



Treatment of Radiation Induced Tissue Hypoxia with Hyperbaric Oxygen Therapy

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Abstract

Radiation therapy induces DNA damage to both cancer cells and normal cells. Cells that divide the most rapidly are the most susceptible to this type of treatment. Susceptible cells include not only cancer cells, but also epithelial cells, cells of the GI mucosa, endothelial cells, and fibroblasts. Deterioration of the blood supply of the radiated tissue from the development of endarteritis and arteriolar-capillary fibrosis leads to a reduction in vascular volume and tissue hypoxia. This eventually leads to tissue necrosis.

The cornerstone of treating radiation injury is the restoration of tissue oxygenation through angiogenesis. This formation of a new vascular supply restores adequate oxygenation of the tissues and the ability to heal.

Hyperbaric oxygen therapy (HBOT) is useful in initiating angiogenesis. The hypoxia caused by radiation injury promotes the production of growth factors, which stimulate the hypoxic endothelial cells to divide. The limiting factor at this point is adequate oxygen to support the metabolism of mitosis. HBOT can provide the necessary oxygen to sustain this cell division, which leads to the growth of new vessels (angiogenesis) in this hypoxic radiation injured environment.

The following case demonstrates the beneficial effects of hyperbaric oxygen therapy (HBOT) on hypoxic radiation injured tissue.

History and Physical Exam

This is a 79 year old white male who presented with a non-healing ulceration of the anterior right lower extremity, which had been present for 3 years. He had received local wound care and skin grafting without any improvement. The wound originated after he underwent a resection of a sarcoma of his right lower extremity with follow up radiation therapy. The patient noted that during the course of the radiation therapy, the operative wound began to separate and gradually developed into the present non-healing ulceration. During the course of this treatment, he also was found to have a metastatic nodule in his right lung requiring a right pneumonectomy.

His past medical history was positive for hypertension and dyslipidemia. He was also a heavy smoker in the past but quit over 20 years ago.

Review of systems was negative for claudication and rest pain, but was positive for persistent edema secondary to chronic venous insufficiency.

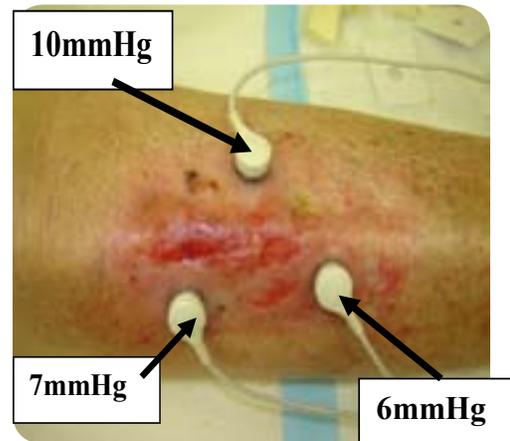
Physical exam revealed good pulses throughout both lower extremities. His legs were edematous with varicose veins and stasis changes. The ulcers are demonstrated in the photograph below. Note the fibrotic peri-ulcer skin and the copious serous drainage from the multiple ulcers.

Before Treatment



The work up included a culture which was positive for staphylococcus aureus and transcutaneous oximetry revealed reversible local tissue hypoxia of the peri-ulcer skin.

TcpO2 Study



Treatment

The wound was initially treated with Iodo-sorb. Elevation and salt restriction were recommended to try to control the edema and hyperbaric oxygen therapy was initiated. Transcutaneous oximetry was performed during the initial hyperbaric treatment. The pO₂ of the peri-ulcer skin was 873 mmHg on 100% oxygen at 2 ATA in a monoplace chamber. We felt that 2 ATA was adequate to deliver sufficient oxygen to the injured tissues, which would promote angiogenesis and wound healing.

The edema became more prominent due to the patients reluctance to elevate his leg sufficiently.

During Treatment



The problem created by the edema was overcome by gaining the patients cooperation and switching the local wound care to a combination of Acticoat 7, Allevyn, and a Profore Lite Compression Wrap.

Hyperbaric oxygen therapy was continued with the above wound care. The ulcers continued to fill in with new skin and the fibrotic peri-ulcer skin improved in texture and color.

During HBO Treatment



During HBO Treatment



The wound went on to close completely.

After Treatment



Conclusion

Despite sound medical and surgical care, nonhealing wounds and ulcers are not an uncommon occurrence after radiation therapy for the treatment of various cancers. This nonhealing is due to hypoxia of the radiated tissue created by the gradual destruction of its vascular supply. Hyperbaric oxygen therapy is a proven adjuvant in the treatment of these radiation injuries, providing the oxygen necessary to promote healing of these recalcitrant wounds.

About Precision Health Care

Precision Health Care is a comprehensive wound healing and hyperbaric medicine service organization dedicated to the development of state-of-the-art hyperbaric and wound healing centers through partnership and collaboration with our affiliate hospitals.

Community-based and patient-focused, we are driven by this mission philosophy: To provide select hospitals safe, comprehensive, compassionate wound healing and hyperbaric services for patients in need.

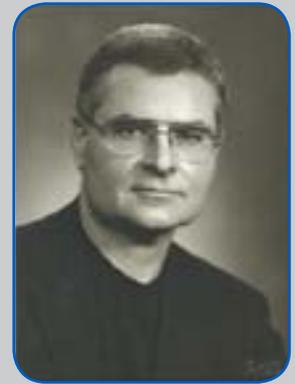
Questions or Comments?

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About the Author



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THE PRIMARY CARE PHYSICIAN SHOULD REFER THE PATIENT FOR ADVANCED WOUND CARE IN A WOUND HEALING CENTER IF THE PATIENT:

- Has a wound that persists for more than 30 days after treatment
- Has a wound and Reynaud's phenomenon
- Has purpura
- Has a wound and hypertension
- Has gangrene or necrotic tissue in a wound
- Has a wound and diabetes