cirrhosis. Both patients have been started on iron chelation and have been clinically stable in the months since their diagnosis.

Our findings are significant for several reasons. First, we do not believe that HPS with cirrhosis secondary to recurrent transfusions in patients with sickle cell anaemia has been previously described. Secondly, given the prevalence of iron overload-induced cirrhosis in patients with sickle cell anaesthesia, as well as the prevalence of HPS in patients with cirrhosis, there are likely to be other undiagnosed cases of HPS in this population. However, the decrease in nitric oxide availability in patients with sickle cell anaesthesia may have a protective effect against the formation of HPS, since elevated nitric oxide levels have been associated with the development of HPS [10]. Thirdly, HPS is not part of the current differential diagnosis of unexplained chronic hypoxaemia in patients with sickle cell anaesthesia. While conditions such as pulmonary venous hypertension, pulmonary arterial hypertension, chronic pulmonary embolism and interstitial lung disease should be first considered, we believe that HPS should also be considered in patients with chronic hypoxaemia. Finally, our report underscores the importance of new therapeutic options that are available to treat chronic iron overload.

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A breathtaking reverse bungee jump

To the Editors:

Bungee jumping became popular in the early 1980s. Owing to the prevailing professionalism in the field, accidents are extremely rare. However, occasional medical complications do occur. They are mostly ophthalmologic, but spinal and vascular lesions have been reported [1]. Respiratory complications have also been described (one case of pulmonary haemorrhage [2] and one case of bilateral pneumothoraces in a patient at risk [3]). Reverse bungee jumping is an increasingly widespread fairground attraction during which a one- or two-person passenger cradle is hurled vertically up to 80 m into the air by the sudden release of previously stretched elastic ropes (fig. 1). Exceptional accidents have been reported (one case of subdural haematoma [4] and one case of pneumothorax [5]). We describe a case of acute hemidiaphragmatic elevation with diaphragm weakness possibly linked to this activity.

A 52-yr-old office worker (175 cm; 97 kg; body mass index 31.7 kg·m⁻²) was referred to our outpatient clinic in May 2006

to investigate recent-onset exercise dyspnoea (self-characterised as “hindering usual acrobatic dance performances”). The patient also reported mild orthopnoea. He did not smoke and had no history of chronic disease, previous surgery or traumatism. Clinical examination was unremarkable. Chest radiography showed an elevated right hemidiaphragm (fig. 2a) capped by passive atelectasis. Thoracic computed tomography did not show other abnormalities. Blood chemistry and blood cell counts were normal. Vital capacity was 87% predicted, falling to 73% pred in the supine position. Sniff nasal inspiratory pressure was 57% pred (64 cmH₂O). Cervical magnetic stimulation of the phrenic nerves showed electromyographic responses with normal latencies on both sides (right: 6 ms; left: 6.3 ms; expected values between 5.5 and 6.5 ms) but diminished amplitude on the right side (right-to-left ratio 0.5). The corresponding diaphragm twitch oesophageal pressure was low, at 4.7 cmH₂O (expected value >11 cmH₂O), and so was the twitch transdiaphragmatic pressure, at 10.9 cmH₂O (expected value >20 cmH₂O).

FIGURE 1. A typical reverse bungee jump attraction. Image courtesy of Andrew Dunn.

Thoracic computed tomography showed the absence of diaphragmatic rupture (fig. 2b). Notably, it also showed multiple images suggestive of hepatic haemangiomas, the largest of which was 11 cm in diameter. There was no history of

shoulder pain, no electromyographic abnormalities in the shoulder muscles and no signs of cervical arthrosis on cervical radiography. A diagnosis of diaphragmatic “eventration” without phrenic nerve lesion was made. Further discussion with the patient revealed that he was able to pin-point the beginning of his respiratory problems. He dated them from a day spent in a theme park a few weeks before, and clearly remembered having felt most unwell, with abdominal pain and a feeling of suffocation, immediately after a reverse bungee jump. We explained to the patient that a diaphragm plication could alleviate his symptoms, but that delayed recovery was not impossible [6]. He chose not have surgery. Over the next 18 months, the symptoms progressively receded, the patient finally reporting being back to his initial form. Repeated pulmonary function tests showed a recovery of vital capacity (91% pred in October 2007, with no supine fall). Chest radiography showed a progressive return of the right hemidiaphragm to a roughly normal position (fig. 2c). The patient declined repeated phrenic nerve stimulation. He was lost to follow-up after October 2007. The patient had been informed at the time of initial investigations that his data could be used for scientific purposes and had agreed to this in writing.

Medical complications from roller coasters and other funfair attractions are exceedingly rare. However, submitting large populations of untrained and unselected persons to violent physical constraints is bound to reveal otherwise silent abnormalities, hence the importance of cautionary notices warning people with or at risk of specified medical conditions. It is also important to identify and describe proven or strongly suspected complications for future reference.

In our patient, one possible mechanism to explain the unilateral hemidiaphragm elevation would be a phrenic nerve stretch lesion resulting from a sudden neck movement. Such lesions have been described after chiropractic manipulation of the neck or as a result of “whiplash” in the context of a motorcycle accident [7]. One then expects the diaphragm response to phrenic nerve stimulation, if not abolished, to be

FIGURE 2. a) Initial chest radiograph, taken on May 11, 2005. b) Coronal computed tomography image contemporary with the initial investigations; note the presence of a hepatic mass, classified as one of several probable haemangiomas after contrast imaging and ultrasounds. c) Follow-up chest radiograph taken on October 2, 2007, at a time when the patient no longer complained of dyspnoea; the right hemidiaphragm is still slightly elevated, but recovery has clearly occurred.

both attenuated and delayed [7]. This was not the case in our patient, where phrenic nerve conduction times were normal and symmetrical, in spite of the reduced amplitude of the motor response on the affected side. This amplitude reduction could correspond to moderate axonal loss, but could simply have been due to the hemidiaphragm elevation modifying the spatial relationship between the muscle and the electrodes. Notably, a partial phrenic lesion would easily explain the observed recovery [6]. Another possible mechanism to consider would be a diaphragmatic, rather than phrenic, lesion. Transient upward accelerations have an inspiratory effect on the chest wall, whereas downward accelerations are expiratory [8]. Therefore, during a reverse bungee jump, the respiratory system will be exposed to a brutal shift from an ascent-related inspiratory force, which can reach $4\text{--}5 \times g$, to a descent-related expiratory force, the abdominal content being suddenly “projected” in the cephalad direction at the moment of the trajectory reversal. Given the dome-shaped nature of the diaphragm, the corresponding force will be applied uniformly and perpendicularly to all its surfaces if the abdominal content behaves like a Newtonian incompressible fluid, which is a reasonable assumption. Even in the presence of very severe constraints, this should prevent diaphragm damage, as in the case of an egg not cracking when exposed uniformly to extreme pressures. This hypothesis is consistent with the fact that thousands of bungee or reverse bungee jumps, funfair elevator rides, centrifuges, or similar challenges occur daily without causing an epidemic of diaphragm eventrations, and also more generally with the fact that the diaphragm does resist extremely high and sustained abdominal pressures during labour. However, submitted to pressure, an egg breaks if there is a regional weakening of its shell or if the pressure distribution becomes nonuniform. Diaphragmatic rupture in response to a major increase in abdominal pressure could thus reveal a previously unknown diaphragm defect, a mechanism that has been proposed to explain the exceptional occurrences of labour-related diaphragm ruptures [9, 10]. The diaphragm can also give way to a nonuniform rise in abdominal pressure, as in the case of near-side motor vehicle accidents [11]. In our patient, the heterogeneous nature of the haemangiomas liver could have been responsible for such a mechanism. Of note, no diaphragm rupture was documented. Diaphragmatic “elongation” (strain- or sprain-like) was thus more likely and would also be consistent with the observed spontaneous recovery.

Whichever of the suspected mechanisms was actually involved, this observation is a reminder that it is important to look carefully for both cervical and abdominothoracic traumas, even in the distant past, when investigating the nature of a hemidiaphragm elevation.

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