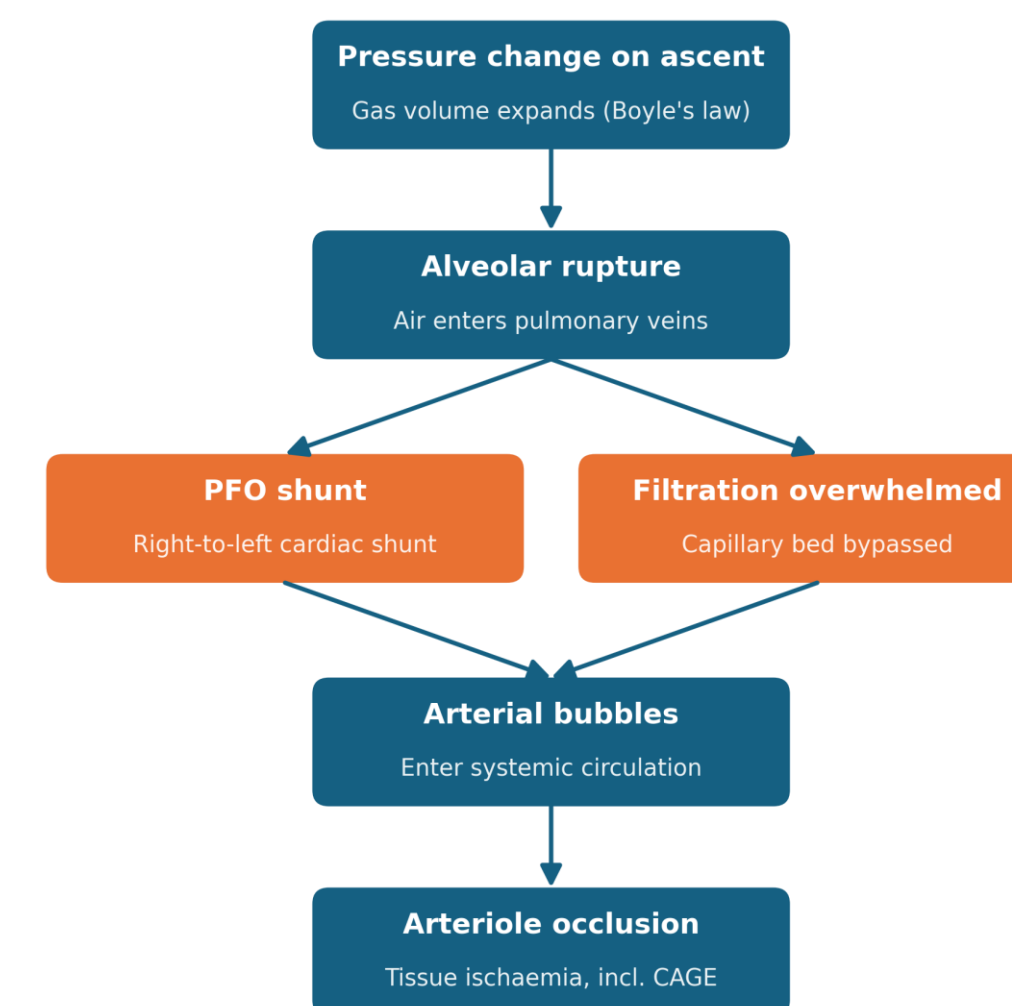
Methods

- PubMed, Ovid and ResearchGate were searched with the terms, "arterial gas embolism", "scuba diving", "diving injury", "decompression sickness".
- Only peer-reviewed, English, human studies were included. Management studies post-1990 were included due to standardised hyperbaric protocols (REF). Studies not distinguishing AGE and DCS were excluded.
- 526 records were identified. 98 were assessed for eligibility, 29 were included.

Results

Mechanisms

- Pulmonary barotrauma from rapid ascent is predominantly the preceding event to introduce emboli.
- The mechanisms for arterialisation include a Patent Foramen Ovale, arteriovenous anastomoses and overwhelming of pulmonary capillary filtration systems.²
- The relative contributions of each remains debated through mainly physiological studies.



Contested / alternative arterialisation pathways

Risk factors and prevention

Evidence strength by risk factor

PFO contribution Limited case control comparative data	Strong
Breath-holding High correlation, supported by physiological studies; limited by reliance on case reports	Strong
Post-dive exertion Physiological studies, small sample sizes	Moderate
Air-trapping diseases Evidence of bubble formation, reliance on case reports	Moderate
Rapid ascent Poor evidence specific to AGE, only for bubble formation	Weak
Repetitive diving Analysis of bubble grade but not symptomatic endpoints	Weak

Diagnosis and outcomes

- AGE is diagnosed clinically by neurological symptoms presenting rapidly upon ascent.⁴
- Radiological scans have poor sensitivity but positive findings warrant immediate intervention.
- Factors such as CK levels are proposed to be prognostic markers with further research.⁵
- Prompt intervention with hyperbaric oxygen is consistently associated with favourable outcomes and neurological recovery.

Limitations

- The evidence is largely derived from observational studies and case reports due to its rarity and mortality leading to limited comparative trials.
- Many studies group AGE with DCS in risk factor and outcome reporting.
- Some studies measure venous bubble burden, not considering arterialisation and symptom-based endpoints.

Conclusion

- AGE is a rare diving-related complication with high mortality risk but favourable outcomes with prompt hyperbaric treatment.
- Its pathophysiology and the contribution of risk factors remains poorly understood.
- Standardised AGE diagnostic criteria and reporting is required to strengthen the evidence base, support prevention and management guidance

Key clinical message :

Early recognition and prompt hyperbaric treatment are strongly associated with positive recovery. The evidence around mechanisms and risk factor evaluation remains uncertain.

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3 - Honěk J, Šrámek M, Šefc L, Januška J, Fiedler J, Horváth M, et al. Effect of catheter-based patent foramen ovale closure on the occurrence of arterial bubbles in scuba divers. JACC: Cardiovascular Interventions [Internet]. 2014 Apr [cited 2026 Aug 10];7(4):403–8. Available from: <https://www.sciencedirect.com/science/article/pii/S1936879814004452>
4 - Vladimír Červenák, Vít Všianský, Cviková M, Brichta J, Vinklárěk J, Jakub Štefela, et al. Cerebral air embolism: Neurologic manifestations, prognosis, and outcome. Frontiers in Neurology. 2024 June 19;15.
5 - Smith RM, Neuman TS. Elevation of serum creatine kinase in divers with arterial gas embolization. New England Journal of Medicine. 1994 Jan 6;330(1):19–24.