



CASE REPORT

Acute ischemic colitis during scuba diving: Report of a unique case

Konstantinos Goumas, Androniki Poulou, Ioannis Tyrmipas, Dimitrios Dandakis, Stavros Bartzokis, Magdalini Tsamouri, Kalipso Barbati, Dimitrios Soutos

Konstantinos Goumas, Androniki Poulou, Ioannis Tyrmipas, Dimitrios Dandakis, Stavros Bartzokis, Dimitrios Soutos, Department of Gastroenterology, Red Cross Hospital of Athens, Athens, Greece

Magdalini Tsamouri, Kalipso Barbati, Department of Pathology, Red Cross Hospital of Athens, Athens, Greece

Author contributions: Goumas K organised the whole manuscript and supervised the process, Poulou A performed the colonoscopy, Tyrmipas I and Dandakis D organised the patient data and figures, Bartzokis S helped write and correct the manuscript, Barbati K and Tsamouri M were the pathologists that examined patient biopsies and Soutos D is the director of the Gastroenterology department.

Correspondence to: Dimitrios Dandakis, Department of Gastroenterology, Red Cross Hospital of Athens, Ochis 12, 11522 Athens, Greece. ddandakis@yahoo.com

Telephone: +30-6944798901 Fax: +30-210-8215277

Received: November 7, 2007 Revised: March 19, 2008

Accepted: March 26, 2008

Published online: May 28, 2008

Decompression sickness; Ischemic colitis; Scuba diving

Peer reviewer: Luis Rodrigo, Professor, Gastroenterology Service, Hospital Central de Asturias, c/Celestino Villamil, s.n., Oviedo 33.006, Spain

Goumas K, Poulou A, Tyrmipas I, Dandakis D, Bartzokis S, Tsamouri M, Barbati K, Soutos D. Acute ischemic colitis during scuba diving: Report of a unique case. *World J Gastroenterol* 2008; 14(20): 3262-3265 Available from: URL: <http://www.wjgnet.com/1007-9327/14/3262.asp> DOI: <http://dx.doi.org/10.3748/wjg.14.3262>

INTRODUCTION

Diving is a difficult underwater activity in which environmental conditions can affect body structure and function. Barotrauma is caused by compression during descent or expansion during ascent, of the gas filled spaces of the body and it may be associated with pneumothorax, pneumomediastinum and embolism. Decompression sickness may occur when gas, which has dissolved in tissues at depth, eventually produces bubbles which occasionally result in severe cardiorespiratory and neurological emergencies^[1].

Approximately 13% of divers complain of gastrointestinal disturbances upon ascent, while most of them present as aerophagy^[2]. Rarer, more severe diving-associated gastrointestinal manifestations have been reported in the literature, including a few cases of gastrointestinal barotraumas, mainly gastric rupture^[3-6] and a case of small bowel infarction due to thrombosis of mesenteric veins^[7]. We describe a clinical case of ischemic colitis in a 27-year-old male admitted to our emergency department, who manifested abdominal pain while he was in the process of scuba diving 20 meters undersea, followed by bloody diarrhoea as soon as he ascended to sea level. Taking into account his past medical history, the thorough impeccable clinical and laboratory examinations and presence of no other factors predisposing to ischemia of the colon, we assume that a possible relationship between the diving conditions and the pathogenesis of ischemic colitis may exist. This case, is as far as we know, the first report relating scuba diving with acute ischemic colitis.

Abstract

The presentation of clinical symptoms due to decompression during diving, varies significantly, as mainly minor disturbances for the gastrointestinal tract in particular have been reported. The following case debates whether diving can cause severe symptoms from the gastrointestinal system. We describe a clinical case of ischemic colitis presented in a 27-year-old male, who manifested abdominal pain while in the process of scuba diving 20 meters undersea, followed by bloody diarrhoea as soon as he ascended to sea level. Taking into account his past medical history, the thorough, impeccable clinical and laboratory examinations and presence of no other factors predisposing to ischemia of the colon, we assume that a possible relationship between diving conditions and the pathogenesis of ischemic colitis may exist. This unusual case might represent a hematologic manifestation of decompression sickness, due to increased coagulability and/or transient air emboli, occurring during a routine scuba diving ascent to sea level.

© 2008 The WJG Press. All rights reserved.

Key words: Air emboli; Barotraumas; Coagulability;

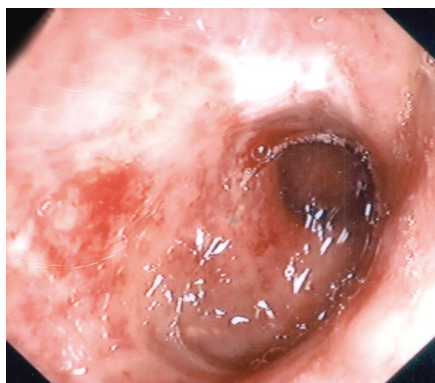


Figure 1 Endoscopic image of patient's ischemic colitis.

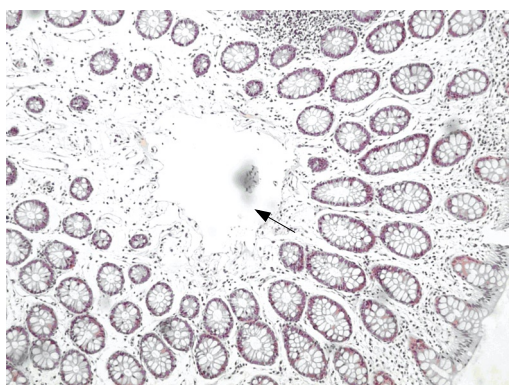


Figure 2 HE staining of colonic mucosa with an air bubble in the lamina propria (arrow).

CASE REPORT

A 27-year-old male novice scuba diver came to the emergency department of our hospital, accompanied by his father, suffering from lower abdominal pain with concurrent bloody diarrhoea. He reported that 2 h earlier, he was submerged for approximately 5 min at a depth of 20 meters when he experienced an acute and intense lower abdominal pain with a simultaneous urge to defecate. Further, he insisted that although under stress, his ascent had been completely normal, under control and in accordance with a scheduled dive plan. Immediately after reaching the surface, he had two loose bowel movements followed by bloody diarrhoea and tenesmus. Our patient was a non-smoker, was taking no medication, and his past medical history was limited to a known Gilbert's syndrome. When admitted to the accident and emergency department his vital signs were: blood pressure of 120/80 mmHg, pulse rate of 72 bpm and respiratory rate of approximately 12 breaths/min. Physical examination revealed a moderate abdominal tenderness at the left lower quadrant and a mild abdominal distention, while per rectum examination confirmed the presence of fresh blood in the lumen with no other apparent physical signs of clinical importance detected.

Laboratory results were: Hematocrit (HCT): 47.1%, white cell counts (WCC): 7.800/ μ L with 63%

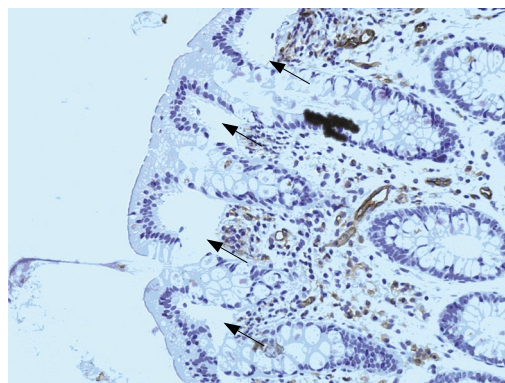


Figure 3 Immunohistochemistry for CD31 revealing lack of staining in the areas of air bubbles in the lamina propria (arrows).

neutrophils, 27% lymphocytes, 7% monocytes and 3% eosinophils, platelet (PLT): 236.000/ μ L, total-bilirubin: 2.73 mg/dL, Direct-bilirubin: 0.25 mg/dL and serum lactic dehydrogenase: 223 U/L. Coagulation tests including prothrombin time (PT), international normalized ratio (INR), activated partial thromboplastin time (APTT), fibrinogen, protein S, protein C, antithrombin III and V leiden factor were in the normal range. Urea and electrolytes, antiphospholipid antibodies, serum amylase, blood gases and all other tests including urine analysis were also normal. Chest and abdominal X-rays plus ultrasound examination of both upper and lower abdomen did not reveal any pathological findings. Colonoscopy, with inspection of the terminal ileum, performed 24 h later, revealed an edematous mucosa of the sigmoid colon in extent of 20 cm, with redness, superficial ulcerations and submucosal haemorrhages (Figure 1). The histological study of specimens taken from the affected area showed findings compatible with ischemic colitis, while the pathologist noticed presence of air in the lamina propria but not intravascularly (Figures 2 and 3). No air was detected in the colon wall by magnetic resonance tomography performed 2 d after admission.

The patient recovered uneventfully with bloody diarrhoea ceasing a few hours after admission and abdominal pain progressively diminishing till disappearance in 48 h. The patient was discharged with complete comeback 4 d after admission. The follow-up colonoscopy two mo later showed complete endoscopic and histologic healing of the mucosa (Figure 4) with the patient free of any clinical symptoms.

DISCUSSION

Abdominal discomfort and belching due to air swallowing are quite frequent manifestations during diving, with more severe gastrointestinal complications scarcely described. Gastric rupture due to expansion of intra-gastric air during a quick ascent to sea level has been described in a few case reports^[3-6]. Massive pneumoperitoneum without rupture of an abdominal hollow viscous organ, possibly caused by lung

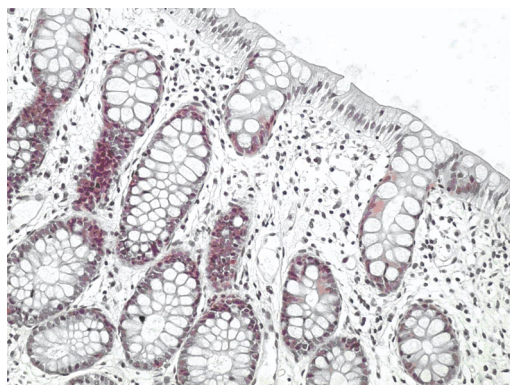


Figure 4 HE staining of normal histologic appearance of our patient's colonic mucosa, 2 mo after the ischemic colitis episode.

barotrauma has also been reported^[8]. Gertler *et al* have presented a case of mesenteric vein thrombosis as a unique complication of decompression sickness^[7]. Finally, we must emphasize that a confirmed case of acute ischemic colitis in association with scuba diving has never been reported.

In our case, the patient's clinical manifestations of ischemic colitis initiated with acute abdominal pain while at a depth of 20 meters under sea, progressing to bloody diarrhoea on the surface. Several environmental parameters during diving can alter body function and structure^[1], as for approximately every 10 meters of descent in sea water ambient pressure increases by 100 kPa (1 bar). The air trapped in body cavities including the gastrointestinal tract, is therefore subjected to compression during descent and expansion during ascent to sea level, which may lead to tissue damage such as gastric rupture^[3-6]. Decompression sickness occurs when the partial pressure of gas trapped in the hollow cavities of the body raises in direct proportion to the increase in ambient pressure. This leads to large volumes of inert gas, mainly nitrogen, which dissolve in tissues while at depth transforming to bubbles during ascent to sea level. In addition breathing workload increases due to a combination of increased gas density, increased hydrostatic pressure and altered respiratory mechanisms. Finally, a number of unpredictable events such as malfunction of a diving equipment or technical issues, as well as panic attacks or hypothermia of the diver, may increase the existing physical and/or psychological stress. In our case, except for the arduous and stress inducing conditions during underwater activity, other factors predisposing to ischemic colitis were not identified.

Our patient's past medical history was free of thrombotic events whilst complete examination and evaluation of the patient, including specific blood tests, did not reveal any type of coagulopathy. On the other hand, the pathophysiologic mechanism of decompression sickness could predispose to vascular obstruction and venous infarction^[9]. The partial pressure of body gases increases during a scuba dive, resulting in a time-dependent concentration of mainly nitrogen in body fluids and tissues. Bubbles can be formed during

ascent due to rapid decrease of barometric pressure. Bubbles are formed predominately in the venous circulation, although in overwhelming decompression sickness they can be found in the arterial circulation also^[10], causing vascular obstruction due to coalition. Although bubble formation is considered as the causative mechanism of decompression sickness, a series of hematological disorders leading to a hypercoagulable state have been described^[9,11]. *In vitro* experiments concluded that increased vascular permeability, vascular obstruction due to fat emboli and interaction of the bubble surface with the cellular elements of the blood, may contribute to the pathogenesis of decompression sickness^[9,12]. Mesenteric vein thrombosis^[7], retinal artery occlusion^[13] and vascular obstruction due to fat emboli^[14], have previously been reported as unique complications of decompression sickness. The presence of trapped air in the lamina propria, likely of intravascular origin, demonstrated in biopsies taken from the colonic area with ischemic lesions, supports the thesis that decompression sickness was the main cause of our patient's colonic ischemia. Vascular bubbles and bowel wall congestion are the visceral changes described in decompression sickness^[15]. It has recently been reported that magnetic resonance imaging (MRI) may be superior to autopsy in the demonstration of gas in intraparenchymal blood vessels of internal organs^[16]. Our patient's MRI scan didn't reveal any intravascular air bubbles, which can be attributed to the 48 h delay between the scan and the onset of the acute episode. Finally, a procedure that may lead to rapid alleviation of decompression sickness symptoms^[3,6,8] is recompression, which in our case was not implemented due to the rapid clinical improvement and complete recovery of the patient.

In conclusion, this unusual case emphasizes the probability that scuba diving can cause colonic ischemia, even in young patients with no known coagulation disorders or other factors predisposing to colonic ischemia.

REFERENCES

- 1 **Goddard D**, Currie G, Denison D, Farrell P, Ross J, Stephenson R, Watt S, Wilmshurst P. British Thoracic Society guidelines on respiratory aspects of fitness for diving. *Thorax* 2003; **58**: 3-13
- 2 **Lundgren CE**, Ornhagen H. Nausea and abdominal discomfort--possible relation to aerophagia during diving: an epidemiologic study. *Undersea Biomed Res* 1975; **2**: 155-160
- 3 **Hunter JD**, Roobottom CA, Bryson PJ, Brown C. Conservative management of gastric rupture following scuba diving. *J Accid Emerg Med* 1998; **15**: 116-117
- 4 **Hayden JD**, Davies JB, Martin IG. Diaphragmatic rupture resulting from gastrointestinal barotrauma in a scuba diver. *Br J Sports Med* 1998; **32**: 75-76
- 5 **Haller C**, Guenot C, Azagury D, Rosso R. [Intestinal barotrauma after diving--mechanical ileus in incarceration of the last loop of the small intestine between a mobile cecum and sigmoid] *Swiss Surg* 2003; **9**: 181-183
- 6 **Petri NM**, Vranjkovic-Petri L, Aras N, Druzijanic N. Gastric rupture in a diver due to rapid ascent. *Croat Med J* 2002; **43**: 42-44

- 7 **Gertler SL**, Stein J, Simon T, Miyai K. Mesenteric venous thrombosis as sole complication of decompression sickness. *Dig Dis Sci* 1984; **29**: 91-95
- 8 **Oh ST**, Kim W, Jeon HM, Kim JS, Kim KW, Yoo SJ, Kim EK. Massive pneumoperitoneum after scuba diving. *J Korean Med Sci* 2003; **18**: 281-283
- 9 **Philp RB**. A review of blood changes associated with compression-decompression: relationship to decompression sickness. *Undersea Biomed Res* 1974; **1**: 117-150
- 10 **Catchpole HR**, Gersh I. Pathogenic factors and pathological consequences of decompression sickness. *Physiol Rev* 1947; **27**: 360-397
- 11 **Philp RB**, Ackles KN, Inwood MJ, Livingstone SD, Achimastos A, Binns-Smith M, Radomski MW. Changes in the hemostatic system and in blood and urine chemistry of human subjects following decompression from a hyperbaric environment. *Aerosp Med* 1972; **43**: 498-505
- 12 **Levin LL**, Stewart GJ, Lynch PR, Bove AA. Blood and blood vessel wall changes induced by decompression sickness in dogs. *J Appl Physiol* 1981; **50**: 944-949
- 13 **Hsu AA**, Wong TM, How J, Tan J, Tan KT. Retinal artery occlusion in a diver. *Singapore Med J* 1992; **33**: 299-301
- 14 **Kitano M**, Hayashi K. Acute decompression sickness--report of an autopsy case with widespread fat embolism. *Acta Pathol Jpn* 1981; **31**: 269-276
- 15 **Waller SO**. Autopsy features in scuba diving fatalities. *Med J Aust* 1970; **1**: 1106-1108
- 16 **Plattner T**, Thali MJ, Yen K, Sonnenschein M, Stoupis C, Vock P, Zwygart-Brugger K, Kilchor T, Dirnhofer R. Virtopsy-postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) in a fatal scuba diving incident. *J Forensic Sci* 2003; **48**: 1347-1355

S- Editor Sun YL L- Editor Lalor PF E- Editor Lu W