Scuba diving post-bleomycin therapy: A case report

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ABSTRACT
Though there are theoretical risks to scuba diving after undergoing chemotherapy with bleomycin [1-6], this case report demonstrates that it may be done without obvious injury if one takes adequate precautions. In this case, one year was allowed to elapse prior to a return to diving. Subsequently 52 dives have been accomplished with no observable adverse effects. Studies are recommended to determine what precautions should be instituted.

CASE REPORT
A 53-year-old sports scuba diver was diagnosed with testicular cancer (Stage I non-seminomatous disease [mixed embryonal carcinoma and seminoma]) in April of 2006. He underwent right orchiectomy, with post-surgical beta-HCG initially falling to normal.

However, this tumor marker began to rise: On 29 August 2006, the value was 28 mIU/ml. By 1 September 2006 it was 39 mIU/ml; and on 10 September 2006 it was 66 mIU/ml. PET scanning with simultaneous CT showed an involved left periaortic lymph node in the abdomen. For this non-smoker with normal renal function the oncologist recommended treatment with three cycles of bleomycin, etoposide and cis-platinum (BEP).

During informed consent for this treatment, the oncologist cautioned that after receiving bleomycin the patient was not to scuba dive again. This was an unacceptable prospect for the patient (a medical doctor), so he reviewed the literature.

According to Huls et al. [7] “the incidence of fatal pulmonary toxicity in this low risk [testicular cancer] population is approximately 2 to 3%. Patients treated with bleomycin are sensitive to oxygen-mediated lung injury.”

In this study, the authors discuss a case of a scuba diver who they advise against resuming diving “…since scuba divers are exposed to high partial oxygen pressures.” The authors find the theoretical considerations serious, and they discourage such patients from resuming scuba diving.

A related letter to the editor [8] continues the same argument, noting not only this risk of pulmonary fibrosis, hypoxia and death, but the increased risk of scuba-related barotrauma (including pneumothorax, pneumomediastinum and air embolism) as well. The study writer adds that the treatment of decompression illness and barotraumas includes 100% oxygen therapy, which may further damage lungs exposed to bleomycin.

The findings of this paper were discussed with the patient’s oncologist, who was unable to find anything favorable on the subject in the literature, or in consultation with an eminent authority on seminoma. This left the patient with two options:
1. to agree he would never return to scuba; or
2. to minimize his risk in making that return.

Understanding the potential risks before starting chemotherapy, he decided to pursue the second option.

Pulmonary function tests (PFTs) were performed (Table 1, Page 456) at these times:
• prior to starting bleomycin therapy (4 October 2006);
• on two occasions during therapy (23 October and 13 November 2006); and
• on 28 November 2007 prior to his return to scuba.

Initially all values were supernormal, with an FVC of 104% predicted, FEV1 of 120% and uncorrected DLCO of 41.92 (115% predicted.) BEP chemotherapy was administered at standard doses and schedules for three cycles, from 2 October 2006 through 29 November 2006. Cumulative bleomycin dose was 270 mg. Following the first cycle of bleomycin, the patient’s DLCO had already dropped off to 31.37 (86% predicted.)
The patient allowed one year to elapse after chemotherapy prior to a return to scuba diving. On his return, he adopted an arbitrary limit of 30-foot dives, noting this would increase air pressures to 2 atmospheres only, with an equivalent increase in \( \text{Pao}_2 \).

He completed two dives in Belize on 29 May 2008. The first was aborted after approximately five minutes, due to technical reasons. However, the second dive lasted a full 45 minutes at 30 feet during which he suffered no respiratory symptoms or fatigue. Subsequent to those dives, the patient chose to wait at least six weeks for any type of inflammatory response and fibrotic reaction. PFTs were repeated on 6 August 2008, more than eight weeks after the dives, and results were the best ever post-chemotherapy (Table 1, above).

In the meantime, \textit{Lancet} published an article that reported the treatment of young men with testicular cancer, noting this: “... many of our previous patients have resumed scuba diving without complications... Several of these people, whom we have followed-up for 5 to 10 years are men who dive almost daily...” [9]. The article was devoid of any pulmonary function data, however, as well as details of the scuba diving experiences.

In November 2008 the patient traveled to Bonaire, Netherlands Antilles, in the southern Caribbean, where he completed 17 dives. Dives typically consisted of dropping down to 60 feet, meandering against the current until his air pressure dropped to 1,500 psi, then rising to 30 feet and doubling back to where the dive had started. Again, the patient noted that he felt good after all dives, with no respiratory symptoms or fatigue. Three months elapsed before he repeated studies (20 February 2009), where results were consistent with previous results, excluding the August 2008 set, where the DLCO appears to have been an anomaly.

Between 27 September and 2 October 2009 the patient was in Cozumel, Mexico, where he made 12 drift dives. Dives averaged 61 feet, with two of the dives being deeper than 90 feet. There, the patient reported that he purposefully remained at that depth for more than five minutes during both dives. Again, he recorded that he felt good, with no respiratory symptoms or fatigue after this series of dives. He scheduled PFTs for December, but the tests had to be postponed until January 2010, as he reported a bout of bronchitis.

Neither the bronchitis nor the diving seems to have had any significant effect on his pulmonary function, as the % predicted DLCO has not changed significantly (shown in Table 1) from that of previous studies.

### DISCUSSION

Though studied in animal models [10], the mechanism of oxygen-induced injury to post-bleomycin patients is unknown. De Wit \textit{et al.} [10] proposed an idiosyncratic reaction in individuals so predisposed. Were that to be the case, those 2-3% who are at risk of fatal pulmonary toxicity should avoid exposure to high oxygen titers, while those not so predisposed would not be at risk. Unfortunately, not knowing who might be at risk makes recommendations problematic.
CONCLUSION
This case report demonstrates that though bleomycin may be associated with an initial reduction in DLCO, a cautious return to scuba diving, including a one-year delay and gradual exposure to increasing depths, did not produce any obvious adverse effects to this diver. However, this is not an endorsement of scuba diving or exposure to high oxygen concentrations after bleomycin treatment, particularly without a time interval between bleomycin treatment and subsequent scuba diving, monitoring of pulmonary function, or limits on diving depths and bottom times, as well as using standard precautions to limit barotrauma. A large-scale study is recommended to determine these and other safety parameters in young men who may be cured of their testicular cancers and want to return to scuba diving.

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