

Pre-hospital triage issue in gastric barotrauma

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Case Report

A 50 year old experienced scuba diver (>1500 dives; called the patient infra) with an instructor level degree started a normal dive accompanied by 2 buddies (normal descent to a depth of 30 meters). In order to equilibrate the inner and outer pressure of the tympanic membrane during his descent the patient swallowed small amounts of compressed air (aerophagia). Because the ear equilibration kept being uneven in one ear, the diver experienced alternate vertigo and one sided ear pain. The combination of these symptoms caused the diver to panic at the depth of 30 meters, 5 minutes after initiating the dive and he made an emergency ascent, far exceeding the maximal allowed ascending speed of 10m per minute. At the surface this emergency ascent caused excruciating epigastric pain and dyspnea. Initial evaluation was done by other experienced divers (which implicates they have basic medical knowledge regarding dive accidents) and a medical doctor who happened to be present:

- A clear and safe
- B tachypnea (50^{/'}); Saturation 97% at FiO₂ 21%; bilateral symmetrical thoracal expansion; hypoventilation; no hemoptoe
- C heart rate 152^{/'}; capillary refill 3 sec.; Non invasive blood pressure (NIBP) not available; normal central and peripheral pulses
- D pupils equal and reactive to light (PEARL); Glasgow coma scale 15/15; no motor or sensory deficit; glycemia not available

In divers training it is emphasized to give additional oxygen with any major diving incident, so 100% oxygen via a non-rebreathing oxygen mask was applied. First responders including an emergency physician (MUG), found the patient in the same condition as aforementioned with additional vital signs NIBP 115/72mmHg and glycemia 103mg/dl. Physical examination showed no signs of an acute abdomen, however the abdominal wall was tense and tender. The patient was transferred to a medical center with an available hyperbaric oxygen therapy (HBOT) but lacking an emergency room (ER), operating room (OR) and intensive care (IC)-unit. In this center the patient was refused because the most adequate care could not be provided and he was sent to the nearest medical center with an ER, OR and IC-unit where he was diagnosed with a stomach perforation caused by barotrauma. Urgent laparotomy was performed and the patient was admitted to the IC-unit for antibiotic treatment and observation.

Pathophysiology and discussion:

In the aforementioned case the pathophysiology is a consequence of the Boyle–Mariotte law (pressure x volume = cte): the swallowed air during the descent of the patient could not escape from the stomach to the mouth or to the intestines in the small time frame of the emergency ascent. This resulted in a quick expansion of the stomach's volume presumably times 4 (depth of 30m below surface where surrounding pressure is 4 atm. compared to the 1 atm. at the surface). This caused a

stomach wall rupture and tense and tender abdominal wall in combination with the excruciating pain. At first evaluation on the diving site, intestinal decompression sickness was hypothesized and because of this reason an emergency transfer was made to a medical center with a HBOT.

The prevalence of diving incidents worldwide ranges from 7 to 35 injuries per 10 000 divers ranging from minor (e.g. mask squeeze) to major (e.g. decompression sickness and pulmonary barotrauma) and possibly death (e.g. drowning or sudden heart death) [1]. Because of the altered physics, diving incidents have a number of very specific syndromes and etiologies. Because these are rare, it is difficult for first responders to triage these patients correctly pre-hospital. Only a few case reports about gastro-intestinal barotrauma have been published [2] [3]. Direct consequences of a gastric barotrauma are haemodynamic instability (blood loss secondary to the gastric wall perforation) and cerebral arterial gas embolism (CAGE), both which can have serious consequences if not diagnosed in an early stage of the incident and preferably at the scene [4] to avoid severe and delayed consequences [5].

Conclusion:

Diving incidents can cause symptoms ranging from minor to major pathologies and possibly death. Frequently the morbidity and mortality is time sensitive so a correct pre-hospital triage will make a difference in the outcome of the patient as shown by this case report. This case demonstrates that every gas containing volume in the human body is susceptible to barotrauma. Future research could aim towards a comprehensible flowchart for first responders in order to make an easy to assess but correct triage pre-hospital.

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