Reflections on BTT

We shall examine several articles and publications:

- https://pdfs.semanticscholar.org/e509/42eb5c492d7a7f1882f0695539db23a70643.pdf
http://www.freediving.biz/education/laryngospasm.html

- https://www.sciencedirect.com/science/article/pii/S0750765800800088

- https://www.srlf.org/wp-content/uploads/2015/11/0912-Reanimation-Vol18-N8-p702_707.pdf

- **Document pdf 1 : Drowning, an inventory in 2014. Michelet P, Bouzana F, Bessereau J Pôle RUSH, Assistance Publique des Hôpitaux de Marseille, CHU La Timone, Marseille**

- **Document pdf 2 : National Association of First Aid Instructors and Monitors - P. CHAVADA - 2018**


The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

CURRENT CONCEPTS

Drowning

David Szpilman, M.D., Joost J.L.M. Bierens, M.D., Ph.D., Anthony J. Handley, M.D., and James P. Orlowski, M.D.

- **Document pdf 3 : Drowning: Towards greater medical understanding**
P. Michelet – Urgences Timone 2

- **Document pdf 4 : The General Directorate for Civil Protection and Crisis Management recommendations**

- **Document pdf 5 : Drowning and cardiac arrest; Pre-hospital care. Les Jeudis de l'urgence December 18, 2014**

- **Joseph Mayon et al. Drowning, Update 2009, Anesthesiology, 2009, 110 : 1309 – 1401.**

- **B Robinson et al, Natural disasters and the lung, Respirology, 2011, 16: 386 – 395**

- **UM Shilling et al. Drowning, Minerva anaesthesiologica, 2011, 78 (1): 69 – 77 D Szpilman et al, Drowning, The New England Journal of Medicine, 2012, 2 (366): 2102 – 2110**

- **PK Suominen, Neurologic long term outcome after drowning in children, Scandinavian journal of trauma, resuscitation and emergency medicine. 2012, 20 (55): 1 – 7**

- **A. A. Topjian, Brain resuscitation in the drowning victim, Neurocrit Care, 2012, 17 (3) : 441 – 467.**

Based on an existing concept: apnea, and more importantly, apnea diving or freediving is, by definition, a voluntary cessation of breathing. Through their will, the subject stops breathing, therefore the breathing mechanism no longer functions (no inspiration, no expiration).

Assuming that the freediver dives with their lungs full (after an inspiration), they will hold their breath for as long as they can.

In the event of hypoxic blackout, the subject no longer having enough oxygen to supply their brain, they will lose consciousness and switch to the reflexive breathing mechanism.

The previous texts have demonstrated that if the subject is immersed, a laryngospasm response may occur to protect the subject from drowning.

This laryngospasm is not automatic, i.e. it is not a recurrent response in the event of blackout.

Therefore, it is considered to be a response to a loss of awareness and consciousness due to extended apnea i.e. hypoxia, AND to the fact that the subject is underwater.

It was also explained to us that this laryngospasm would not have a defined duration, it could last up to 120 seconds but could just as easily stop in a few seconds.

What is clearly established in all the observations on this subject is that no doctor or scientist can give a definite response to this question. This whole study is based on conjecture.

In the case of freediving, three scenarios are considered:

- **the subject experiences a blackout at the surface** following a severe samba. In this very specific case, the subject seems to recover their senses quite quickly and be almost out of danger if their airway is clear of water; the BTT process appears to be the recommended and preferred approach, because "natural" and reflexive breathing will be triggered within seconds after loss of consciousness (nevertheless, since the subject was previously immersed and in apnea, there is every reason to believe that this may continue from a few seconds to almost two minutes). In theory, the subject will have stopped breathing but will not be in respiratory distress, (there is currently no scientific proof). Moreover, there is no evidence that this blackout, although apparently harmless and the result of a "simple hypoxia", is actually no more serious than it appears (not a simple blackout with loss of consciousness, but a more serious accident, such as a stroke, pneumothorax, pneumomediastin, decompression sickness, etc,)

- **the subject experiences a blackout underwater. There are two possible scenarios:**

- a) It is assumed that laryngospasm occurs after air is expelled (for an undefined period of time), thereby protecting the freediver. It is difficult to perform rescue breaths on the freediver who arrives at the surface in this condition precisely because they are protected by laryngospasm.

- b) The same phenomenon applies here, except that in this case, the subject being underwater, if the laryngospasm stops, the reflexive recovery breathing mechanism will kick in; chronologically: 1. Expiration 2. Presumed laryngospasm, (the apnea subject left with full lungs) 3. Inspiration which will transform into inhalation because the subject is underwater. In this specific case, if the subject reaches the surface without having inhaled water, either due to a safety diver intervention, or because the blackout occurred near the surface during ascent, or by chance, the subject will surface unconscious and have stopped breathing. Then we are dealing with a freediver blackout without laryngospasm, who is not breathing even though they have already exhaled. As a result, they have not just stopped breathing but are also suffering from respiratory distress (lack of oxygen supply to the brain).

BTT recommends leaving the blackout subject on their back, blowing on the receptors around their airways in order to allow them to recover normal breathing, assuming that the laryngospasm protective effect prevents water from entering (by shutting down the breathing response mechanism) but still allows gas exchange (respiration).

Another BTT recommendation is that if after a few seconds the subject has not recovered consciousness, rescue breaths should be performed to provoke a reflex and relaunch the breathing mechanism.

In this specific case, and following rescue breaths, in the majority of cases the subject will resume normal breathing.

Instantaneous rescue breaths (blowing air into a subject after their recovery or return to the surface) requires a direct flow of air, by mouth to mouth or mouth-to-nose rescue breaths, in order to quickly trigger and restart reflexive breathing.

The opinion and analysis of Doctor CARL WILLEM, hyperbaric physician

"Here are some interesting excerpts from a freediver's perspective on the subject of simple hypoxic blackout.

He advocates the Blow Tap Talk technique to wake the freediver and claims that rescue breaths from the outset could be responsible for drowning by releasing the laryngospasm or risk triggering vomiting with a passage of food into the lungs by false swallowing.

It is very intriguing to note that in this excerpt there is no scientific evidence but only conjecture, which is admitted by the author.

In any case, it is known from a reliable and scientifically verifiable source that hypoxia can be aggravated by IPE or lung squeeze and/or drowning.

In this case, hypoxic blackout is the consequence of a pathology that can be severe and in this case CPR protocol should be the first choice.

There is still no scientific evidence to suggest that in hypoxic blackout there is ***complete or incomplete*** *laryngospasm and therefore no risk of drowning.*

What is the role of the soft palate? Vocal cords in the airway obstruction that could protect the freediver from drowning? Nobody really knows for sure! Therefore, once again, the precautionary principle overrides all other techniques.

When blackout occurs underwater, how can we tell if there has been even the most minimal inhalation of water, even in the event of the rapid and apparently effective intervention of a safety freediver? (In 1 recently observed case the characteristic IPE pulmonary lesions and drowning lesions were identified in the scan): these would be impossible to detect without imaging.

Assessment of the level of consciousness is also an issue in the analysis; in hypoxic blackout, there is some reference to semi-unconsciousness.

In the medico-legal document constituting the WC 2019 emergency plan, I stipulate that the first contact with a victim who has stopped breathing should be initiated by stimulation as a rule, but this does not imply the "Blow Tap Talk" protocol: removing the mask, touching the victim, applying pressure to the body, making noise, exposing them to wind, or blowing on them are naturally practised stimulating measures. If this is not effective, we recommend following up with 3 gentle rescue breaths: mouth to nose (or mouth to mouth if no trismus exists making it ineffective).

If there is any doubt about inhalation and therefore drowning or non-hypoxic cardio-respiratory accident, then immediately switch to the CPR protocol, i.e. 5 breaths from the outset.

O2 should be used as quickly as possible with a mask that leaves no respiratory strain.
I also recommend that a floating 02 bottle be made readily available for victims so that it can be administered as quickly as possible.

It is now clear that there is no scientific evidence to support the management of hypoxic blackout (which may be more complicated than expected) without giving priority to respiratory distress.

Science and new experimental practices are constantly generating new insights.

"Since most freedivers suffering from blackout do not "wake up" within 10-15 seconds - whatever we do - these seconds could be used to move the victim to a safer area where other actions can be undertaken.

In practice: moving the body onto a low platform instead of practising BTT or RB. ***It is possible that the TIME itself and moving the victim are as effective as BTT.*** *The body feels a touch, there is noise and wind - stimuli that may work almost as well as direct BTT. Even if there is no natural recovery, we now have the body out of water on solid ground where various other actions can be taken that would be impossible or even risky in water.*

"Over the past 10 years, the freediving community has developed many procedures to improve freediving safety. Techniques and procedures for handling blackout accidents caused by prolonged breathing failure leading to hypoxia.

"However, there is still a division in the freediving world in relation to certain details. While some advocate: "A quick blow of air into the lungs" (the so-called rescue breath) - Others consider: "That it is impossible to blow air (against the supposed laryngospasm) into the lungs of a blacked out diver."

There are differences in the way safety techniques are taught. Is there one right way? Have we found the ultimate response to blackout (BO) ? ***No one can really say for sure.*** *There could be techniques that are similar yet very different, which can be more or less equal in terms of efficacy."*

"Unconsciousness is sometimes classified according to certain levels (The Glasgow coma scale ranges from 3-15 levels). Scientists have started to believe that the blackout suffered by freedivers is a form of semi-unconsciousness."

A respected scientist (Christopher W. Dueker) claims:

"A person who /…/ loses consciousness in the water will not have protective laryngeal reflexes." and " a breath-hold diver who loses consciousness will not develop laryngospasm".

"However, we know from experience that there is a sealing process: freediver laryngospasm (FLS) or the soft palate? The soft palate cannot be sealed if the head is tilted back. In this case, the body must rely solely on FLS to prevent water from entering the lungs (or their diving buddy to control their head)."

"If water enters the lungs even in small amounts such as a couple of deciliters, there is a risk of drowning."

"According to estimates by doctors and scientists, laryngospasm in drowning can last up to 2 minutes, although this can sometimes vary."

"In most victims the laryngospasm relaxes sometime after unconsciousness and water fills the lungs resulting in wet drowning", Christopher Dueker (MD)

"There is nobody present to measure the duration of a laryngospasm and the exact time it was initiated."

"There is also confusion as to the type of closure and what parts are involved: vocal cords, larynx, epiglottis."

"BTT signifies (blow tap talk):

1) Expose the face to air - remove all facial equipment (mask, noseclip, goggles).

2) Stimulate breathing by blowing hard and close to the face (nose, eyes).

3) Talk to the subconscious (make the victim feel safe, say their name, tell them where they are and that they are safe and that they can start breathing).

4) Contact the subconscious mind through touch. Tap them on the cheeks, squeeze their arm, even stroke and caress it, it is all about making the victim feel safe, safe enough so that they can initiate the release of the FSL (laryngospasm) "by themselves" (subconsciously)."

"If you feel you can blow air into the victim and the victim is still unconscious then CPR is required."

"To date, there has been limited interest in understanding or developing resources to explore laryngospasm in trained freedivers."

The Position et analyse of Professeur MICHELET, Chef de Service - Service des Urgences Timone 2, Assistance Publique des Hôpitaux de Marseille, Coordinateur DES de Médecine d'Urgence, Aix Marseille Université.

Laryngospasm is a reflex reaction mainly found in children and does not involve the awakening of the victim. Consequently, blackout and laryngospasm are compatible.

Laryngospasm is regularly discussed but its frequency is completely unknown (it appears to be more common in children in drowning cases), these are specialist opinions that must of course be taken into account, but which are lacking in solid scientific data.

The problem is acute hypoxemia and its consequences. The brain is unable to tolerate this aggression, especially in victims who are undergoing physical exertion. In my opinion, neither blackout nor neurological manifestations should be downplayed. Until proven otherwise, "samba" is a hypoxemia seizure, a reflection of the brain's suffering.

It is impossible for me to consider this otherwise and we must do everything we can to ensure that this suffering ends quickly.

Patients who experience generalised seizures sometimes feel quite well afterwards and do not necessarily complain, therefore we do not expect complaints from victims, which does not detract from the potential severity.

In this respect, your conclusions are satisfactory to me because the sooner the brain recovers an oxygen supply, the better. What about the long-term brain status of athletes who have experienced multiple episodes? I believe that we must do everything we can to preserve the neurological future of these athletes.

The freediver suffering from blackout is in respiratory distress expressed as acute hypoxemia. The physiology of diving is consistent with this and we are aware that hypercapnia does not cause such acute disorders.

At the same time, I am a little less worried about inhalation and drowning if there are witnesses present. Certainly, it can be observed on films and reports that as soon as the victim is seen and given the frequent surface proximity, they are rapidly secured against this risk. Of course, in the absence of witnesses, we know that shallow water blackout can be fatal, notably through drowning and/or persistent brain damage.

During emergency rescue, the evolution is excellent, but the hypoxemia must be corrected!

In the case of mouth-to-mouth/nose rescue breathing: the guidelines for managing cardiac arrest by drowning should be kept in mind.

Cardiac arrest is hypoxemic and therefore breathing should be restored (synonymous for me with oxygenation) by the first-aider if necessary.

When we treat children suffering from drowning in a short time period, we often find that rescue breathing alone causes everything (heart, breathing and even consciousness) to return.

I don't believe in the risk of vomiting through mouth to mouth alone, otherwise we would have known about it a long time ago in relation to drowning.

Finally, I share the view of population changes, with older divers potentially affected by cardiovascular diseases, which adds both risk and the need to ensure rapid re-oxygenation.

In view of this and considering that:

- Each person is unique and will react differently to an accident
- We can never be sure that the freediver suffering from blackout has solely stopped breathing or has associated respiratory distress.
- We are never certain that blackout is induced solely by a relatively simple hypoxia or by another more serious phenomenon (squeeze, OPI, pneumothorax, cardiac arrest, stroke, DCS, DCI etc….)
- The **brain needs a supply of O2 in order to function and not have its processes altered**
- It has been demonstrated that, when the larynx is blocked by laryngospasm, if the patient still has breathing reflexes or contractions, respiratory depression exists in the lungs and as a result **flooding of the lungs by plasma, surfactant etc.**
- There is a lot of evidence that new practices allow poorly trained subjects to descend to great depths without first adapting to pressure (Mouth Fill, packing techniques, etc...), thereby inducing and creating mechanical injuries if depression is strong and/or the lungs weakened (more and more people are prone to pulmonary squeeze or oedema when training on Mouthfill or empty lungs)
- Most of the time and in most cases, rescue breathing, especially if the laryngospasm has stopped, will restart the breathing mechanism.
- In considering the **precautionary principle**, a subject who has stopped breathing must recover normal breathing as **quickly as possible**
- In France, in the event of drowning or suspected water inhalation, **the first-aid precautionary principle recommends 5 mouth-to-mouth or mouth-to-nose rescue breaths**

Accordingly, we have reached the following conclusion and recommendations:

With regard to club practice composed of training without an "equipped" medical team:
BTT is recommended, with a relative delay of a few seconds before switching to rescue breaths + 02

With regard to competitive practice, with the objective of maximum performance with a fully equipped medical team:

1. **As a precautionary principle, it is highly recommended to prefer rescue breaths after the loss of consciousness in a practising freediver, especially in deep water.**
2. **This method must be carried out by a person with prior training in first aid procedures alone and/or in a team comprising artificial ventilation techniques**
3. **The victim should be taken as quickly as possible to the medical team best able to respond.**

Acknowledgements:

- Docteur Carl WILLEM, *Médecine du Sport (D.E.S.C. UCL) Médecine Tropicale (D.E.S.C. UCL) Médecine Hyperbare et Sub-aquatique (D.I.U. ULB, UA) Médecine Générale (D.E.S.C. UCL)*

- Docteur Philippe AFRIAT, *Docteur en médecine, Capacité de médecine du sport Marseille, Diplôme inter universitaire de traumatologie du sport Marseille, Diplôme inter universitaire de cardiologie du sport Paris, Diplôme inter universitaire de médecine subaquatique et hyperbare Marseille, Diplôme d'échographie de l'appareil locomoteur Paris Médecin libéral spécialiste en médecine du sport échographie diagnostique et interventionnelle Monaco*

- *Claude CHAPUIS, Maître de conférence à l'UFR STAPS de Nice, Brevet d'Etat de Plongée Subaquatique, Instructeur International de Plongée en Apnée, fondateur de AIDA*

- *Cédric PALERME, Brevet d'Etat de Plongée Subaquatique, Instructeur International de Plongée en Apnée, Expert en entrainement en apnée profonde, Juge International AIDA*

- *Pierre FROLLA, Brevet d'Etat de Plongée Subaquatique, Instructeur International de Plongée en Apnée, Expert en entrainement en apnée profonde et en Sauvetage Aquatique et Subaquatique, Coordinateur des Activités Subaquatiques au sein de la FMAS, Directeur du Centre de Sauvetage Aquatique et de Plongée de Monaco*

- *Frederic BUYLE, Instructeur International de Plongée en Apnée et en Plongée Scaphandre, Expert en entrainement en apnée profonde, Environnementaliste*

- *Professeur Pierre MICHELET, Chef de Service - Service des Urgences Timone 2, Assistance Publique des Hôpitaux de Marseille, Coordinateur DES de Médecine d'Urgence, Aix Marseille Université*

- Prof. Yann-Erick Claessens, Department of Emergency Medicine, Centre Hospitalier Princesse Grace, 1 avenue Pasteur BP489, MC-98002 Principauté de Monaco

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