

## **HBO<sub>2</sub> in snake envenomation (*atrox albinus* rattlesnake): a case report in a human**

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### **ABSTRACT**

A patient suffered from an envenomation that, at his hospitalization, was judged severe: Grade 3 out of 3, as defined in clinical studies for CroFab™ antidote [Crotalidae Polyvalent Immune Fab (Ovine)]. In addition to the usual antivenom treatment we applied adjunctive hyperbaric oxygen (HBO<sub>2</sub>) therapy. Our aim was to facilitate better control of the lesions, already presenting as problematic wounds and at high risk of necrotizing soft tissue infection with compart-

ment aspects. The regimen consisted of six treatments, one daily at 2.4 atmospheres absolute at 25 minutes x3 (75 minutes) at FiO<sub>2</sub>=1, with two five-minute air breaks interposed. The therapy was well tolerated in spite of the patient's declared trait of claustrophobia. Our findings at a long-term follow up suggest that HBO<sub>2</sub> therapy may be reasonably and effectively administered at least in the post-acute phase of such occurrences.

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### **INTRODUCTION**

During the procedures of the usual daily care of those animals entrusted to him in a dedicated reptile house, the patient received a single-tooth bite to his left hand by one of the most venomous snakes present: an albino *Crotalus atrox* (Figure 1). There was a rapid onset of edema followed by tissue necrosis, as is commonly observed at the bite site in these cases. Even if unobserved in this occurrence, further effects are possible with such bites. This is highly dependent on the extent of venom toxicity: petechiation, disseminated intravascular coagulation (DIC), ecchymoses, myocardial lesions and renal necrosis [1].

### **MATERIALS AND METHODS**

#### **The patient**

A 61-year-old male. Soon after the bite he self-applied a tourniquet [a behavior to be avoided as an inadequate maneuver: traditional tight (arterial) tourniquets are not recommended (level of evidence: E) [2,3]] and moved on his own to the local emergency department, where he was found conscious, cooperative and hemodynamically stable.

The wound was a Grade 3 of 4, as per its contamination. It was further evaluated using the MESS index (Mangled Extremity Severity Score), netting a score of 4-6 points as per risk of amputation: 1-2 points were assigned due to the injury (kind of energy involved in the lesion); 0-1 for aspects related to the cardiovascular impairment; 1 for ischemia; and

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**KEYWORDS:** snake bite, envenomation, hyperbaric oxygen, adjuvant, therapy



**Figure 1:** The patient received a single-tooth bite to his left hand by an albino *Crotalus atrox*.



**Figure 2A:** The wound on Day 1 was demonstrating numerous hemorrhagic vesicles and progressing edema. Serous hemorrhagic phlegmons were developing at the wrist and forearm.

**Figure 2B:** Surgical curettage with extensive dressing change and drainage of localized skin bullae, with adjuvant HBO<sub>2</sub> therapy demonstrates an improvement by Day 3.



2 points for the age group of the case. Limbs with scores higher than 6 usually require amputation [4].

The left hand demonstrated numerous hemorrhagic vesicles and progressing edema. Serous hemorrhagic phlegmons were developing at the wrist and forearm, with significant swelling that extended upward to the shoulder. Posterior ecchymotic lesions were present at the root of the arm. The patient, hemodynamically normotensive, developed two transient episodes of hypotension that responded well to intravenous fluid infusion; his medical history (Hx) was already positive for sinus bradycardia. There were no significant changes in motility nor sensorium of the left arm and hand, and ulnar and radial pulses were palpable.

The envenomation was judged as severe, Grade 3 of 3, as defined in clinical studies for CroFab™ anti-dote [Crotalidae Polyvalent Immune Fab (Ovine)] [5], but there were no systemic signs of toxicity. Nevertheless we registered:

- platelet distribution width (PDW) 9.0 fL (reference interval: 9.9-17.0);
- mean platelet volume (MPV) 8.2 fL (reference value: 9.1-13.0);
- mild elevation in aspartate aminotransferase (AST) 64 U/L (10-40 U/L) and alanin transferase (ALT) 109 U/L (07-56 U/L); and
- signs of an initial coagulation impairment with fibrinogen value at 474 mg/dL (reference interval: 150-400), in a hypofibrinogenic condition due to the malnutrition habits registered in patient's Hx, and D-dimer at 725 ng/mL (reference value < or = 250 ng/mL).

The laboratory tests reveal a modest leukocytosis. Diuresis was preserved (at least 1mL/kg/hour). Over the next few hours the patient received intravenous fluid infusion and benzodiazepines for anxiety.

### Treatment

The patient received fluids and antibiotic prophylaxis (amoxicillin/clavulanic acid: 1.2g x 3/die) and a standard initial dose of six vials of CroFab™ antidote [Crotalidae Polyvalent Immune Fab (Ovine)], started six hours from the bite. Four vials were administered immediately at the State Hospital in the Republic of San Marino, the country where the envenomation had occurred. Two further vials were given in Pavia, Italy, under the care of the NHS AntiVenom Center (six vials in total), where the patient had been transported by helicopter with an emergency medical team. A further 12 additional vials were ordered from the United Kingdom as a precaution, but there was no need to administer them. The patient had demonstrated neither acute reaction to the antivenin exposure nor the undesired delayed serum sickness or the potential febrile response sometimes observed.

On the third day of continuing conservative therapy, the patient received surgical curettage, with extensive dressing change and drainage of localized skin bullae, and was then transferred from Pavia back to the San Marino State Hospital for adjuvant hyperbaric oxygen (HBO<sub>2</sub>) therapy. On the following day we were authorized to administer such treatment due to the incipient compartment syndrome that had been diagnosed at the General Surgery Department at the San Marino National Hospital,

The regimen applied: six times, 1 treatment/day at 2.4 atmospheres absolute at 25 minutes x3 (75 minutes) at FiO<sub>2</sub>=1, with two five-minute air breaks interposed. The therapy was well tolerated despite the patient's declared trait of claustrophobia. HBO<sub>2</sub> therapy was continued daily until the patient was discharged.

We observed a progressive and evident healing of the lesions on the patient's left hand. He was able to leave the hospital after six treatments at our Hyperbaric Unit; the patient was then enrolled in a further program of physiatric rehabilitation of the affected arm.

### RESULTS

The cutaneous lesions were healed in 40 days. On exam, eight months from the use of antivenin, standard therapy and adjuvant HBO<sub>2</sub> therapy, the evidence of improvement was limited to subjective feedback using the patient's esthetic and functional 'restitutio' rather than clinical evidence of healed lesions.

Although at follow-up one year from the event the patient noted persistent stiffness of the left hand, with a remaining partial closure of that hand (estimated at 60%-70%), he maintained that he had made a near-complete recovery. The clinical evidence at that time also confirmed this.

### CONCLUSIONS

In this case, hyperbaric oxygen therapy provided a helpful adjuvant treatment for the suspected ischemic areas of the hand and forearm. Previous descriptions of HBO<sub>2</sub> therapy after envenomations appear to show it is reasonable and effective to administer hyperbaric oxygen in the post-acute phase [6,7,8,9].

### Conflict of interest statement

Dr. Camporesi's participation in this paper was in 2015, well before his appointment as editor-in-chief of *UHM* in January 2016.

The authors have declared that no other conflict of interest exists with this submission.



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