Freediving

Freediving, free-diving, free diving, breath-hold diving, or skin diving is a form of underwater diving that relies on breath-holding until resurfacing rather than the use of breathing apparatus such as scuba gear.

Besides the limits of breath-hold, immersion in water and exposure to high ambient pressure also have physiological effects that limit the depths and duration possible in freediving.

Many competitive breath-hold divers use dry apnoea routines to improve their tolerance to hypoxia and hypercapnia, varying the amount of prior hyperventilation and lung volume. When hyperventilating and exhaling to residual volume prior to starting a breath-hold, hypoxia is reached quickly and without too much discomfort from the respiratory drive. Cerebral hypoxia with loss of consciousness (LOC) can easily result.

Valdivia-Valdivia et al. from the Neurosurgery Department, St. Joseph's Hospital, Tampa report on a case where an unsupervised diver used a nose clip that is thought to have interfered with his resumption of breathing after LOC. Consequently, he suffered an extended period of severe hypoxia, with poor ventilation and recovery. He also held his breath on empty lungs; thus, trying to inhale created an intrathoracic sub-atmospheric pressure. Upon imaging at the hospital, severe intralobular pulmonary edema was noted, with similarities to images presented in divers suffering from pulmonary barotrauma of descent (squeeze, immersion pulmonary edema). Describing the physiological phenomena observed in this case highlights the risks associated with unsupervised exhalatory breath-holding after hyperventilation as a training practice in competitive freediving [1].

Decompression illness (DCI) is well known in compressed-air diving but has been considered anecdotal in breath-hold divers. Nonetheless, reported cases and field studies of the Japanese Ama, commercial or professional breath-hold divers, support DCI as a clinical entity. Clinical characteristics of DCI in Ama divers mainly suggest neurological involvement, especially stroke-like cerebral events with sparing of the spinal cord. Female Ama divers achieving deep depths have rarely experienced a panic-like neurosis from anxiety disorders. Neuroradiological studies of Ama divers have shown symptomatic and/or asymptomatic ischaemic lesions situated in the basal ganglia, brainstem, and deep and superficial cerebral white matter, suggesting arterial insufficiency. The underlying mechanism(s) of brain damage in breath-hold diving remain to be elucidated; one of the plausible mechanisms is arterialization of venous nitrogen bubbles passing through right to left shunts in the heart or lungs. Although the treatment for DCI in Ama divers has not been specifically established, oxygen breathing should be given as soon as possible for injured divers. The strategy for prevention of diving-related disorders includes reducing extreme diving schedules, prolonging surface intervals and avoiding long periods of repetitive diving. This review discusses the clinical manifestations of diving-related disorders in Ama divers and the controversial mechanisms [2]

1)
Valdivia-Valdivia JM, Räisänen-Sokolowski A, Lindholm P. Prolonged syncope with multifactorial pulmonary oedema related to dry apnoea training: Safety concerns in unsupervised dry static apnoea. Diving Hyperb Med. 2021 Jun 30;51(2):210-215. doi: 10.28920/dhm51.2.210-215. PMID: 34157738.
2)

Kohshi K, Tamaki H, Lemaître F, Morimatsu Y, Denoble PJ, Ishitake T. Diving-related disorders in commercial breath-hold divers (Ama) of Japan. Diving Hyperb Med. 2021 Jun 30;51(2):199-206. doi: 10.28920/dhm51.2.199-206. PMID: 34157736.