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Description of an eye barotrauma in scuba diving with clinical discussion

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ABSTRACT

In this paper we report and discuss a scuba diving accident caused by compression of the mask at a depth of 9.1 m resulting in conjunctiva haemorrhage of both eyes in a 21-year-old male. After five weeks and benefiting from immediate post-accident medical attention and medication followed by ophthalmologic examinations the patient recovered with no chronic effects neither in vision nor in the eyes.

1. Introduction

As recognized by authors[1,2], eye barotraumas are a potentially threatening vision lesion that may occur during scuba diving when there is a difference between pressures at a given depth which may lead to damage of the eye and periocular structures. Deficient adaptation of the diving mask to the face together with diving techniques are accepted as main causes[3]. Eye barotraumas are easily avoided if the diver regularly equalizes internal mask air by blowing small amounts of air through the nose[4,5]. The use of swimming goggles for diving is as such not advisable since mask compensation is not possible[5]. With the spread of recreational diving all over the world, the importance of reporting accidents and updating literature on diving medical conditions is of the utmost importance[6].

In this paper we describe an eye barotrauma and its clinical treatment until total recovery of the patient while also discussing its causes and immediate after accident medical actions.

2. Accident description

While diving in a shallow area of Angra do Heroísmo's Bay, Azores, Portugal and under proper supervision by one of us (JPB) who is a certified diving instructor, a 21 year old male spent 23 min at a maximum depth of 9.1 metres. During all the dive time he was constantly checked and no signs of distress or pain were communicated to, or noticed by, the instructor. When at the

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surface, however, the patient showed a marked edema in upper and lower palpebrae from both eyes, presenting an erythema of violaceous coloration suggesting a bilateral periocular ecchymosis (Figure 1). Immediately subjected to a medical examination by one of us (PB), an experienced internal and aerospatiale medicine physician, the patient opened both eyes with no difficulties showing a symmetrical conjunctiva hemorrhage but with no pain, itching, burning or vision alterations.

A neurological examination was also performed on the spot and showed no affection of visual acuity as well as normal eyeball movements, wide field vision and pupillary reflexes. Physiological additional examinations were normal with no changes/alterations of vital signs or concerning any organ or system.

Figure 1. Patient's eyes immediately after diving at a depth of 9.1 m during 23 min in Angra do Heroísmo Bay, Azores, Portugal.

3. Prophylactic measures and pharmacological prescription

With the diagnosis of conjunctival hemorrhage caused by barotrauma and probably aggravated by the manual pressure that the patient revealed to have made many times during the dive since he felt the need to compress the mask because it was displaced; a visual rest was prescribed with dark sunglasses and topic application of prednisolone acetate, neomicin sulfate and polymixyn sulfate eye drops. Posology recommended was of two drops in each eye for eight hour intervals.

4. Medical surveillance during the first week

Until the 29th August the patient was observed daily and while the palpebral edema and ecchymosis diminished in three days the conjunctival hemorrhage showed a slower absorption.

Upon the patient's returned to where he lives, Lisbon (PT), he was observed by an ophthalmologist who confirmed the initial diagnosis and did not detect any further eye lesions maintaining the above therapeutical procedures until a full reabsorption of the lesion.

5. Full recovery after five weeks

The patient kept the original medical prescription and showed full recovery from all lesions by the 3rd October (Figures 2–5).

Figure 2. The patient's eyes after two weeks showing a disappearance of the palpebral edema but still with wide hemorrhage.

Figure 3. Overall symmetrical reabsorption of hemorrhage after three weeks.

Figure 4. Hemorrhage diminishment after four weeks although showing asymmetry especially in the lateral margin of the right eye.

Figure 5. Patient's eye by 3 October 2016 showing complete hemorrhage absorption and total cure.

5. Discussion

Scuba diving accidents are extensively reported in international diving authorities' fact-file publications[7] and many newspapers and webpages throughout the world. Fatalities are regularly reported and discussed mainly by Vann and Lang[8]. While rare, scuba diving accidents do occur and a vast majority of fatalities are mainly caused by asphyxia, drowning and cardiac problems[9]. However, the low number of fatal accidents, less than 10^{-6} (0.0001 percent) may be considered negligible[9] and recreational scuba diving is now considered a safe activity when properly monitored.

Benign accidents such as the one described here are probably much more common since several occurrences are described as anedoctical in newspapers and outreach publications. newspapers and outreach publications. However, this case happened at a low depth equivalent to a pressure of 1.9 bar. Would it be higher and the probable outcome would certainly be more serious. A similar accident reported by the World Recreational Scuba Training Council[10] was also with no consequences probably because of immediate medical attention such as the one we describe.

As specified by De Sá *et al*.[1] and Salahuddin *et al*.[6] diving standards and medical procedures should be of high relevance for any person experiencing scuba diving. Since this activity is indeed growing worldwide and even becoming common, proper training of monitors and insctructors is more than ever an absolute necessity.

Conflict of interest statement

We declare that we have no conflict of interest.

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References

[1] De Sá MFA, Rodrigues MPM, de Mendonça RC, de Sá JCA. [Ocular barotrauma during scuba diving]. *Rev Bras Oftalmol* 2011; **70**(6): 419-21. Portuguese.

[2] Yeoh R, Yeoh R, Singh M. Barotraumatic ocular haemorrhage sustained while scuba diving. *Clin Experiment Ophthalmol* 2008; **36**(6): 581-2.

[3] Butler CFK Jr. Diving and hyperbaric ophthalmology. *Surv Ophthalmol* 1995; **39**(5): 347-66.

[4] Rudge FW. Ocular barotrauma caused by mask squeeze during a scuba dive. *South Med J* 1994; **87**(7): 749-50.

[5] Butler FK, Gurney N. Orbital hemorrhage following facemask barotrauma. *Undersea Hyperb Med* 2001; **28**(1): 31-4.

[6] Salahuddin M, James LA, Bass ES. SCUBA medicine: a first responder's guide to diving injuries. *Curr Sports Med Rep* 2011; **10**(3): 134-9.

[7] Lippmann J. Recreational scuba diving and snorkelling safety in Australia: an identification, summary and analysis of policies, legislation and standards relevant to recreational scuba diving and snorkeling. Sydney: Royal Life Saving Society Australia; 2008. [Online] Available from: http://www.royallifesaving.com.au/__data/assets/pdf_file/0013/4045/Scuba_Diving_Report_Final_2008.pdf [Accessed on 25th November, 2016]

[8] Vann RD, Lang MA, editors. Recreational diving fatalities. Proceedings of the Divers Alert Network; 2010 Apr 8-10; Durham, North Carolina. Durham: Divers Alert Network; 2011.

[9] Denoble PJ, Marroni A, Vann RD. Annual fatality rates and associated risk factors for recreational scuba diving. In: Vann RD, Lang MA, editors. Recreational diving fatalities. Proceedings of the Divers Alert Network; 2010 Apr 8-10; Durham, North Carolina. Durham: Divers Alert Network; 2011. p. 73-85.

[10] World Recreational Scuba Training Council (WRSTC). Dive standards and medical statement. Florida: World Recreational Scuba Training Council; 2006. [Online] Available from: http://wrstc.com/standards-downloads/ [Accessed on 12th November, 2016]