



Osteoradionecrosis and Hyperbaric Oxygen

The recent introduction of radiation therapy for the treatment of solid tumors allows previously untreatable cancers to be cured. Now physicians face the challenge of aiding survivors. Unfortunately, the radiation beam used to fight cancer damages more than the tumor. Normal tissue in the path of the beam often sustains damage. Destruction of tissue also occurs. Even today, many physicians consider chronic radiation effects as irreversible, but hyperbaric oxygen therapy (HBOT) offers opportunities to repair damage.

Both bone and soft tissue suffer damage from therapeutic radiation. Bone is 1.8 times as dense as soft tissue and thereby absorbs a proportionately larger dose of incident radiation than does soft tissue.

High doses of radiation upsets the normal balance of osteoclastic destruction and osteoblastic reconstruction occurring in bone. Cell death of these osteocytes and osteoblasts leads to osteoporosis and eventually to osteonecrosis.

Doses of radiation necessary to produce adequate tumor kill in head and neck cancers are accompanied by an unfortunately high incidence of osteoradionecrosis. The mandible is often involved following radiotherapy of these tumors, and is over represented in osteoradionecrosis.

Osteoradionecrosis most commonly involves the mandible. The mandible is often involved because head and neck cancers are common, and radiation therapy in these cancers is very effective. Most cases of mandibular osteoradionecrosis originate from tooth extraction after development of radiation caries. The trauma of tooth extraction causes a breakdown of gum tissue and subsequent progressive bone necrosis. Exposed bone is often visible. Granulation tissue cannot form a bridge over dead bone, and the infection continues despite meticulous wound care and antibiotics; **the resolution rate is only about 8% without HBOT.**

Beginning in 1979, Marx and others demonstrated that osteoradionecrosis is a wound healing defect related to a **chronic hypoxic state**. In 1984, Marx published a study of 150 cases of osteoradionecrosis in the mandible. In his examination, Marx divided the disease into three stages of advancing clinical activity. This staging and the HBOT treatment of osteoradionecrosis he described became the standard for planning the treatment of mandibular and soft tissue ORN. The strategy has implications for the treatment of ORN in other tissues as well.

The 1990 Consensus Paper of the National Cancer Institute on the Oral Complications of Cancer therapies states "**The treatment of ORN with antibiotics and surgical debridement**

frequently fails, with progressive involvement of the remaining mandible. The keystone of the treatment of ORN is the provision of adequate tissue oxygenation in the damaged bone. This is best done by using hyperbaric oxygen therapy (HBOT). In the event that dental extractions are required following radiation, meticulous surgical technique and antibiotic prophylaxis are necessary."

References

- Beehler MR, Marx RE Hyperbaric oxygen induced angiogenesis and fibroplasia in human irradiated tissues, in Proceedings of the 65th Meeting of the American Association of Oral and Maxillofacial Surgery, 1983, pp 78-79.
- Davis, JC, Hunt TK (eds) Problem Wounds The Role of Oxygen. New York Elsevier, 1988, pp 65-110.
- Friedman RB Osteoradionecrosis Causes and Prevention. NCI Monograph 1990 9145-149.
- Hart GB, Mainous EG Treatment of radiation necrosis with hyperbaric oxygen. Cancer 372580, 1976.
- Hart GB, Strauss MB Hyperbaric oxygen in the management of radiation injury, in Schmutz J (ed) Proceedings of the First Swiss Symposium on Hyperbaric Medicine. Stiftung für Hyperbare Medizin. Basel 1986, pp. 31-51.
- Kaufman T, Hirshowitz B, Monies-Chass I Hyperbaric oxygen for post-irradiation osteomyelitis of the chest wall. Harefuah 97220-222, 1979.
- Mainous EG, Hart GB Osteoradionecrosis of the mandible Treatment with hyperbaric oxygen. Arch Otolaryngol 101173, 1975.
- Mainous EG, Boyle PJ Hyperbaric oxygen in total rehabilitation of patients with mandibular osteoradionecrosis. Int J Oral Surg 3297, 1974.
- Marx RE A new concept in the treatment of osteoradionecrosis. J Oral Maxillofac Surg 41351, 1983.
- Marx RE, Johnson RP, Kline SN Prevention of osteoradionecrosis A randomized prospective clinical trial of hyperbaric oxygen versus penicillin. J Am Dental Assn 11149, 1985.
- Marx RE Osteoradionecrosis A new concept of its pathophysiology. J Oral Maxillofac Surg 48283, 1983.
- Marx RE Osteoradionecrosis of the jaws Review and update. Hyperbaric Oxygen Rev 578-126, 1984.
- Myers, RAM, Marx RE Use of hyperbaric oxygen in postradiation head and neck surgery. NCI Monograph 19909,151-157.
- National Cancer Institute Consensus Development Conference on Oral Complications of Cancer Therapies Diagnosis, Prevention, and Treatment. National Cancer Institute Monographs 19909,3-8.
- Plemister DB Radium necrosis of the bone. Am J Roentgenol 16340, 1926. Stampfli WP, Kerr HD Fracture of the femoral neck following pelvic irradiation. AM J Roentgenol 5771-83, 1947.