The Journal of TRAUMA® Injury, Infection, and Critical Care

Gastric and Omental Incarceration through an Occult Traumatic Diaphragmatic Hernia in a Scuba Diver

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J Trauma. 2002;52:146–148.

Scuba (self-contained underwater breathing apparatus) diving is one of the most rapidly growing pastimes and remains a high-risk sport. The diver swims in a denser environment than air, with pressure variations of 1 bar every 10 m depth in fresh water. The case of a gastric and omental incarceration through an occult traumatic diaphragmatic hernia in a fit young scuba diver is reported.

CASE REPORT

A 31-year-old male in good physical condition was diving in fresh water at a depth of 12 m. After a routine ascent from this depth, he had to swim with effort against a strong current for 15–20 minutes to reach shore. He used backstroke while still breathing through his mouth piece. After a couple of hours, he developed epigastric discomfort and dizziness. Before diving he consumed neither alcohol nor any other carbonated liquid. Similar symptoms had been noted after a similar dive 2 months ago and had resolved spontaneously. During the night, his complaints worsened and he was hospitalized early in the morning.

Clinical examination was normal with the exception of abdominal pain at palpation. Laboratory testing and ultrasound were also normal. A plain chest x-ray showed left sided pleural effusion and nonvisualization of the left diaphragm (Fig. 1). After 24 hours, the patient was still experiencing pain, and a chest x-ray demonstrated an increased pleural effusion. The IV contrast-enhanced thoracoabdominal CT scan demonstrated a near completely obliterated left thoracic cavity. Furthermore, there was a deconfiguration of the diaphragm on the left side, a pleural effusion, an intrathoracic fluid-and-air–containing, walled, and fat-containing structure compressing the ipsilateral lung and displacing the mediastinum to the right (Fig. 2). After introduction of a nasogastric tube (the part of which seemed normal) and administration of contrast liquid, the stomach was shown to be infradiaphragmatic, but with atypical morphology. During these 24 hours, the patient's hemoglobin fell from 158 to 134 g/L, and in the afternoon he developed severe dyspnea. The chest x-ray then demonstrated a white left lung with a midline shift of the mediastinum to the right. Left lateral thoracotomy was performed and a two-thirds necrotic stomach with a necrotic omentum majus were diagnosed (Fig. 3). The right anterior part of the diaphragm showed an old rupture of 5 cm size. Laparotomy was necessary to resect the necrotic stomach and a Roux-en-Y reconstruction was performed. The diaphragmatic defect was closed. The patient made an uneventful postoperative recovery.

DISCUSSION

In relation to gas, two types of diving complications are known: N_2 saturation of the body and its well known but rarely explained consequences, and barotrauma (tissue injury resulting from the failure of a gas-filled body to balance its internal pressure against changes in the environmental pressure). The rapid pressure fall during ascent leads to gas retention, which can be measured by the Boyle-Mariotte law (pressure $\times$ volume $=$ constant). Failure to release the ex-

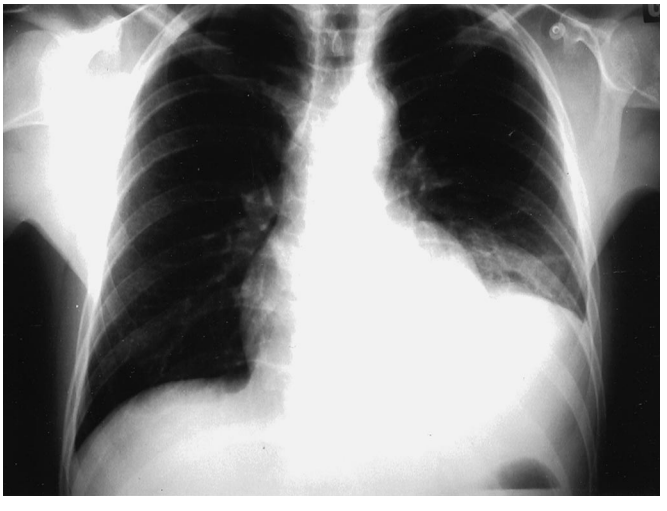

Fig. 1. *Plain chest x-ray showing a left sided pleural effusion and nonvisualization of the left diaphragm. The gastric air bubble seems to be infradiaphragmatic.*

Submitted for publication September 15, 2000.
Accepted for publication August 8, 2001.

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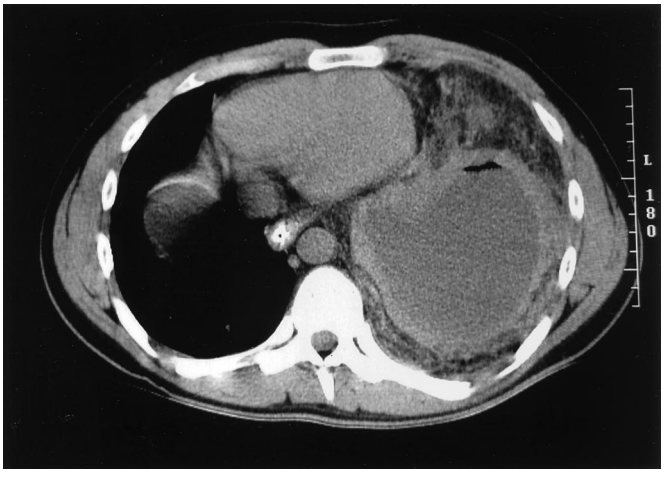

Fig. 2. *Abdominal CT scan. Pleural effusion on the left side with an intrathoracic fluid-and-air–containing, walled structure as well as a fat-containing structure compressing the ipsilateral lung and displacing the mediastinum to the right. The nasogastric tube is in place.*

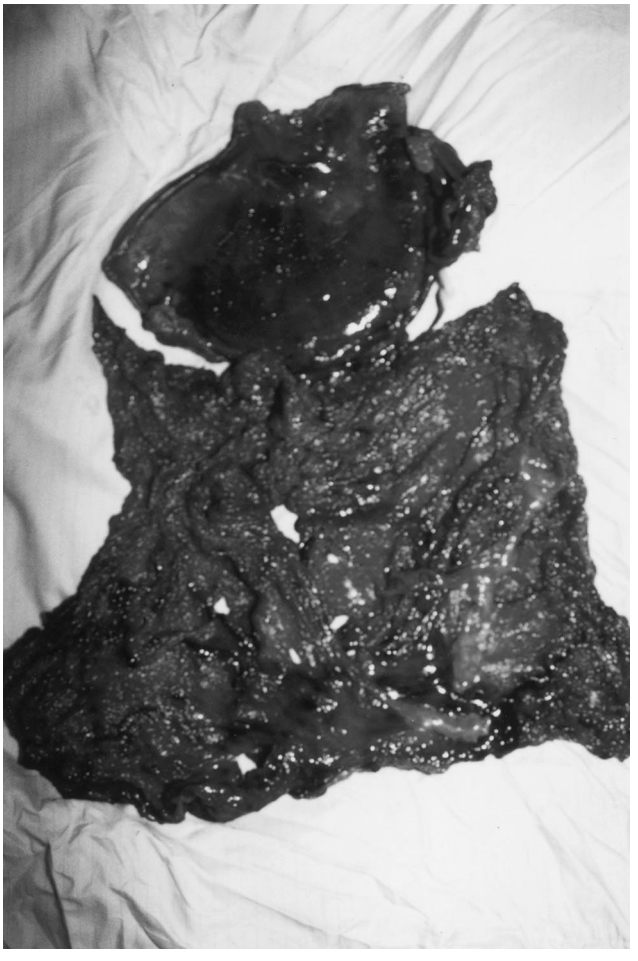

Fig. 3. *Necrosis of two thirds of the stomach and necrotic omentum majus.*

panded gas can result from simple dental amalgam loss to rupture of the lung or hollow viscera. These life-threatening conditions must be diagnosed early and must be treated immediately. Several gastric ruptures secondary to scuba diving have been reported, and laparotomy or laparoscopy is indicated clearly.[1–4] Hayden et al. recently described a case of diaphragmatic rupture with herniated stomach and herniated transverse colon in a scuba diver after an uncomplicated laparoscopic Nissen fundoplication.[5] Injuries to the diaphragm are rare (0.8–3.3% of all polytraumatized patients),[6,7] may remain asymptomatic for up to 50 years,[8] and are frequently overlooked (11.8–40%).[9] Only after this operation and at precise interrogation did our patient remember a minor blunt abdominal trauma 18 years ago (car accident with little free liquid at ultrasound, treated conservatively). There is no other explanation for the diaphragmatic defect, as it was clearly old and posttraumatic and not congenital. During ascent, the gas in the stomach expanded and the stomach herniated through the diaphragmatic defect into the pleural cavity. Due to the strong current, the swimming back to reach shore was tiring and, with his mouth piece still in his mouth, it is possible that some air had been swallowed. This may have contributed to the fact that the stomach did not slide back and therefore incarcerated. The CT scan did not clearly demonstrate a diaphragmatic rupture, nor did it show clearly any herniated viscera. Initially, the patient was not very symptomatic, but during the following 24 hours he developed increasing dyspnea. It was concluded that he had a pleural barotrauma and the decision was made to do a thoracotomy.

Two conclusions may be drawn from this rare case of a scuba diver developing gastric and omental incarceration through an occult posttraumatic diaphragmatic hernia. First, a diaphragmatic hernia cannot be excluded simply by a CT scan. When in doubt, a Gastrografin swallow study is indicated. CT is a reliable tool in the diagnosis of suspected diaphragmatic injury in the acute trauma setting, but performs poorly long after trauma.[10] Second, this case and the one reported by Hayden et al. clearly demonstrate the difficulties encountered in both clinical examination and history taking in young persons desiring to dive. It is essential to consider all the physical laws that may operate during a scuba dive and to be aware of all medical conditions of the person in question. Hints in the patient's past medical history, such as blunt abdominal or thoracic trauma, may need complementary examinations before signing a certificate of aptitude for diving.

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