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Case Report Open Access

Hyperbaric Oxygen as and Adjust to Management of Periocular Necrotizing Fasciitis: A Report of 2 Cases

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Abstract

Introduction: Necrotizing fasciitis is a rare but potentially fatal soft tissue infection. It involves rapidly progressive necrosis of fascia and subcutaneous fat often with necrosis of the overlying skin. Patients may have systemic toxicity, characterized by altered mental status, malaise, leukocytosis, fever, chills, and pain. It most commonly involves the trunk, extremities and perineum. It is often associated with minor trauma, surgery, diabetes mellitus, or intravenous drug abuse. Mortality rate range is 20-40%. Early diagnosis and aggressive treatment are essential for preventing tissue loss and increasing survival.

When necrotizing fasciitis involves the orbit it can threaten vision, lead to cavernous sinus thrombosis and death. Reports indicate that outcomes are usually poor with unsightly scarring, visual impairment or the more serious problems mentioned above.

We report our experience with two patients treated using Hyperbaric Oxygen (HBO) treatments as an adjunct in their management. Both had excellent clinical outcomes with preservation of vision and almost imperceptible cosmetic effects.

Case presentation: Two patients with Group A Streptococcus periocular necrotizing fasciitis were referred to the first author for emergency medical management. Both patients were healthy females with no history of trauma who presented with rapid-onset periocular pain and edema. Antibiotics were started immediately followed by prompt surgical exploration and debridement and post-operative initiation hyperbaric oxygen treatments. Both patients had excellent outcomes results without loss of vision or complex oculoplastic intervention.

Conclusion: Historically, periocular necrotizing fasciitis has had high complications rates. With prompt, aggressive treatment and adjunctive HBO therapy, our 2 patients achieved complete recovery with satisfactory cosmesis and only minimial cicatricial changes. We strongly recommend HBO be used as an adjunct in the management of periocular necrotizing fasciitis.

Keywords: Necrotizing fasciitis; Hyperbaric oxygen

Introduction

Necrotizing fasciitis of the orbit initially may be indistinguishable from orbital cellulitis. It is caused by a variety of organisms, most commonly group A streptococcus, non-group A streptococcus and staphylococcus species. Necrotizing fasciitis caused by group A streptococci is known as streptococcal gangrene or hospital gangrene and was described in 1871 [1]. Periorbital necrotizing fasciitis may be associated with sinusitis, but usually without a history of trauma [2-4].

Hyperbaric oxygen has been used as an adjunct for managing necrotizing soft tissue infections (HBO Committee Report). Although the benefits of HBO for necrotizing fasciitis is not clearly established, we were unable to locate any specific references for using this modality for eyes and life-threatening conditions.....[comments cut off]....of test the benefits of antibiotics, surgery and HBO for this potentially eye-threatening, life-threatening infection.

Case Presentations

JC was a 41 y.o. white female who presented to the emergency department complaining of pain, rapidly progressive swelling and discharge in the medial canthal region of the left eve that worsened over several hours (Figure 1A). She had a history of mild sinusitis and had an upper minor respiratory illness the week prior. She denied any history of trauma. An MRI study revealed soft tissue edema (Figure 1B).

The patient's visual acuity at the time of initial examination was 20/20 OD and 20/40 OS. Her intraocular pressures were normal OD at 13 and but borderline elevated at 22 mmHg OS. Extraocular motility was full in the right eye and was decreased to -1 in all gazes in the left eye. Proptosis was present on the left orbit as well as 4+ left facial edema. The left lower eyelid was tender to palpation.

The intravenous administration of Vancomycin, piperacillin/tazobactam and Levofloxacin commenced immediately. Within 6 hours of presentation, exploration and debridement of the periorbital tissues were done in the operating room (Figure 1C). A small Penrose drain was left in place for 48 hours (Figure 1D). HBO treatments (2 atmospheres absolute, 90 minutes twice a day) were started the day after surgery. Cultures grew group A strep and antibiotics were switched to Nafcillin. The patient was discharged home on the 5th hospital day on oral antibiotics (Figures 1E and 1F). Over the next 4 weeks, the tissues normalized and did not require oculoplastic surgery to achieve a satisfactory cosmetic result (Figures 1G and 1H).

E.O. was a 56 y.o. white female who presented with a 2-days history of increased swelling, warmth, redness, and pain in the left upper eyelid (Figure 2A). She denied any trauma or constitutional symptoms. Her visual acuity was 20/200 OD and 20/400 OS. Ischemic left upper eyelid

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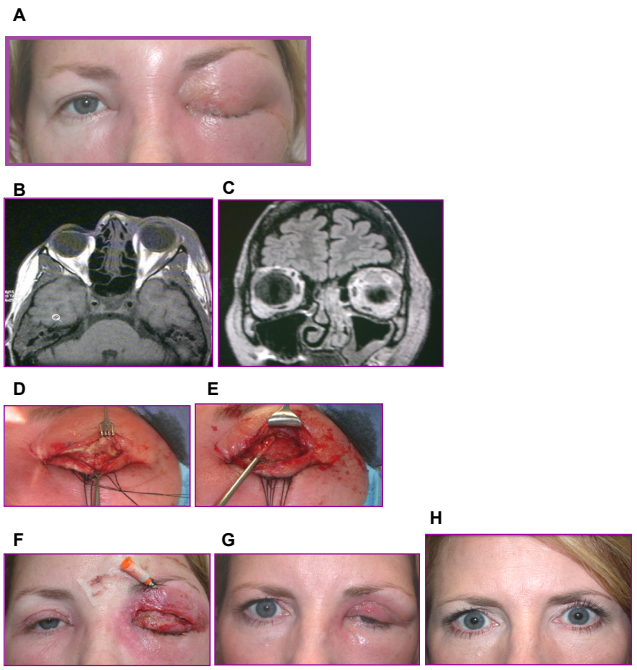

Figure 1: A: Preoperatively, there was extensive upper and lower eyelid edema. **B,C:** MRI demonstrated marked periorbital involvement and edema. **D,E:** Intraoperatively, there was significant ischemia and edema of orbicularis muscle with removal of exudative material with a curette. **F:** In the immediately postoperative period with a drain in place, the patient had decreased edema and pain. **G:** Postoperative week 1, the patient continued to have reduction in erythema and edema. **H:** Several months later, the patient had made a full recovery without the need for reconstruction.

tissues with bullae were present. There was mild edema of the right upper eyelid. Immediate debridement (Figure 2B) in the operating room was done, concomitant with starting intravenous antibiotics including Vancomycin, clindamycin, and Ceftrazidime. Twice a day HBO treatments were started the morning after surgery (Figure 2C). Acute renal insufficiency resolved during the 8 day hospitalization. She was discharged on d for four weeks and outpatient HBO treatments two hours a day at 2 atmospheres absolute for four days. Postoperatively, minor scarring of the left upper eyelid (Figure 2D) was managed with a full-thickness skin graft to the left upper lid with lower lid blepharoplasty to remove redundant tissue, resulting in a very satisfactory cosmetic appearance (Figures 2E-2H).

Discussion

HBO has been approved for use as an adjunct in managing 15 different conditions, including decompression sickness, arteriolar gas embolus, non-healing diabetic foot ulcers [5], psoriasis [6], late radiation tissue injury in gynecologic malignancies [7], and autism [8], as well as progressive, necrotizing soft tissue infections. It has been used "off-label" uses include cerebral palsy, established strokes, autism, multiple sclerosis, injury.

Proposed mechanisms for HBO are 1) oxygenation of ischemic hypoxic tissue, 2) neutrophil oxidative killing, 3) suppression of bacteria multiplication, 4) augmentation of antibiotic effectiveness, 5) enhanced fibroblast function and 6) angiogenesis.

Oxygenation of ischemic, hypoxic tissue

Edema, vasospasm, sludging and shock contribute to these problems. HBO increases plasma & tissue oxygen tensions 10-fold. This is enough to maintain tissue viability without red blood cell oxygen delivery and makes oxygen no more flow dependent than any of the other non-cellular substances in the blood.

Neutrophil oxidative killing

In the presence of hypoxia, neutrophils lose their ability to kill bacteria by generation of oxygen dependent superoxides and peroxides. During the respiratory burst in the phagosome, oxygen utilization increase up to 100-fold. The 10-fold increase in tissue oxygen tensions achieved with HBO mitigate the harmful effects hypoxia has on this mechanism.

Suppression of bacteria multiplication

Even though streptococcus are facultative aerobes, high oxygen tensions suppress their growth. Necrotizing soft tissue infections often have mixed aerobic and anaerobic flora especially in the immunosuppressed host. Mixed infections are an approved indication for HBO.

Augmentation of antibiotic effectiveness

Certain antibiotics are brought into the bacteria by oxygen dependent active transport across the bacterial cell wall. In hypoxic environments, antibiotics such as aminoglycosides, amphotericin and probably vancomycin are ineffective due to this effect. Increased oxygen tensions in the tissue fluids mitigates this problem.

Enhanced fibroblast function

Fibroblasts are also highly oxygen dependent like the neutrophil.

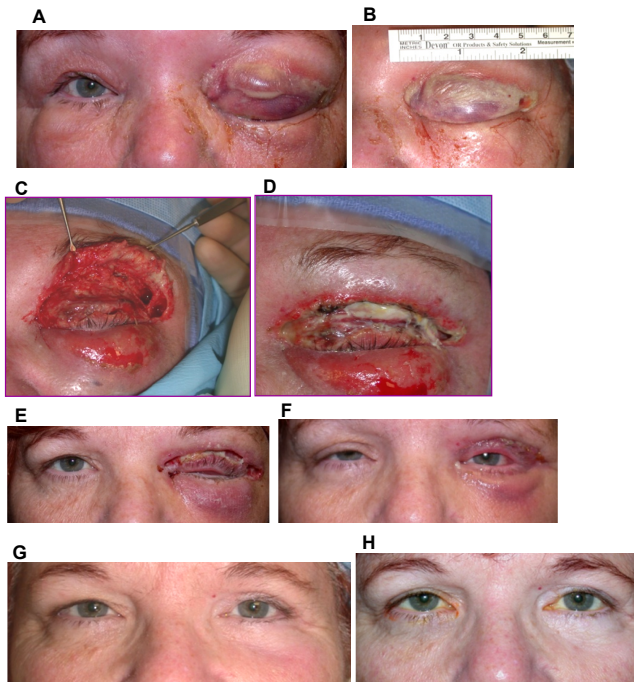

Figure 2: A,B: Preoperatively, the patient had ischemia and bullae of the left upper eyelid. **C,D:** Intraoperatively, the patient has ischemia of the skin and orbicularis muscle. **E,F:** Postoperative day 3 and week 1, she had significant improvement in periorbital erythema and edema. **G:** Four months after the onset of infection, the patient had recovered with scarring of the upper eyelid. **H:** Following left upper eyelid skin graft and lower eyelid blepharoplasty, the patient made a full recovery.

Growth factors that lead to fibroblast migration, multiplication and secretory activities appear to be "signaled" by adequate oxygen tensions. When inadequate, "harmful" factors such as transforming growth factor beta-1 lead to cicatrix formation.

Angiogenesis

Vascular endothelial growth factor function is improved by increasing oxygen tensions. Likewise, in order for fibroblasts to secrete a matrix which can be used as a scaffold for angiogenesis, adequate oxygen tensions are required.

Shayegani et al. [9] reported 2 patients who sustained severe visual loss from ophthalmic artery occlusion after periocular necrotizing fasciitis. One occurred in a healthy female; the other patient was immunosuppressed from being on dexamethasone. Both wound up requiring sustained intubation. Neither of these patients received HBO. Elner et al. [10] found that periocular necrotizing fasciitis frequently was bilateral, with 5 of 7 (71%) patients suffering vision loss from ophthalmic or central retinal artery occlusions, and 4 of the 7 (57%) patients requiring exenteration. None of these patients received HBO.

There are a few case reports of periocular necrotizing fasciitis following bilateral upper eyelid and lower eyelid blepharoplasty in an otherwise healthy individuals, both with incisional blepharoplasty [11] and 4-lid laser blepharoplasty [12]. The person undergoing conventional blepharoplasty recovered after initiation of treatment within 12 hours as well as HBO. The patient receiving laser blepharoplasty recovered well without the need for hyperbaric oxygen. In a review of 5 cases (some without surgical trauma, some with) [13], patients all did well with intravenous antibiotics and surgical debridement without adjunctive HBO. Treatment included prompt, aggressive antibiotic therapy as well as minimally invasive surgical debridement [14].

HBO for necrotizing fasciitis remains controversial; there are both proponents of HBO [2] as well as skeptics [15]. Some authors purport that it may help reduce oxidative damage. There have been reports of recovery both with and without HBO. Shupak et al. [15] retrospective study of necrotizing fasciitis found that the mortality rates and the number of surgical debridements was higher in the group receiving HBO, but confounders such as severity of initial presentation, interiml from onset to definite management and comorbidities were not matched between the arms of the study and none included periocular necrotizing fasciitis.

Conclusions

Historically, periocular necrotizing fasciitis and mucormycosis have had high complication rates. The use of HBO as an adjunct to antibiotic and surgical management augments the resolution of sepsis and may help minimize cicatricial changes in our patients. The mechanisms of HBO complement surgical interventions and antibiotics in this potentially vision-threatening, life-threatening condition. HBO therapy has been used with success in previous cases of periocular necrotizing fasciitis. As in our cases, these cases were diagnosed and treated early, and our outcomes appeared far better than the reported cases where HBO was not used.

Consent

Written informed consent was obtained from the patient for publication of this case report and any of accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing Interests

The author(s) declare that they have no competing interests.

Authors' Contributions

Alice Song examined the patients before and after treatment and performed the surgery. Michael Strauss administered the hyperbaric oxygen treatment. Julia Song, Michael Song, and Trisa Palmares performed the literature search. All authors read and approved the final manuscript.

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