Reducing the risk of drowning after helicopter ditching: An assessment of the performance of three emergency breathing systems

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Introduction

When a helicopter ditches in water it commonly capsizes and floats inverted (3) and crew and passengers must make an underwater escape while breath-holding. If the water is cold it is likely that the 'cold-shock' response (5) will be triggered and breath hold time will be reduced (1). The inability to maintain a breath-hold on cold water submersion after helicopter ditching contributes to the 20–50% mortality rate in otherwise survivable accidents (2). The potential time to escape a ditched and inverted helicopter may vary between ideal (28s) and rough sea-state conditions (92s; 4). In order to reduce the risk of drowning, Emergency Breathing Systems (EBS) are carried in helicopters for passengers regularly flying over cold water (e.g. oil platform workers). This study compared three types of EUBS commercially available at the time of testing (a compressed gas system (CG); a rebreather system (RB); and a hybrid system (H)) with a secondary aim of providing guidelines on the future testing of EBS.

Methods

Eight healthy, non-smoking participants (5 male, 3 female) volunteered for the experiment (mean [s.d]; age 25 [4.5] yrs; height 1.74 [0.11] m; mass 70.12 [8.73] kg). They were non-habituated and were competent swimmers with limited or no prior experience of using EBS. Each EBS was examined during water deployment (Wdep) and over 90 s in cool (25°C) and cold water (12°C) immersion to the neck (Imm), and submersion (Subm). Participants wore standardized clothing, including jeans, t-shirt, cotton shirt, woollen jumper and an immersion dry suit. Measures taken were Wdep time, stay time ([Imm] and [Subm]), and dyspnoea rating on a 10 cm visual analogue scale ranging from (0 cm) – not at all breathless to 10 cm – extremely breathless 10cm) and rated the ease of each device use; comfort of device, ease of breathing, comfort of breathing and overall confidence in the device (Likert scale ranging from 1 (negative rating) to 5 (positive rating).

Results

Mean [SD] data show Wdep was slower in the H (17.7 s) than the RB (10.0 s) and CG (8.1 s). Stay time was greatest in the H (90.0 s) compared to the RB (68.3 s) and CG (87.0 s); stay time in CG was also greater than with the RB. Dyspnoea ratings were greater in the RB (6.5 cm) compared to the CG (2.4 cm) and H (1.9 cm). Across devices, stay time in cold water was shorter ($P<0.05$) during submersion than immersion (85.9 s vs. 70.1 s); all $P<0.05$. During submersion stay time was shorter ($P<0.05$) in cold compared to cool water (12°C: 62.8 s; 25°C: 77.5 s). On average across all subjective responses, H was most highly rated (3.9 [0.6]) followed by CG (3.8 [0.4]) and RB (2.9 [0.4]).

Discussion

All of the devices tested enabled the participants to extend underwater stay time beyond that which has been reported to occur during breath-holding whilst submersed in cold water (5°C) (10 s; 6). It is likely that the use of these EBS would reduce the risk of drowning in a helicopter ditching and inversion. The data suggest that the CG and H devices outperformed the RB device but the H device required longer to deploy. The difference in the performances of each EBS was most discernable during cold-water submersion and it is recommended that this test condition is included in future standards for testing EBS.

References

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