

Hyperbaric Oxygen Treatment for Soft Tissue Radiation Injury

Each year 1.2 million new cases of invasive cancer are diagnosed in the United States. Of these, approximately one-half will receive radiation therapy, and approximately one-half of this group will become long-term survivors. Unfortunately, of these long-term survivors, about five percent will develop complications related to radiation treatment usually following a delay or latent period. Radiation therapy may produce an obliterative endarteritis in the adjacent normal tissue that progressively worsens over time producing a bone and soft tissue envelope in the target field that is hypovascular, hypocellular, and hypoxic (ref 1). As shown in Figure 1, accidental trauma, intentional surgical intervention, or infection may produce injury in tissue that is unable to respond with an effective healing response.

Any tissue within the irradiated field may be subject to radiation induced failure or necrosis. Radiation cystitis, proctitis, and enteritis are the most common clinical presentations although radiation injury to larynx has been reported with devastating consequences. Skin, subcutaneous tissue, and muscle in any area can be affected making surgical procedures in these areas particularly prone to complications. Typically, conservative management of delayed radiation injury including soft tissue radionecrosis has been unsatisfactory. Some soft tissue



failure may be life threatening, and definitive therapy may require very aggressive surgical intervention in severely compromised patients. Even when surgical intervention is undertaken, infection, dehiscence, and delayed or failed healing occur more frequently in this group of patients.

Hyperbaric oxygen treatment has been shown to be beneficial in treating established soft tissue radiation injury and when used pre-and post-operatively to support



elective surgery may reduce the risks of wound infection, dehiscence, and healing failure (ref 2). This treatment approach has been referred to as the Marx protocol. Hyperbaric oxygen treatment has been shown to stimulate angiogenesis within previously irradiated tissue restoring measured tissue oxygen levels to about 80 percent of non radiated tissue values restoring vascular and cellular density, supporting osteoclast resorption of necrotic bone, and supporting enhanced healing of soft tissue defects (ref 3).

The Progress of Tissue Injury Over Time Following Radiation Treatment

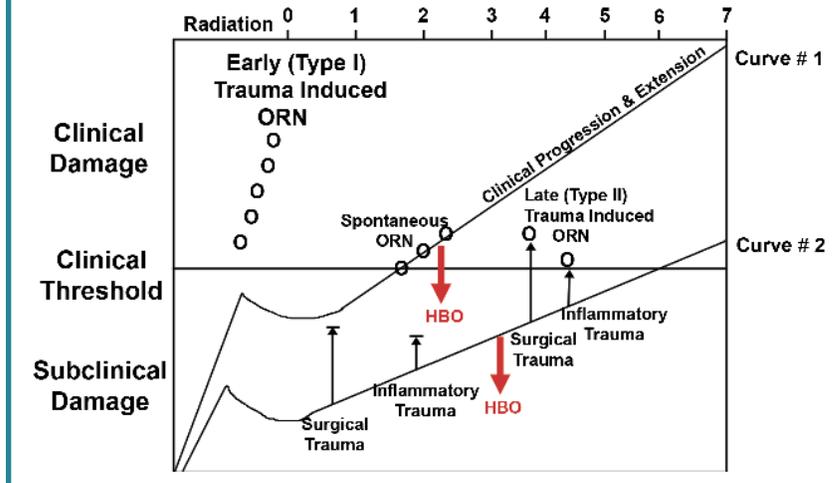


Figure 1. The Progress of Tissue Injury Over Time Following Radiation Treatment

Radiation tissue injury occurs in two phases: an acute phase (type I) that occurs during or shortly after radiation treatment, and a late or progressive phase (type II) that typically occurs several years following radiation treatment. Surgical trauma, local inflammation, or infection can move the curve to the clinical threshold of frank radionecrosis. HBO can move the injury curve down below the clinical threshold.

Pressure Points

Table 1. Hyperbaric Oxygen Treatment in Soft Tissue Radionecrosis

Condition	# Studies / # Patients	Outcome with Hyperbaric Oxygen Treatment
Laryngeal necrosis	3 studies / 35 patients	Only 6 of 35 patients underwent laryngectomy
Cystitis	14 case series / 136 patients	82.4% resolved
Proctitis, Enteritis	11 studies / 105 cases	34 (32%) resolved, 67 (64%) improved

Treatment of Soft Tissue Radionecrosis

Feldmeier (ref 4) has recently reviewed the literature on hyperbaric oxygen treatment and various forms of soft tissue radionecrosis. Table 1 summarizes the results of this review.

Additionally, clinical experience suggests that following the Marx protocol (ref 2) in patients having elective soft tissue reconstruction such as breast implant placement or reconstruction may benefit with fewer wound complications when 20 hyperbaric oxygen treatments are administered pre-operatively and 10 administered immediately post-operatively.

The hyperbaric oxygen treatment protocol used is once daily hyperbaric oxygen treatment administered at 2.4 ATA for 90 minutes of 100 percent oxygen breathing. Patients with established soft tissue radionecrosis may require 40-60 or more treatments depending upon the extent of tissue injury and degree of symptoms.

Complications

The most common complication of hyperbaric oxygen treatment is middle ear barotraumas which may occur slightly more frequently in patients who previously received head and neck radiation. Central nervous system oxygen toxicity can also occur. For this reason all patients referred for hyperbaric oxygen treatment for radiation tissue injury must be evaluated and managed by a physician specifically trained in hyperbaric medicine. There is no increased incidence of recurrence of oral cancer or increased rate of tumor growth.

Recommendation

Hyperbaric oxygen treatment has been shown in a recent evidence based review (ref 4) to provide significant benefit in treating established soft tissue radiation necrosis, especially laryngeal necrosis and radiation cystitis, proctitis, and enteritis. Although prolonged treatment courses may be required, results with hyperbaric oxygen treatment have been significantly better than with

conventional interventions. Perioperative hyperbaric oxygen treatment may also significantly reduce soft tissue post surgical wound healing complications in patients presenting for elective reconstructive surgery in a previously irradiated tissue bed.

References

- (ref 1) Marx RE. Osteoradionecrosis: A new concept of its pathophysiology. *J Oral Maxillofacial Surg* 1983; 41:283-288.
- (ref 2) Johnson RP, Marx RE, Buckley SB. Hyperbaric oxygen in oral and maxillofacial surgery. In: *Controversies in Oral and Maxillofacial Surgery*. P Worthington and JR Evans (eds). Philadelphia, WB Saunders Co., 1994, pp107-126.
- (ref 3) Marx RE. Part II: A new concept in the treatment of Osteoradionecrosis. *J Oral Maxillofac Surg* 1983; 41:351-357.
- (ref 4) Feldmeier JJ, Hampson NB. A systematic review of the literature reporting the application of hyperbaric oxygen prevention and treatment of delayed radiation injuries: An evidence based approach. *UHM* 2002; 29(1):4-30.

† CATHOLIC HEALTH
INITIATIVES

Franciscan Health System
St. Joseph Medical Center

Hyperbaric Medicine Service

1717 South "J" Street • Tacoma, WA 98401

Ph: (253) 426-6630 • Fax: (253) 426-6545

www.fhshealth.org/location/sjmc.asp

Pressure Points

A Publication of Praxis Clinical Services
Robert A Warriner, III, M.D., FACA, FCCP
Chief Medical Officer

17772 E. 17th Street, Suite 205
Tustin, CA 92780
888-345-3300

www.PraxisUSA.com