

Diaphragmatic injury a hidden issue for divers following trauma: Case report

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Abstract

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Occult diaphragmatic injury was uncovered in a patient who returned to scuba diving after a traumatic injury. Diaphragmatic injury can be a difficult diagnosis in the setting of trauma and a significant number of injuries are missed on the initial presentation. This has potential implications to those wishing to return to diving after trauma, and diving doctors must maintain a high degree of suspicion for such injuries.

Case report

A 40 year-old female scuba diver presented to a regional emergency department (1,200 km north of the state capital and the nearest hyperbaric facility) with chest pain and vomiting following a recreational dive. The patient, an experienced diver, was returning to diving after a few years absence and was undertaking a morning shore dive. She was forced to abandon after 15 min due to left shoulder and chest pain, without any shortness of breath. At no point during the dive did she proceed deeper than 10 metres' sea water (msw) and there was no history of an uncontrolled ascent. She completed a 3 min safety stop at 5 msw with symptoms persisting on surfacing.

After exiting the water she developed nausea and vomiting, with ongoing chest pain maximal around the left shoulder, pleuritic in nature and described as 8/10 in severity. Due to the persistent nature of the pain she presented to the local emergency department that afternoon. Interestingly, on a refresher dive a few weeks prior, her first dive since 2015, she had developed a similar discomfort which had spontaneously resolved within an hour post dive.

On presentation her observations were all within normal limits, and diving first aid was commenced with high flow oxygen and intravenous fluids. On examination the pain in her left shoulder region could not be replicated on palpation, but reduced air entry in the left base was noted. Neurological examination was reported as being unremarkable. Routine blood gas and ECG were unremarkable and a chest X-ray (CXR) was performed to assess for the initial differential

diagnosis of pneumothorax or pneumomediastinum. Decompression sickness (DCS) was not considered likely due to the short, shallow diving profile.

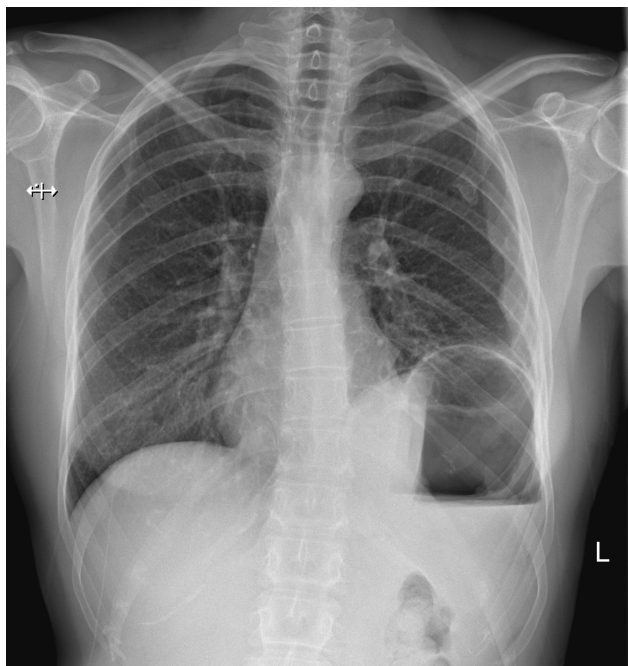
The patient's past medical history included a motor vehicle accident in 2015. This resulted in a subluxation of C1/C2, fractured pelvis and left sided rib fractures with a pneumothorax requiring an intercostal catheter. She was otherwise fit and well with a normal body mass index.

After discussion and on review of her CXR by the Fiona Stanley Hyperbaric Medicine Unit it was noted that there was a markedly distended, likely gastric bubble, in the left hemithorax (Figure 1). The treating team were advised to site a nasogastric tube (NGT), which initially drained 200 ml of air and 70 ml of fluid. The patient had persisting symptoms overnight, but was able to pass flatus. Repeat CXR the next morning showed progression of the gastric distension (Figure 2) raising concerns for an incarcerated hernia and the decision was made to transfer the patient to a tertiary centre with surgical facilities (1,200 km south) via the Royal Flying Doctor Service in a sea level cabin. A CT scan was performed on arrival which confirmed diaphragmatic rupture with hernia of the stomach and possibly the spleen. There was near complete collapse of the left lung with mild mediastinal shift to the right. (Figure 3)

An endoscopic NGT placement and decompression of the stomach was performed, due to the inability to decompress the stomach with prior blind placement of the NGT. The patient then proceeded to a laparoscopic repair of the hernia, where it was noted intraoperatively that she had a 10 x 6

Figure 1

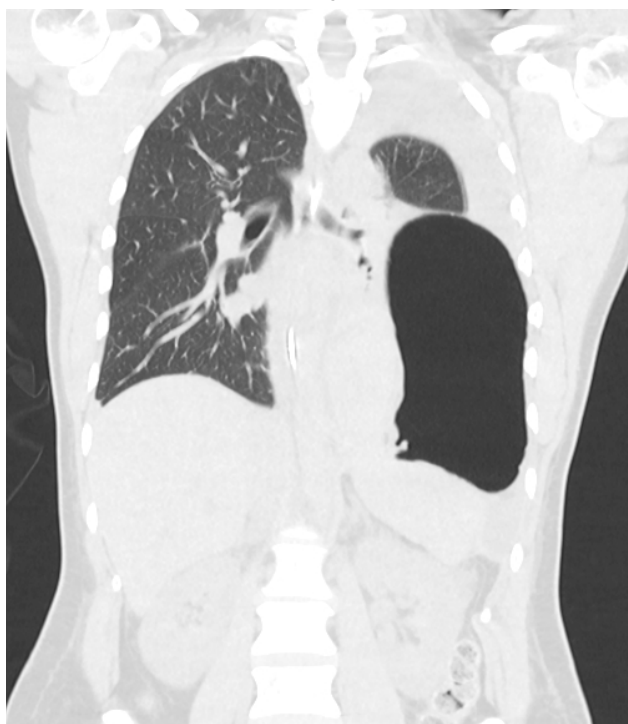
Initial CXR showing distended probable gastric bubble, in the left hemithorax

**Figure 2**

Follow-up CXR showing progression of the gastric distension

**Figure 3**

Coronal thoraco-abdominal CT scan showing diaphragmatic rupture, hernia of the stomach and possibly the spleen, with near complete collapse of the left lung with mild mediastinal shift to the right



cm hernia in the left diaphragm that contained stomach and the left lobe of the liver, with no sac present. The hernia was primarily closed with sutures and then reinforced with biomesh.

Discussion

This is an unusual case of an undiagnosed pathology uncovered by diving. There is one previous case of delayed diaphragmatic hernia being uncovered by diving, where a 40 year-old male had presented with thoracic and abdominal pain with associated dyspnoea following a dive to 50 msw. He was found to have transverse colon, small bowel and omentum in the diaphragmatic hernia. He had a background of chest trauma secondary to an MVA six years prior to his episode.¹

Diaphragmatic hernia in admitted patients following blunt thoracic or abdominal trauma has been reported in up to 5% of cases.² Delayed recognition occurs in up to 15% of cases, due often to minimal initial symptoms and other complicating injuries.³ In a targeted history following diagnosis, our patient had not described any reflux or digestive symptoms following her accident; just non-descript feelings of occasional shortness of breath and one episode of left shoulder spasm a year prior to her dives. Though diagnostic imaging is better with the use of helical CT, sensitivities of the diagnosis of diaphragmatic injury have still been reported between 50–87%.^{4–5} Diaphragmatic hernias have also been misdiagnosed on CXR leading to the inappropriate use of chest drains.⁶ A small case series reported an average age of 41 years at detection of the hernia with a mean time of 6.5 years following the traumatic event.⁷ This is in keeping with the demographics of the two cases reported in divers.

The issue of missed diaphragmatic injury following trauma is particularly relevant to people returning to diving. The

ingestion of gas at depth with expansion on ascent (according to Boyle's Law) creates the potential to promote herniation through an acquired deficit. In divers presenting with chest or shoulder pain after diving the typical differential diagnoses would include pneumothorax, pneumomediastinum or musculoskeletal DCS. However as this case demonstrates, with a past history of trauma, special attention must be paid to the CXR to rule out diaphragmatic hernia as a cause of symptoms. It is also important to note the difficulty in decompressing the herniated stomach with blind NGT placements, which should warrant urgent transfer to a centre with endoscopic and surgical facilities. In terms of prevention, doctors performing diving medicals should also maintain a high degree of suspicion for the potential of undiagnosed traumatic diaphragmatic hernias in relevant patients to minimise the occurrence of such cases in the future.

References

- 1 Baudoin Y, Lacroix G, Louge P, Platel JP. An unusual diving accident: A case of delayed presentation of traumatic diaphragmatic rupture. *J Emerg Med*. 2013;45(3):e81–2. doi: [10.1016/j.jemermed.2013.03.028](https://doi.org/10.1016/j.jemermed.2013.03.028). PMID: 23849368.
- 2 Abdelshafy M, Khalifa YSE. Traumatic diaphragmatic hernia challenging diagnosis and early management. *J Egypt Soc Cardio-Thorac Surg*. 2018;26:219–27. doi: [10.1016/j.jescts.2018.07.001](https://doi.org/10.1016/j.jescts.2018.07.001).
- 3 Shah R, Sabanathan S, Mearns AJ, Choudhury AK. Traumatic rupture of diaphragm. *Ann Thorac Surg*. 1995;60:1444–9. doi: [10.1016/0003-4975\(95\)00629-Y](https://doi.org/10.1016/0003-4975(95)00629-Y). PMID: 8526655.
- 4 Iochum S, Ludig T, Walter F, Sebbag H, Grosdidier G, Blum AG. Imaging of diaphragmatic injury: A diagnostic challenge? *Radiographics*. 2002;22 Spec No:S103–16; discussion S116–8. PMID: 12376604.
- 5 Desir A, Ghaye B. CT of blunt diaphragmatic rupture. *Radiographics*. 2012;32:477–98. doi: [10.1148/rg.322115082](https://doi.org/10.1148/rg.322115082). PMID: 22411944.
- 6 Magu S, Agarwal S, Jain N, Dalal N. Diaphragmatic hernia mimicking hydropneumothorax: Common error in emergency department. *BMJ Case Rep*. 2013;Bcr2012008547. doi: [10.1136/bcr-2012-008547](https://doi.org/10.1136/bcr-2012-008547). PMID: 23907963. PMCID: PMC3762391.
- 7 Davoodabadi A, Fakharian E, Mohammadzadeh M, Abdorrahim Kashi E, Mirzadeh AS. Blunt traumatic hernia of diaphragm with late presentation. *Arch Trauma Res*. 2012;1(3):89–92. doi: [10.5812/atr.7593](https://doi.org/10.5812/atr.7593). PMID: 24396754. PMCID: PMC3876542.

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