Case reports

Problems with an intrathecal pump in a paraplegic scuba diver

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Abstract

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Scuba diving with an intrathecal baclofen pump is encouraged for people with spinal cord injury who are suffering from spasticity. However, the diving depth is limited to 10 metres in this context. Proper physician and patient education in this respect is mandatory since non-compliance can lead to an irreversible loss of drug reservoir capacity due to collapse of the bottom shield. We report such an incident in a paraplegic diver diving to depths down to 30 metres' water.

Introduction

For more than three decades, scuba diving has been identified as a positive neuro-rehabilitative strategy.[1] People with spinal cord injury (SCI) often suffer from severe spasticity impairing quality of life and can benefit greatly from aquatic therapy. Aquatherapy, performed under the right circumstances, can alleviate spasticity and provides many paraplegic patients with a unique feeling of freedom, resulting from buoyancy.[2] In this report, we describe a paraplegic scuba diver who had a collapsed intrathecal baclofen (ITB) pump after diving to depths down to 30 metres' water (mw).

Case report

A 41-year-old male patient was seen at the outpatient clinic for a refill of his recently implanted ITB pump (Medtronic SynchroMed II®) which had been implanted for the treatment of spasticity after sustaining a traumatic high thoracic spinal cord injury (T4) secondary to a road traffic accident in 2003 (level T4, American Spinal Injury Association (ASIA) Impairment Scale A[3]). Spasticity was well controlled and the patient had no complaints at that time. However, after aspiration of the residual volume, only 13 ml could be injected into the pump. At a refill three years earlier, an identical problem was encountered after the patient went scuba diving to 30 mw when only 27 cc could be injected into a 40 cc ITB pump.[4] At that time, the patient was unaware of Medtronic's advisory of a 10-metre diving depth restriction.[5] At the battery end-of-life, the collapsed pump was replaced by a smaller (20 cc) ITB pump for aesthetic reasons.

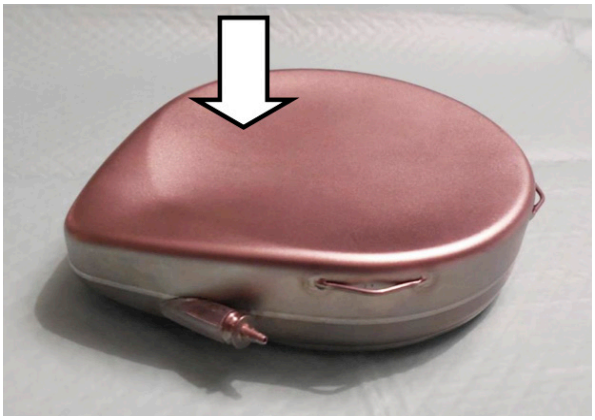
At his visit three years later, he admitted repeated non-compliance, still diving to 30 mw. He reported absolutely no side-effects during diving and stated that diving has a very positive effect on his spasticity. He described a huge positive impact of scuba diving on his quality of life as, whilst underwater, he experienced no handicap or impairment. His diving history revealed that diving to 30 mw had only occurred on two occasions. In between times, he dived two to three days per month, limiting his diving depth to approximately 20 mw. A certified diving buddy always accompanied him.

Figure 1 shows the ITB pump after removal. Although the collapsed pump was still functional, the patient requested its removal so he could continue deep diving. Ceassing the baclofen infusion was associated with the recurrence of debilitating spasticity. To control this, botulinum toxin injections and eventually selective peripheral neurotomies were performed. Two years after removal of the ITB pump and one-and-half years after his last neurotomy, the patient remains satisfied and continues to dive.

Discussion

Intrathecal baclofen (ITB) is an established treatment option for severe spasticity that is insufficiently controlled by oral medication and physical therapy. Since scuba diving offers mobility-impaired people the unique opportunity for three-dimensional movement through a gravity-free environment,[1] the possibility of diving with an ITB pump needs to be discussed with the individual patient.

Figure 1
Collapsed bottom shield of 20 ml intrathecal baclofen pump upon surgical removal



Research on cardiac pacemakers and scuba diving indicates that recommendations vary from country to country.[6] For example, the United Kingdom Sport Diving Medical Committee (UKSDMC) advises the use of resin-filled pacemakers rather than a gas-filled model. The maximum diving depth recommended by the UKSDMC is 10 mw, shallower than the depth rating on the pacemaker model. Other official diving associations are less conservative and allow diving in accordance with the manufacturer's recommendations.[7]

Searching PubMed, only one case report (that of the same patient) could be retrieved concerning ITB pump dysfunction after scuba diving.[4] As mentioned above, Medtronic's guidelines prescribe a maximum diving depth of 10 mw (201.3 kPa)[5] and warn that the bottom shield of the ITB pump may collapse during a single exposure to a pressure greater than his, especially when the pump is not entirely full or after repeated exposure to increased pressures even less than 201.3 kPa.

Mechanical deformation results in a diminished drug reservoir capacity and thus a need for more frequent refills. Besides deformation, a temporary effect on pump flow rate exists due to the increased pressure since the flow rate accuracy decreases by approximately 3% for a pressure of up to 251.3 kPa (15 metres' sea water). Further testing indicated that, when pressure continues to increase and although the pump head continues to rotate, the pump is not able to generate sufficient pressure to dispense, causing the flow to stop. This phenomenon occurs at a pressure of 304 kPa. The pump regains its normal function at normal ambient pressure. Our patient never experienced an increase in the level of spasticity during or after diving, although pump flow would have been temporarily reduced during dives to 20 mw or deeper.

Although the collapsed ITB pump was still functional and spasticity was well controlled, the patient himself insisted on removal with the aim of continuing deep water diving. Given the increasing popularity of scuba diving amongst people with paraplegia, it is important for their carers and diving physicians assessing fitness to dive to be aware of the potential technical problems associated with infusion pumps and other implantable devices.

Conclusion

This report describes a diver with SCI whose physical and mental health benefitted greatly from scuba diving. However, scuba diving with an ITB pump should be restricted to the diving depth recommended by the manufacturers. In this case, non-compliance led to an irreversible loss of reservoir capacity from collapse of the bottom shield of a Medtronic Synchromed II® and likely decreased flow rates during diving to depths of 20 mw or deeper. Proper physician and patient education on scuba diving and ITB therapy is essential to guarantee patient safety whilst enjoying the benefits of scuba diving.

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