

# Retroperitoneal extensive free air bubbles due to decompression illness

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## ABSTRACT

Decompression illness (DCI) is a rare condition caused by air bubbles that arise because of a rapid decrease in ambient pressure. These air bubbles exert both physical and chemical effects associated with a range of findings from asymptomatic clinical presentation to death. In the literature, changes in consciousness, severe musculoskeletal and abdominal pain, respiratory distress, and skin changes have been described. The diagnosis of DCI is difficult, but anamnesis and physical examination are helpful. Radiologic evaluation is useful for determining possible complications in patients with severe disease and excluding other acute pathologies. In computed tomography (CT) images of patients diagnosed with DCI, air bubbles in the portal venous system, iliac and mesenteric veins, the vena cava inferior (VCI), and the cerebral and spinal arteries have been described before. Herein, we present the clinical and CT findings of two cases of DCI with extensive intra-abdominal free bubbles evident on abdominal CT.

**Keywords:** Abdominal pain; computed tomography; decompression illness; free air bubbles.

## INTRODUCTION

Decompression illness (DCI) is a rare condition caused by air bubbles form using inert gas supersaturation (most commonly nitrogen and helium) because of the rapidly decreasing external pressure. DCI may cause various symptoms due to its effects on the musculoskeletal, hepatobiliary, pulmonary, cardiac, and central nervous systems.<sup>[1]</sup> Although rapid and effective treatment allows recovery in most patients, DCI may cause sequelae or death in some patients.<sup>[2]</sup>

In computed tomography (CT) images of patients diagnosed with DCI, air bubbles in the portal venous system, iliac and mesenteric veins, the vena cava inferior (VCI), and the cerebral and spinal arteries have been described in the literature.<sup>[3]</sup> In addition, osteonecrosis, pneumothorax and subcutaneous emphysema have been reported in those with DCI.<sup>[4]</sup>

Herein, we present the clinical and CT findings of two cases of DCI with intra-abdominal free bubbles evident on abdominal CT. To our knowledge, intra-abdominal free bubbles associated with DCI have not been reported in the literature.

## CASE REPORT

**Case 1** – A 37-year-old male patient presented to the emergency department with extensive abdominal and left shoulder pain after self-contained underwater breathing apparatus (SCUBA) diving. On anamnesis, he reported performing three dives to a depth of about 50 m over 45 min and developed pain about half an hour after the last dive. On physical examination, he was conscious, cooperative and oriented. The vital signs were stable and there were no significant findings on abdominal examination. Given the severe abdominal pain that rendered physical examination impossible, the patient underwent contrast-enhanced abdominal

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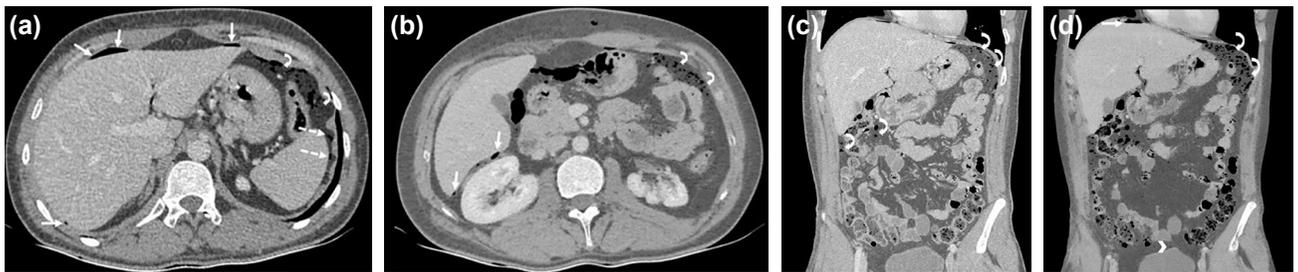
CT. The CT images showed millimeter-sized air bubbles in the perihepatic and perisplenic regions and in fatty tissue between intestinal segments (Fig. 1). Air bubbles were also detected in the retroperitoneal region, around the bladder, and near the vascular structures accompanying fatty tissue heterogeneity (Fig. 1). As a result of his anamnesis and the CT and clinical findings, the patient was diagnosed with DCI and referred for hyperbaric oxygen therapy (HBOT). After HBOT, his symptoms resolved, and all air bubbles were disappeared on the following CT. The patient's consent was obtained for this study.

**Case 2** – A 41-year-old male professional SCUBA diver was brought to the emergency department by ambulance due to abdominal pain and general weakness that had occurred after SCUBA diving. In his anamnesis, he reported that he had been diagnosed with DCI four years ago and had been treated using HBOT and recovered without any sequelae. On physical examination, the patient was conscious, cooperative, and oriented. His vital findings were stable. Abdominal examination revealed rebound tenderness in all quadrants. Based on these findings, the patient was diagnosed with DCI and underwent contrast-enhanced abdominal CT to exclude other possible acute abdominal pathologies. CT examination revealed air bubbles in the intraperitoneal region near the subdiaphragm and mesentery (Fig. 2). He was diagnosed with DCI and referred for HBOT. The radiologic findings regressed on the following CT. The patient's consent was obtained for this study.

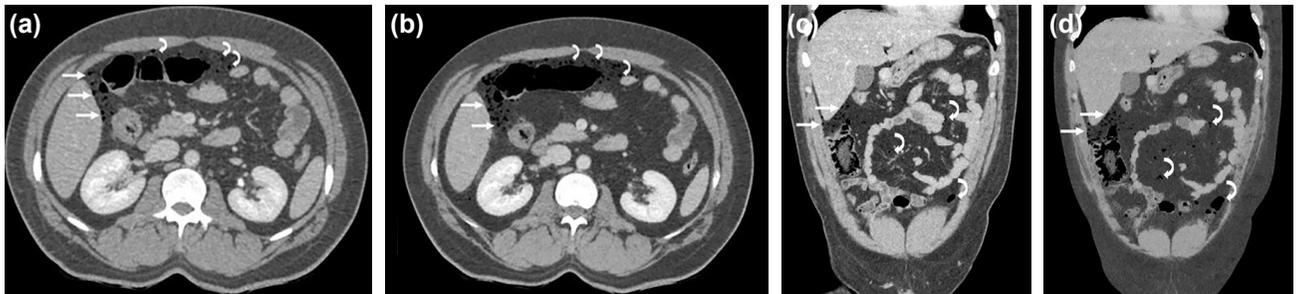
## DISCUSSION

Despite many preventative efforts and technological advances, DCI remains a severe condition; the risk of occurrence is 0.02% per dive and DCI is most often seen in SCUBA divers. [1] DCI is classified as arterial gas embolism (AGE) or decompression sickness (DCS). In AGE, pulmonary barotrauma damages the alveolar capillaries such that alveolar air passes into the vascular lumen. AGE may cause acute loss of function in the target organ. DCS is divided into two subgroups: DCS types I and II. DCS type I is more common and the clinical course is better. Generally, the musculoskeletal system and skin are affected. DCS type II is associated with more severe clinical findings and a poorer prognosis than type I. Pulmonary symptoms, hypovolemic shock, and sensory and motor loss are frequently encountered.

The diagnosis of DCI is difficult, but anamnesis and physical examination are helpful. Radiologic evaluation is useful to determine possible complications in patients with severe disease and exclude other acute pathologies. In patients with diagnoses of DCI, portal Doppler ultrasound and echocardiography are the first choices for gas evaluation of the portal venous system. As CT has the advantages of rapidity and high sensitivity, it is the first choice for detection of AGE and may reveal lung parenchyma, pneumothorax, and intraabdominal solid organ damage, as well as exclude other acute pathologies. Magnetic resonance imaging is preferred when evaluating the central nervous system, being superior to CT for detecting acute ischemia.



**Figure 1.** Axial (a) axial reformatted minimum intensity projection (MinIP) (b), coronal (c), and coronal reformatted MinIP (d) contrast-enhanced abdominal computed tomography (CT) revealed millimeter-sized air bubbles in the perihepatic (long white arrows) and perisplenic (dashed white arrow) regions, and fatty tissue between intestinal segments (curved white arrows). Air bubbles were also detected in the retroperitoneal region and around the bladder (arrowhead), accompanied by fatty tissue heterogeneity.



**Figure 2.** Axial (a) axial reformatted MinIP (b), coronal (c), and coronal reformatted MinIP (d) contrast-enhanced abdominal CT showed free air bubbles in the perihepatic (long white arrows) and perisplenic (dashed white arrow) regions and in fatty tissue between intestinal segments (curved white arrows).

As DCI is rare, consensus treatment protocols have not yet been established. Based on the case series and animal models, high-pressure 100% oxygen is the basic treatment.<sup>[5]</sup> Of all patients, 80% recover completely, 15% have sequelae and 5% die.<sup>[2]</sup>

In conclusion, DCI is a severe condition, presenting with a wide spectrum of symptoms depending on the system affected.<sup>[6]</sup> CT examination sensitively detects AGE and can be used to evaluate the lung parenchyma, pneumothorax, and extent of intraabdominal solid organ damage; CT also excludes other acute pathologies.

**Informed Consent:** Written informed consent was obtained from the patients for the publication of the case report and the accompanying images.

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I.B.A.; Critical revision: C.A., M.S.

**Conflict of Interest:** None declared.

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## OLGU SUNUMU - ÖZET

### Dekompresyon hastalığına bağlı oluşan intraperitoneal ve retroperitoneal alanda serbest hava kabarcıkları

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Dekompresyon hastalığı (DKH), ortama basıncındaki hızlı düşüşe bağlı ortaya çıkan hava kabarcıklarının neden olduğu nadir bir durumdur. Bu hava kabarcıkları hem fiziksel hem de kimyasal etkiler göstererek, semptomsuz klinik prezentasyondan ölüme dek geniş bir spektrumda bulgulara neden olabilir. Literatürde DKH ile ilişkili olarak; bilinç değişiklikleri, kas-iskelet sisteminde ve karında şiddetli ağrı, solunum sıkıntısı ve cilt değişiklikleri tariflenmiştir. DKH tanısını koymak zordur ancak tanıda öykü ve fizik muayene yol göstericidir. Radyolojik değerlendirme, DKH tanılı hastalarda olası komplikasyonları belirlemek ve karın içi serbest hava kabarcıklarına yol açan diğer akut patolojileri dışlamak için yararlıdır. DKH tanısı konan hastaların bilgisayarlı tomografi (BT) görüntülerinde, portal venöz sistem, iliak ve mezenterik venler, vena kava inferior (VCI) ve serebral ve spinal arterlerde hava kabarcıkları daha önce tariflenmiştir. Bu yazıda, abdominal BT’de belirgin olan karın içi serbest hava kabarcıkları görülen iki DKH olgusunun klinik ve BT bulguları sunuldu.

**Anahtar sözcükler:** Bilgisayarlı tomografi; dekompresyon hastalığı; karın ağrısı; serbest hava kabarcıkları.

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