# Pulmonary barotrauma after helicopter underwater escape training

I read with great interest the case report by Lindblom and Tosterud presenting a case of pulmonary barotrauma and cerebral arterial gas embolism after shallow submersions in a pool, breathing compressed air.[1] Their report cites the two other published reports on this subject.[2–3]

In late 1997 I participated in a conference in Birmingham discussing subjects related to helicopter evacuation training for passengers travelling offshore to work in the oil and gas industry. The majority of the participants were representatives from safety training centres. I have filed my presentation at that meeting, but regrettably I am unaware of any conference proceeding or proper reference to the meeting. However, I believe that it would be of interest to reiterate the case report I presented. The information below is retracted from the manuscript I submitted at the time.

The incident took place in an offshore safety training centre outside Bergen, Norway in May 1997. At the time, training was provided for pilots in the offshore helicopter companies as well as crew members of selected helicopter wings of the Royal Norwegian Air Force (RNoAF). During flight, these crew members were provided with small (0.2–0.4 L) 200 bar compressed air cylinders with a demand regulator. The auxiliary gas supply was provided to allow breathing in the event of evacuation from an upside-down ditched helicopter in sea. The crew members were regularly trained in the use of this breathing apparatus in a helicopter model submerged in a 4 m shallow freshwater pool. The training programme would include familiarisation to minimal submersion of the head at the shallow part of the pool, evacuation from the helicopter model in the upright position at surface and finally evacuation from the rotated model at a water depth of approximately 1 m.

The patient was a 28-year-old male, working mainly for the Norwegian Coast Guard (Lynx helicopter). He was previously healthy and had been examined annually according to the relatively strict requirements for military air crew members. He had participated in two simulated helicopter ditches the same day without any problem. He experienced no technical/practical problem during the last (third) ditch, but complained of restrosternal pain about 15 min later. He had no coughing, but the pitch of his voice changed and he experienced vertigo. He was immediately transferred to the naval base and medically examined by myself approximately 30–40 min after the incident. He felt no problem at that time, and medical examination – including a thorough neurological examination – was normal. He had reported vertigo and neurological affection could not be eliminated. Due to this he was recompressed and treated according to a modified USN Treatment Table 6. He was transferred to Haukeland University Hospital the same evening-Neurological examination was without pathological findings. Chest X-ray demonstrated air in the mediastinum. EEG was normal. He was re-examined with a chest CT 1–2 days later with completely normal findings. He returned to air service without restrictions, but has not been followed up by me.

This incident happened 24 years ago and further medical details are unavailable. From a medical perspective, this story adds little additional information to the three cases already published,[1–3] but underscores that pulmonary barotrauma may occur after helicopter underwater evacuation training (HUET). The reason for bringing this to the attention of the journal readership relates to the ongoing debate on HUET training for helicopter passengers travelling offshore. HUET is one of a large number of factors affecting successful evacuation of a ditched helicopter.[4] Passengers travelling offshore by helicopters are commonly supplied with an emergency breathing system (EBS), and the European Commission has prescribed that "*All persons on board shall carry and be instructed in the use of emergency breathing systems*".[5] The European Union Aviation Safety Agency (EASA) Acceptable Means of Compliance states that the "*EBS …should be an EBS system capable of rapid underwater deployment*".[6] There are three commonly applied EBS systems available for such use:

- A conventional SCUBA open-circuit air breathing system with a small container of pressurised gas connected to a demand regulator.

- A rebreather (simply a rebreather bag connected to a mouthpiece) to be filled with expired gas from the passenger.
- A hybrid rebreather with a small cylinder of compressed gas connected to the rebreather bag injecting compressed air once the EBS is immersed.

The UK Civil Aviation Authority has published a draft standard for EBS[7] and categorised them as "*Class A*" and "*Class B*" (CA EBS and CB EBS). CA EBS should be designed to allow deployment in air as well as submerged, while a CB EBS will require deployment in air. CA EBS is accordingly a more robust system. The miniaturised scuba is generally considered to comply with the CA EBS. Passenger training in the use of these EBS varies between jurisdictions. Canada has established a mandatory in-water training programme including underwater breathing of compressed air. UK (OPITO) offshore workers are inducted with theoretical and 'dry' training in compressed air breathing. In Norway offshore workers are exempted by the national civil aviation authority from the EBS training, but basic offshore safety induction and emergency training includes HUET training by means of the rebreather system. One important explanation for these differences is the risk assessment of pulmonary barotrauma associated with pressurised underwater breathing systems. The fidelity of the training will depend on whether the participants are inducted by theoretical training only or whether they are exposed to underwater breathing. Risk assessment will depend on the expected incidence of complications and their nature. Future risk assessments of HUET training with pressurised breathing gas should consider the present case description as well as the three previously published reports[1–3] of shallow water pulmonary barotrauma and cerebral arterial gas embolism.

## References

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6 Executive Director decision 2016/022/R of 6 October 2016 amending acceptable means of compliance and guidance material to definitions, Part-ARO, Part-ORO, Part-CAT, Part-SPA, Part-NCC, Part-NCO and Part-SPO of Regulation (EU) No 965/2012, (2016).

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