



## Case Study of the Month: *Plastic Surgery use*

**Improving clinical/cost outcomes:** adding hyperbaric oxygen to standard medical and surgical measures.

An 84-year-old female was urgently referred from her surgeon's office for evaluation and treatment recommendations. The previous day the patient had undergone a Mohs surgery and excision of a basal cell carcinoma from the right side of her nose. A rotational flap repaired the resulting soft tissue defect. Within 24 hours, the flap appeared dusky and its viability threatened. (Fig.1)



**Figure 1**

**Significant Medical and Surgical History:** Arthritis, previous Mohs surgical procedure for skin cancer at the right side of her nose; partial hysterectomy.

**Review of Systems:** Essentially unremarkable

### **Assessment:**

- i. Status-post Mohs procedure and excision of a basal cell carcinoma
- ii. Previous similar procedure at the same site
- iii. Early evidence of skin flap compromise, periorbital and perilesional edema
- iv. No patient-specific risks to hyperbaric oxygen therapy

**Recommendations:**

- i. Immediate application of hyperbaric oxygen therapy, per compromised skin flap protocol
- ii. Closely follow clinical progress
- iii. Reevaluation following 10 hyperbaric oxygen treatments

The patient was agreeable to the treatment plan, as was her surgeon. Following completion of the informed consent process, hyperbaric treatments were initiated, on a BID basis. The first treatment was complicated by minor right ear discomfort, relieved with decongestants.

Following four treatments, delivered over approximately 48 hours, there was a marked reduction in edema. (Fig.2) After four treatments, the flap appeared to be improving. By treatment number nine, periorbital edema had resolved and the sutures had been removed. (Fig.3)

Upon completion of the planned 10 treatments the flap appeared healthy and viable. Superficial eschar was greatly diminished. (Fig.4) It was considered that the patient was at the point of maximum benefit and hyperbaric oxygen therapy could be discontinued. The patient was discharged from hyperbaric service to the continued care of her primary physician.

Follow-up at 18 days post-hyperbaric oxygen therapy was significant for a completely healed flap, resolved edema and a good cosmetic result. (Fig.5)



**Figure 2**



**Figure 3**



**Figure 4**



**Figure 5**

**Discussion:**

A wide variety of skin flap options are available for repair of soft tissue defects. For every defect there will usually be one or two management options. The common approach is to begin with the least complex. With each type of flap there will be potential complications, ranging from the poor quality of host tissues to technical shortcomings related to flap design and implementation. In most cases the problem, once identified, can be corrected surgically. Examples include evacuation of thrombus, repositioning of a kinked pedicle or easing tension of an overly tight suture line. Venous outflow compromise may require leech therapy. (1)

Where surgical correction does not fully resolve the threatened state, or the etiology of flap compromise is random pattern ischemia, hyperbaric oxygen therapy has been successfully employed. Mechanisms include delivery of large volumes of oxygen and antagonism of ischemia-reperfusion injury via down regulation of leukocyte receptor sites. (2)

In the case presented above, the patient's flap compromise may have resulted from any combination of recipient bed issues (prior surgery), increased diffusing distances from functioning capillaries to the body of the flap (secondary to edema) and random pattern ischemia (the area of perfusion exceeding arterial inflow capacity).

In larger flaps, the degree of hypoxia and its reversibility secondary to hyperbaric oxygenation can be assessed via transcutaneous oxygen monitoring. (3) The size and location of the flap in this particular case precluded such assessment. The hyperbaric treatment course was, therefore, guided by clinical appearance.

No 'Level 1' evidence is available for any of the options available to overcome skin flap compromise, including hyperbaric oxygen therapy. This may not be too surprising given a general lack of high level evidence across the medical and surgical continuum of diagnostic and therapeutic options. However, the present role of hyperbaric oxygen therapy in plastic surgery has been recently and comprehensively reviewed. (4) This review notes, "...there is enough animal evidence and observational data to warrant the application of hyperbaric oxygen in selective cases..."

In summary, the prompt referral of a threatened flap repair to hyperbaric medicine resulted in a good outcome. The patient required few treatments, provided on an outpatient basis, and were well tolerated, with the exception of minor and temporary ear discomfort.

**References:**

- 1) Kubo T, Yano K, Hosokawa. Management of Flaps with Compromised Venous Outflow in Head and Neck Microsurgical Reconstruction. *Microsurgery* 2002; 22:391-395.
- 2) Buras J. Basic Mechanisms of Hyperbaric Oxygen in the Treatment of Ischemia-Reperfusion Injury. *Internal Anesthesiology Clinics* 2000; 38(1):91-108.
- 3) Clarke D. An Evidence-Based Approach to Hyperbaric Wound Healing. *Blood Gas News* 1998; 7(2):14-20.
- 4) Friedman HIF, Fitzmaurice M, Lefavre JF, et al.: An Evidenced-Based Appraisal of the Use of Hyperbaric Oxygen on Flaps and Grafts. *Plast. Reconstr. Surg.* 2006;

## Table 1. Indications for Hyperbaric Oxygen Therapy Covered for Reimbursement by the Centers for Medicare & Medicaid Services<sup>1</sup>

### Acute Conditions

- Acute carbon monoxide intoxication
- Decompression illness
- Gas embolism
- Gas gangrene
- Acute traumatic peripheral ischemia; as an adjunct to conventional therapeutic measures when loss of function, limb, or life is threatened
- Crush injuries and suturing of severed limbs; as an adjunct to conventional therapeutic measures when loss of function, limb, or life is threatened
- Progressive necrotizing infections (necrotizing fasciitis)
- Acute peripheral arterial insufficiency
- Cyanide poisoning
- Osteoradionecrosis and soft tissue radionecrosis; only as an adjunct to conventional therapy

### Chronic Conditions

- Actinomycosis; only as an adjunct to conventional therapy when the disease process is refractory to antibiotics and surgical treatment
- Preparation and preservation of compromised skin grafts
- Diabetic wounds of the lower extremities in patients who meet the following three criteria:
  1. Patient has type 1 or type 2 diabetes and has a lower extremity wound that is due to diabetes
  2. Patient has a wound classified as Wagner grade III or higher
  3. Patient has failed an adequate course of standard wound therapy
- Chronic refractory osteomyelitis that is unresponsive to conventional medical and surgical management