Abstract—Background: Injuries in divers resulting purely from impact with the water are uncommon in the published literature. We present a case report of pulmonary contusion in a young diver. Case Report: A young, healthy competitive platform diver landed flat on his back in the water from a dive of 10 meters. He complained of upper back pain and had an episode of hemoptysis after the dive. He was initially observed for 15 hours postinjury, and was discharged when three chest radiographs (CXRs) taken at 1, 7, and 11 hours postinjury did not show significant abnormalities. Thirty-six hours postinjury, the patient experienced repeat hemoptysis and returned to the emergency department, where a fourth CXR performed 43 hours postinjury was normal. A computed tomography (CT) scan revealed pulmonary contusion and traumatic subpleural pneumatoceles. The patient was admitted to the cardiothoracic ward for observation. He recovered well with conservative treatment and was discharged on the fifth day after injury with clearance for air travel. In this patient with a high-energy mechanism of rapid deceleration and hemoptysis at the scene, there may be grounds for performing a CT scan of the thorax at the time of the first presentation, although the CT findings did not change conservative management of this patient. Why Should an Emergency Physician Be Aware of This?: Emergency physicians should recognize that a dive into water may generate sufficient impact to produce a pulmonary contusion. If the patient is clinically well and the CXR results are normal, the decision to initiate a CT scan and subsequent disposition may be based on clinical judgement and institutional practice. © 2016 Elsevier Inc. All rights reserved.

Keywords—athletic injuries; computed tomography; diving; hemoptysis; thoracic injuries

INTRODUCTION
Injuries in divers resulting purely from impact with the water are uncommon. We present a case report of pulmonary contusion in a young diver.

CASE REPORT
A young, healthy competitive platform diver landed flat on his back in the water from a dive of 10 meters. He was able to swim to the side of the pool but required assistance to get out of the water. He had an episode of hemoptysis at the scene and complained of upper back pain but was otherwise asymptomatic, with no chest pain or breathlessness. On clinical examination, he was hemodynamically stable with oxygen saturation of 100% on room air. The only injury detected was a perforated left tympanic membrane. He was initially observed for 15 hours postinjury and discharged when three chest radiographs (CXRs) taken at 1, 7, and 11 hours postinjury did not show significant abnormalities. Cervical spine radiographs were normal.
At 43 hours postinjury, the patient experienced repeat hemoptysis and returned to the emergency department where a fourth CXR performed 43 hours postinjury was normal (Figure 1). The patient denied dyspnea or chest pain. Vital signs were stable and the physical examination was once again unremarkable. A computed tomography (CT) scan revealed pulmonary contusion and traumatic subpleural pneumatoceles, the largest measuring 1.2 × 0.4 × 2.6 cm in the posterobasal segment of the left lower lobe (Figure 2).

The patient was admitted to the cardiothoracic ward for observation. There were no additional episodes of hemoptysis. Bedside echocardiography was normal. He recovered well with conservative treatment and was discharged on the fifth day after injury with clearance for air travel.

DISCUSSION

Injuries in divers resulting purely from impact with the water are uncommon. For the clinician not familiar with the existing literature, this mechanism of injury may not raise suspicion of a significant injury, especially if the patient appears clinically well on presentation. One previous case of pulmonary contusion has been reported in a diver who landed awkwardly on his chest in the water from a dive of 1 meter and also experienced hemoptysis at the scene (1). Other injuries have included two reports of inner ear injury, associated in one case with a ruptured tympanic membrane and one case of traumatic rupture of the aorta after a 3-meter dive (2,3). In our patient, the mechanism of injury is likely to have been an awkward landing into the water from a height resulting in significant transmission of energy to the lungs.

The role of a thoracic CT scan in blunt trauma to the chest in a stable, asymptomatic patient with normal serial CXRs is debatable. While CT is regarded as the criterion standard of imaging in cases of blunt chest trauma, it is associated with quantifiable increase in radiation risk and costs. Some studies argue that routine CT scans of the thorax can pick up rare but clinically important injuries and can change patient management, albeit at low rates of 2% to 5% of patients who would not have been predicted to have chest injuries (4,5). In another study, 18.1% of blunt trauma patients evaluated with both CXR and CT had injuries detected on CT but not CXR, yet the majority of injuries detected by CT alone were clinically insignificant, resulting in little or no change in management (6). The value of CT to pick up a pulmonary contusion in young, healthy individuals in the absence of other injury on CXR may be limited, because in this population isolated pulmonary contusion has not been shown to be linked to mortality, nor has occult pulmonary contusion seen only on CT scan been found to correlate to morbidity (7,8).

Taking into account the controversy regarding the use of routine CT scans in patients with blunt trauma, the 2013 American College of Radiology (ACR) Appropriateness Criteria gives a CT scan of the chest with contrast a rating of 9 (i.e., usually appropriate) for first-line evaluation in high-energy mechanism, and recommends that it be used in all cases of high-energy mechanism, abnormal chest radiographs, altered mental status, distracting injuries, or clinically suspected thoracic injury (4).

In our patient, suspicion of thoracic injury in view of hemoptysis and high-energy mechanism could have been grounds for a CT scan on his first presentation, although the CT findings did not change the conservative management of this patient. The presence of a perforated tympanic membrane may have been a surrogate marker of barotrauma or of substantial direct force, both of which were postulated mechanisms in the previous case report of tympanic membrane perforation (2).

Fitness to fly should be assessed logically in the absence of specific guidelines. This patient had traumatic pneumatoceles, a clinical entity seen more often in pediatric patients than in adults—children are not covered by existing guidelines on safe air travel. The British Thoracic Society guidelines for air travel note that commercial aircraft are pressurised to cabin altitudes of up to 8000 feet (2438 meters), at which the PaO₂ falls to 8.0 and 10 kPa, the equivalent of breathing 15.1% oxygen.

Figure 1. Fourth chest radiograph taken 43 hours postinjury, with a normal appearance.
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