A COMPARATIVE INVESTIGATION OF THE PERFORMANCE, RELIABILITY AND SAFETY OF DIVE COMPUTERS WITH SIMULATED AIR-DIVES

Schellart, Nico1,2, Eduard van Riet Paap2
1Dept. of Medical Physics, Acad. Med. Centre, Amsterdam, 2Dutch Foundation for Dive Research (SDR).

Background/Objective
With multilevel simulations, including repetitive and multi-day deco-simulations (including deep stop), emergency ascents, yo-yoing, and extreme temperatures, performance of dive computers (DCs) was compared with DCIEM tables, ZH-L16C %M-values, product specifications and mutually.

Materials and Methods
In 60 test-chamber sessions, 46 DCs of 29 types were examined. No-deco limits (NDLs), depths, stop depths and stop times, and no-fly times (NFTs) were logged (260 simulations). Standard test profiles were realistic and discriminative: maximum diving depth (MDD) 45 msw 6 min, total diving time (TDT) 60 min (Fig. 1), and with 4 h surface interval 27 msw MDD 10 min, TDT 60 min, decent and ascent speed 20 and 10 msw/min.

Results/Discussion
DC behaviour did not always conform to manuals, decompression theory and exercise physiology. Two types showed irreproducible and seven oscillatory behaviour and two unexplainable inconsistencies (Fig. 2) of NDL displays (all pre-2001 types). Depth, time and temperature (mostly severely delayed) were within specifications. Display ergonomics were highly variable. NDLs and NFTs of older DCs were (far) too liberal, but new(er) DCs (1995+, with RGBM or ZH-L8ADT) were more conservative (Fig. 3). However, with large MDDs, at deep and moderate levels all DCs were more liberal than DCIEM allowed. RGBM types became more conservative with multiday simulations. The shallower the level after a deep dive, the larger is the inter-type divergence. Some new types correct adequately emergency ascents (from 45 to 6 msw, 60 msw/min), others less or not at all. To extreme yo-yoing, repetitive (Fig. 4) and 48-0 and 36-0 msw peak-peak in the 45 msw standard profile, no (or minuscule) correction occurred. Haldanian theory does not cover yo-yoing, but RGBM should do. ZH-L8ADT DCs do compensate for refrigeration. Benefit of a deep stop feature could never be confirmed during the dive. Various types handle altitude diving and personal setting identically. This is a questionable method since surface pressure is the dominant factor in the M-value at altitude whereas the M-values of personal settings should be based at the coefficients of the M-values. NFTs are generally shorter than the 12-24-36 (48) h rule.

Conclusion
The more extreme the profile and the larger the aberration from the rules, the greater the differences in NDLs and stop-times become, even with RGBM and ZH-L8ADT DCs. The implementation of established theory sometimes raises questions. Nowadays sold DCs are generally not equipped for handling extreme profiles but for normal use modern DCs are (very) save.