

Immersion Pulmonary Oedema (IPO) Diving Incident

This is a summary of an Immersion Pulmonary Oedema (IPO) incident that occurred during refresher training conducted by a police diving unit. The purpose of this summary is to highlight the risk and presentation of an IPO incident which can occur at any time in routine diving.

At an inland freshwater location, police divers were conducting search training scenario's with divers diving in pairs on SSBA to a maximum depth of 42 metres. The fourth training dive for the day commenced at 1405. Divers Alpha and Bravo dived on a 42 metre decompression table with a bottom time of 15 minutes. Alpha is a Part 3 (SSBA to 50m) qualified Diver and has completed approximately 180 logged dives as a police diver. As such, he is considered an experienced diver.

This DCIEM decompression table called for two decompression stops, the first at six metres for six minutes and the second at three metres for nine minutes. In this location, the majority of the dive time is spent descending slowly to the maximum depth along a sloping bottom and then ascending slowly to the decompression stops, therefore the uptake of inert gas is minimal compared to the actual uptake on the square dive profile used to calculate the diving table. Less than three minutes was spent at the maximum depth on this dive. This dive was therefore considered a conservative profile.

Another diver who completed the same diving profile at the same location, the previous week, using his personal diving computer, reported a two minute deco requirement only, at a three metre depth.

'Okay' checks were conducted on diving comms throughout the dive and Alpha was reported as okay by himself or Bravo on four occasions before returning to a shot line at 12 metres where he again reported as okay before commencing decompression stops. On reaching surface, Alpha removed his full face mask and said he needed help. It was evident from his appearance that he was in distress and his skin colour was poor. He was having trouble breathing and complained of having a full chest, 'he felt flemmy'. Emergency procedures were instigated. His equipment was removed and he was placed on a 100% O₂ rebreather mask by the dedicated Diving Medical Technician (DMT). His oxygen levels were measured at 77%. An ambulance was requested to the scene and preparations were made for evacuation to the surface from the diving pontoon.

In debrief Alpha reported that he felt fine throughout the dive and had no sign of any issues until the time he was at six metres, where, after about four minutes at that depth he developed a minor cough. At that time he was not concerned about the cough but noted that it didn't go away and become gradually worse as the deco continued. They came up to the three metre mark and after approximately two minutes he felt the cough get wetter, feeling like he needed to spit. This continued to worsen during deco and he felt like he was ingesting water and was now feeling quite uncomfortable. With about one minute remaining on deco, he recalls feeling very claustrophobic and just wanted to get his AGA mask off, spit out the phlegm and get air into his lungs. When told to ascend to surface he felt foam expanding in his lungs and felt it coming out of his mouth and nose. He removed his AGA when on surface and wanted to breathe in a big breath to spit out the congestion in his chest but didn't feel he was able to do so. He was very anxious at this time.

This location has a floating surface pontoon. Egress is via a steep ramp and ladder which must be negotiated before an approximate 30 metre walk up a steep incline to ground level. Numerous emergency evacuation drills have been practiced by the diving unit at this location during previous training. The Ambulance call centre was contacted, as was the 'Diver Emergency Service' (DES) where a specialist hyperbaric Doctor was appraised of the situation. The onsite Recompression Chamber was prepared for use (doors opened and gas turned on) and a driver was sent to the highway to meet and guide the ambulance to the location.

The Ambulance was guided in, and after an initial assessment on the pontoon, Alpha was evacuated out of the sinkhole to the surface in a stokes litter by approximately eight officers, He was then conveyed to the regional Hospital. In direct consultation with the DES Doctor, Alpha was given an x-ray and an ultra sound which detected liquid in his lungs. Alpha was given 'Continuous positive airway pressure' (CPAP) therapy to keep his lungs pressurised to maximise O₂ uptake and reduce body fluids in his lungs. A medi-vac was directed to the CBD hospital. Alpha was subsequently relayed by fixed wing aircraft to the city at approximately 2200 hours. In the early hours of the morning he was given a hyperbaric treatment in the recompression chamber which finished at approximately 0600. The initial diagnosis at this time was both Immersion Pulmonary Oedema (IPO) and Decompression Illness (DCI). A shorter follow up treatment was conducted at 1100, and after a very rapid recovery Alpha was released from hospital that afternoon. The final diagnosis was given as Immersion Pulmonary Oedema. (An abnormal accumulation of fluid in the lungs caused by immersion). Subsequent conversation with the treating Doctor, indicates that no specific cause can be identified. Alpha has recovered well and will be reassessed for operational diving duties following future medical testing. A hot debrief was conducted immediately following the incident. Those present, including Interstate Police Divers, did not identify anything which could have been done better. A Unit debrief was held on the 4th March, the incident was discussed in full detail by Alpha and others present on the day. A hyperbaric Doctor was requested to attend the debrief but none were available. A synopsis of the debrief with recommendations was prepared and disseminated within the unit.

Over-hydration is listed as a cause of IPO, the comment from the treating Doctor was that you need to be well hydrated, to minimise the risk of DCI, but don't over hydrate to minimise the risk of IPO.

Main Debrief Points:

- Alpha in hindsight admits he should have advised of his issue before surfacing, particularly in the last two minutes when he began to feel very claustrophobic, His decision in part was influenced by concern that he would be required to go into the Recompression Chamber for not completing his decompression protocols.
- In this incident, the minimal risk of suffering from DCI given the profile and deco already completed was more than offset by Alpha's rapid decline and the delay in access to O₂. Supervisors should always consider the potential for IPO in similar circumstances and risk assess the early cessation of decompression.
- Immediate access to O₂ upon surfacing may have prevented Alpha slipping into unconsciousness given his low O₂ saturation levels when he was initially tested within approximately one minute of surfacing.
- The ambulance officers were quite concerned initially about how Alpha would be evacuated. They subsequently provided praise for the way in which it was managed. Previous emergency drills conducted at this location ensured a safe and efficient evacuation in a real emergency.
- Early contact with the Diver Emergency Service provided specific hyperbaric advice to the emergency doctor at the regional Hospital prior to Alpha's arrival. This very likely hastened his diagnosis and treatment. Previous experience has shown that some Doctor's have little to no experience in diagnosing diving related illnesses.