Letters to the Editor

On diver thermal status and susceptibility to decompression sickness

In a recent Letter to the Editor,[1] Clarke, et al, indicated that divers who deliberately chill themselves on a dive to reduce risk of decompression sickness (DCS) may be misinterpreting our 2007 Navy Experimental Diving Unit (NEDU) report.[2] Indeed, we did not advocate that divers should risk hypothermia on bottom to reduce risk of DCS, nor do we dispute the authors' overall admonition to avoid diving cold unnecessarily. However, Clarke, et al, imply more generally that results of our study are not applicable to recreational or technical divers because the dives we tested were atypical of dives undertaken by such divers. We wish to clarify that our study does have implications for recreational and technical divers, implications that should not be ignored.

The dives we tested were not intended to be typical of dives undertaken in any actual operational context. Instead, we chose to expose divers to temperatures at the extremes of their thermal tolerance in order to ensure that effects of diver thermal status on DCS susceptibility would be found if such effects existed. Our initial test dive profile provided appreciable time both on bottom and during decompression to allow any differential thermal effects during these two dive phases to manifest, while affording a baseline risk of DCS that could be altered by thermal effects without exposing subjects to inordinately high risks of DCS.

Our results strongly indicate that the optimal diver thermal conditions for mitigation of DCS risk or minimization of decompression time entail remaining cool during gas uptake phases of a dive and warm during off-gassing phases. While the dose-response characteristics of our observed thermal effects are almost certainly non-linear in both exposure temperature and duration, it is only reasonable to presume that the effects vary monotonically with these factors. We have no reason to presume that such responses and effects under less extreme conditions would be in directions opposite those found under the conditions we tested. Similarly, responses to thermal exposures even more extreme than we tested might not be larger than the responses we observed, but it would be unwise to ignore the trends in our results under some unfounded presumption that the effects reverse with changes in thermal conditions beyond those tested. Finally, thermal effects on bottom and during decompression in dives to depths other than the 120 feet of sea water (fsw) or 150 fsw depths of the dives we tested are unlikely to be qualitatively different from those observed in our tested dives. The original question has therefore been answered: Chill on bottom decreases DCS susceptibility while chill during decompression increases DCS susceptibility. Under conditions encountered by recreational or technical divers, the only open issue is arguably magnitudes of effects, not directions. Neither does lack of technology to control thermal status during a dive render our study results inapplicable. It only renders the diver unable to actively optimize his or her thermal exposure to minimize DCS risk or decompression obligation.

Effects of diver thermal status on bottom hold regardless of whether the dive has a decompression long enough for a thermal effect to manifest in the decompression phase of the dive. We pointed out that US Navy decompression tables have historically been developed and validated with test dives in which divers were cold and working during bottom phases and cold and resting during decompression phases. Thus, our results indicate that it is not prudent for very warm divers to challenge the US Navy no-stop limits. However, becoming deliberately chilled on bottom only to remain cold during any ensuing decompression stops is similarly ill-advised. We agree with Clarke et al. that relative conservatism of some dive computer algorithms or alternative decompression tables, or the depth and time roundups necessary to determine table-based prescriptions, work in the diver's favour, but note that diving any profile to a shorter bottom time is a ready means to reduce the risk of DCS – i.e., enhance safety – without compromising comfort. Any active diver heating is best limited while on bottom to a minimal level required to safely complete on-bottom tasks, and dialed up only during decompression. Diver warming during decompression should not be so aggressive as to risk heat stress, and care should be taken to ensure that divers remain hydrated.

References

1 Clarke JR, Moon RE, Chimiak JM, Stinton R, Van Hoesen KB, Lang MA. Don't dive cold when you don't have to. *Diving Hyperb Med*. 2015;45:62.

2 Gerth WA, Ruterbusch VL, Long ET. The influence of diver thermal exposure on diver susceptibility to decompression sickness. *Navy Experimental Diving Unit Technical Report 06-07*. Panama City: Navy Experimental Diving Unit; 2007.

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