



# Immersion Pulmonary Oedema

In recent years there has been a growing interest in Immersion Pulmonary Oedema (IPO) as a factor within diving incidents. Although originally reported in the 1980s the condition was until recently thought to be rare.

## Increasing awareness

Immersion Pulmonary Oedema (IPO) was originally reported in a medical journal in 1981 by Dr Peter Wilmshurst and others based on investigations into a number of divers with the condition. Further presentations to the Undersea Medical Society and BSAC Diving Officer's Conference (DOC) took place in 1984. A paper based on this work was published in the Lancet in 1989.

Until recent times the condition was thought to be rare but within the last 5-6 years consideration of the circumstances of diving incidents appears to be showing evidence of IPO being a significant factor. BSAC began highlighting the possibility within the Annual Diving Incident Report from 2016 onwards and Dr Wilmshurst has presented on the subject at two BSAC Diving Conferences (2014 & 2017).

At the 2017 BSAC Diving Conference, Dr Wilmshurst stated that IPO is probably the most common cause of death during sub-aqua diving and triathlons. He pointed out that two thirds of triathlete fatalities occur during the swim phase of the event. He said that the precise numbers are not known because it can be easily mistaken for drowning. Dr Wilmshurst said that IPO can affect the super-fit, but that high blood pressure, undiagnosed heart disease and the normal effects of ageing are exacerbating factors. Cold water and exertion increase the likelihood of an IPO

occurring and he also stated that divers should avoid excessive hydration before a dive. This runs contrary to prior advice to be well hydrated before a dive to reduce the potential for DCI, which he said was unproven and probably of limited effect.

Over recent years within the BSAC Annual Incident Report a number of the incidents described in the associated synopses have been confirmed by medical assessment as involving IPO in the casualty; a number of divers survived by immediately leaving the water and attending hospital. To date 26 incidents have been identified in the entire database (1997-2018) where IPO has been confirmed and for the 2014-2018 reporting years, 73 incidents have been identified where IPO is suspected of being a factor from the synopsis using the factors described within the Annual Reports in recent years.

Since highlighting the importance of IPO for divers in 2014 a number of articles, including personal experiences of suffering IPO, have been published in SCUBA magazine raising awareness.

Pulmonary Oedema may be confused with drowning as both conditions result in fluid collecting in the lungs. First Aid treatment is however likely to be the same for both.

## Causes of IPO

Pulmonary oedema is when fluid passes out of the alveolar (lung) capillaries into the alveolar sacs. IPO is when the cause is immersion.

When we are immersed in water, the hydrostatic pressure causes compression of leg veins. As a result blood that normally pools in the legs is pushed centrally into the chest. The increased central blood volume increases the pressure in the alveolar capillaries and may cause fluid to leak into the lungs and cause difficulty breathing and if not corrected can cause death.

It has been known for some time that high blood pressure carries increased risk of pulmonary oedema, which is why it forms one of the screening questions on a diving medical form. What was previously less understood is that very strenuous exercise could trigger IPO. This had previously been reported in military divers under extremes of training. That level of extreme exercise might arise in diving for example when attempting a rescue of another diver or fighting a current.

## Recognition

BSAC are continuing to consult with an expert to ascertain if IPO is likely in incidents where the description of the incident implies an IPO may have occurred. Whilst the body of information and evidence develops we believe it continues to be important to remind divers to be aware of factors that could indicate IPO which include:-

- Divers with breathing difficulties when not exercising particularly strenuously. Breathing difficulties may be indicated by rapid, uneven or heavy breathing, or coughing uncontrollably.
- Confusion, swimming in the wrong or random directions.
- Inability to carry out normal functions, whilst appearing to have to concentrate on breathing.
- Belief that a regulator is not working properly.
- Indication of 'out of gas' when their regulator(s) are found to be working correctly and with adequate gas supplies.
- Divers refusing or rejecting an alternate source when 'out of gas'.
- Indication of difficulty of breathing when on the surface.

## Treatment

Advice from the medical experts at this time is that if you experience breathing difficulties underwater you should terminate the dive and ascend safely and exit the water. If you recognise any of the above factors in a buddy then assist them from the water as quickly as it is safe to do so.

Once out of the water the casualty should :

- sit upright if conscious,
- be given oxygen,
- keep warm,
- do **NOT** give fluids

It is essential that should any of the above symptoms occur that medical advice be sought.

## Return to diving after IPO

Following a suspected or confirmed case of a diver suffering from an IPO it is essential that the diver seeks examination from a diving doctor who is familiar with the condition. The diver should avoid re-entering the water until medical advice has been obtained and confirmed it is safe to resume in-water activities. It is now well understood that even mild symptoms significantly increase the likelihood of recurrence upon subsequent immersion.

It should be noted that the triggering situation for the condition is immersion in water and not just diving. Consequently, the affected snorkel diver should avoid all forms of immersion including snorkelling, scuba diving, swimming, especially in open water. Extreme exertion, such as in the swimming leg of Triathlon events, can also contribute to the risk of subsequent IPO.