

# A case of spinal epidural haematoma during breath-hold diving

Lucio Tremolizzo, Mirko Patassini, Massimo Malpieri, Carlo Ferrarese and Ildebrando Appollonio

## Abstract

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Spinal epidural haematoma (SEH) is a rare condition usually the result of bleeding of the epidural venous plexus that might present with acute spinal cord compression. It is often due to traumatic events, but 'spontaneous' cases have been described, usually related to different predisposing conditions, such as coagulopathies. A 47-year-old male presented with severe frontal headache and intense cervical pain which developed during a protracted breath-hold spearfishing session. A cervical spine MRI performed 12 days after symptom onset showed a small epidural blood collection on the left side of the spinal canal, at the C7–T1 level. One week later, blood was no longer present and the asymptomatic patient was discharged. Protracted minor trauma (neck flexion) and repeated Valsalva manoeuvres might have played a role in the genesis of this event. The role of decompression sickness is discussed as well.

## Key words

Breath-hold diving, spearfishing, central nervous system, Valsalva manoeuvre, injuries, decompression sickness, case reports

## Introduction

Spinal epidural haematoma (SEH) is a rare condition usually owing to bleeding from the epidural venous plexus and presenting with local and radicular pain associated with acute spinal cord compression that may require urgent surgical decompression. It is often the result of traumatic events, including surgery, intervertebral disc herniation and lumbar puncture.<sup>1–3</sup> However, 'spontaneous' cases of SEH (SSEH) have been described, usually related to coagulopathies or anti-coagulation therapy, vascular malformations, drug abuse, plasma cell myeloma, and non-Hodgkin's lymphoma, among other causes.<sup>3,4</sup> Here, we report a case of a spontaneously recovered SEH that presumably developed during an intense and protracted period of breath-hold spearfishing.

## Case report

A 47-year-old male presented with severe frontal headache and intense cervical pain. The onset came one week earlier, during an intense (operating depth between 15 and 25 metres' sea water, msw) and protracted (repetitive dives over more than 4 h) breath-hold spearfishing session. Past medical history only documented migraine without aura and the patient denied taking any medications during the days before. Neurological examination was unremarkable, although severe tenderness in the cervical region was noted. Headache and cervical tenderness progressively subsided following several days of oral diazepam and paracetamol and intravenous fluid administration. Considering the intensity of the pain, a brain and cervical spine MRI scan was performed 12 days after symptom onset, showing a small epidural blood collection on the left side of the spinal canal, at the C7–T1 level (Figure 1). A bulging disk at the C5–C6 level was

also noted. One week later, blood was no longer present on repeat scanning (Figure 2). The patient was asymptomatic and was discharged with advice to have his blood pressure monitored, since borderline hypertensive values were noted during hospitalisation.

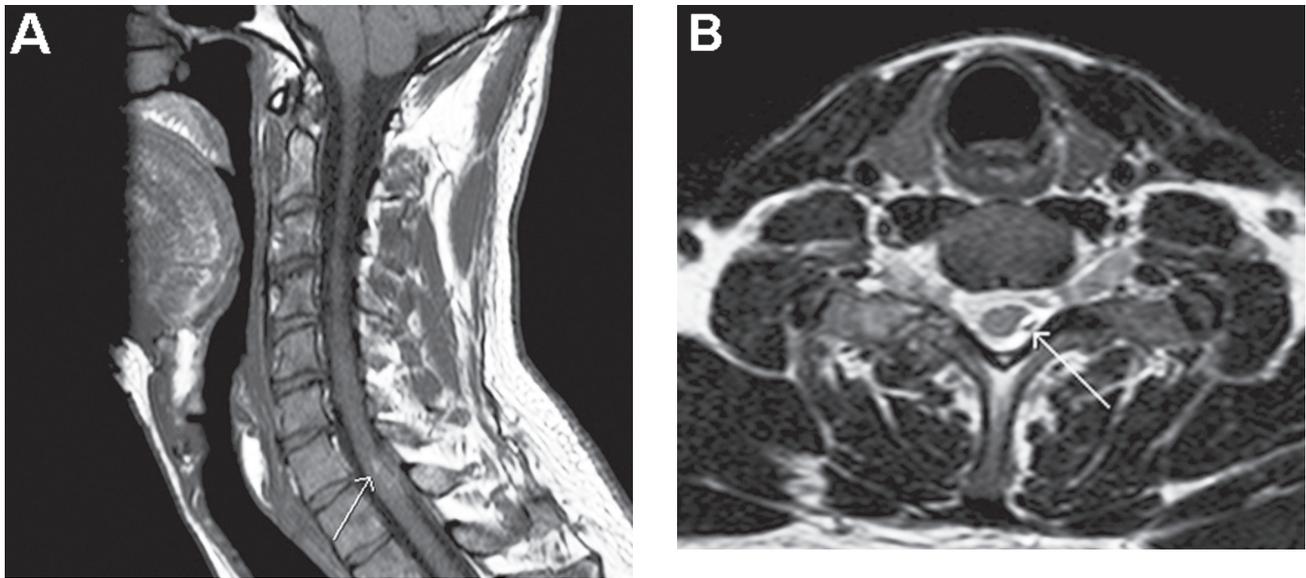
## Discussion

Scuba diving-related haemorrhages have been reported previously, mainly involving tissues classically prone to barotrauma, such as the lungs, the orbital region (mask squeeze) and the inner ear.<sup>5–7</sup> Middle-ear barotrauma, caused by failure to equalise the pressure between the middle ear and ambient pressure during descent (or ascent), is common in diving, and such events can result in pneumocephalus associated with parenchymal and extra-axial haemorrhage.<sup>8</sup> Fatal epidural haematoma overlaying the tegmen tympani has also been reported following air insufflation via a Sieglers speculum.<sup>9</sup> A similar case of pneumocephalus with disruption of the tegmen tympani due to barotrauma during scuba diving was subsequently shown on MRI performed 16 days after the injury.<sup>10</sup> Epidural blood near the base of the skull, and in both mastoids was seen. Rarely, haemorrhagic events following scuba diving have been reported in predisposed subjects in tissues that are not classically targets of barotrauma, e.g., oesophageal variceal bleeding in a patient with a history of cryptogenic liver cirrhosis.<sup>11</sup> Moreover, a case of spontaneous, multiple, albeit subdural, spinal haemorrhages (from C7 to T11) has been reported, occurring in the absence of apparent pre-existing abnormalities.<sup>12</sup>

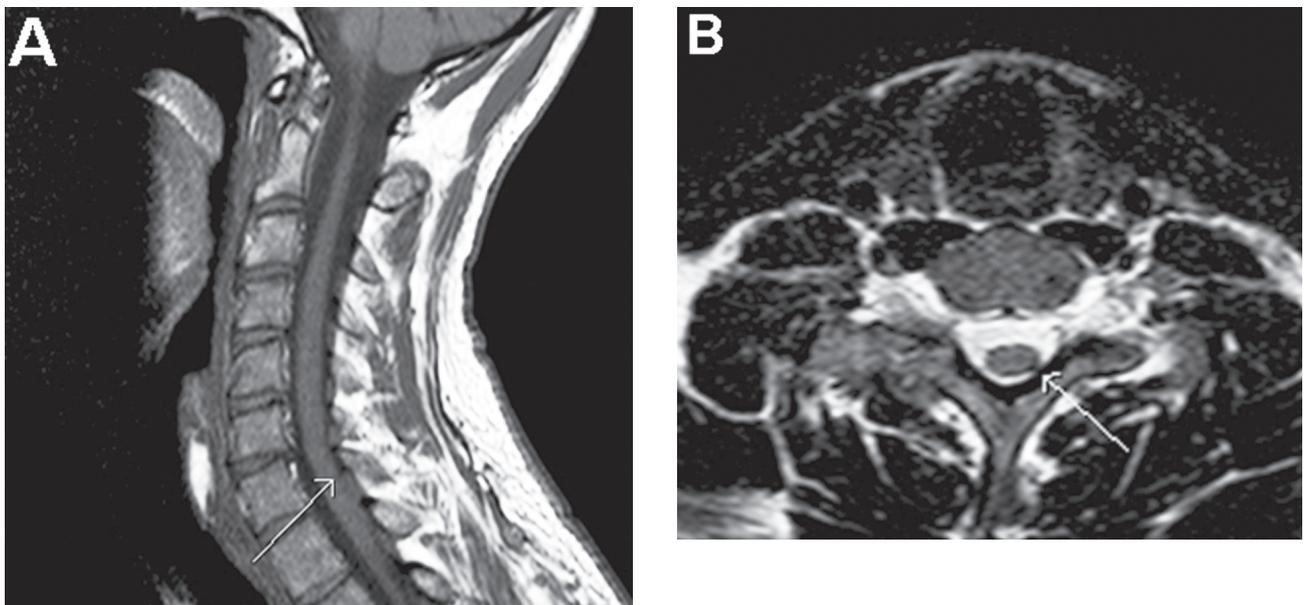
Decompression sickness-related myelopathy might present with perivascular haemorrhages, although in this case it occurred within the spinal cord parenchyma, possibly related

**Figure 1**

Spinal MRI at 12 days following symptom onset (A) sagittal T1WI showing a poorly defined faint epidural hyperintensity at C7–T1 (white arrow), and (B) axial T2WI showing a small inhomogeneous epidural hyperintense collection (white arrow) inducing mild left postero-lateral cord surface compression; no intramedullary hyperintensity was present

**Figure 2**

One week later, both sagittal T1WI (A), and axial T2WI (B) evidenced a complete recovery



to venous infarction.<sup>13</sup> Interestingly, simulated chamber dives in dogs demonstrated that the epidural vertebral venous system became obstructed during spinal cord damage due to decompression sickness.<sup>14</sup> Even accepting the existence of decompression sickness from breath-hold diving, involving protracted apnoeas with short surface intervals,<sup>15,16</sup> we did not find evidence of spinal cord parenchymal damage, and the haemorrhagic event was confined to the epidural space.

Even when spearfishing in shallow waters, many free divers need to repeat the Valsalva manoeuvre frequently to equalise pressure in the middle ear with each descent. Such transient venous hypertension as a result of sudden Valsalva manoeuvres, including coughing and sneezing, is thought to play a role in SSEH.<sup>17</sup> This might be considered as a contributing factor in this diver.

Finally, the subject reported that his operating depths, duration and intensity of the exercise were possibly somewhat excessive for his physical status, and that he was over-weighted for the conditions, necessitating extra effort to maintain buoyancy during surface recovery periods. The effort of continuous flexion-extension of the neck for respiration might have played a role in the genesis of the haemorrhagic event. In fact, minor traumas, such as falling to the ground, protracted crawling, change of posture during sleep, coughing or the Valsalva manoeuvre are all proposed or recorded as possible predisposing factors in published case series of SSEH patients.<sup>18</sup> Analogously, disk herniation is considered in the list of risk factors since dorsal displacement of the annulus or nucleus during acute disk disruption might produce a tear within the venous plexus.<sup>17</sup> However, our patient did not present evidence of complete disk herniation, as he did not have any other known predisposing factors. Interestingly, the involved site, thoracic spine, is the most common for those SEHs that are often referred to as 'spontaneous'. However, only about 40% of the cases remain truly idiopathic, whilst in the rest a precipitating factor could be found.<sup>3,4</sup>

Therefore, considering the aforementioned evidence, we conclude that the most likely predisposing conditions for this event were the overlap of repetitive minor traumas, i.e., the incessant movements of neck flexion, and the frequent Valsalva manoeuvres during breath-hold diving.

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