



## Hyperbaric Oxygen in the Treatment of Radiation Proctitis and Cerebral Necrosis

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### Abstract

**Background:** Hyperbaric oxygen treatment is a challenging topic for radiation side effects.

**Objective:** The main goal is to evaluate the results of hyperbaric oxygen to treat proctitis and cerebral radionecrosis associated with radiotherapy.

**Materials and Methods:** 25 patients diagnosed with radiation proctitis and cerebral radionecrosis were treated with hyperbaric oxygen between 2013 January and 2014 December. 15 patients have radiation proctitis and 10 have cerebral radionecrosis. The symptoms of patients with radiation proctitis were stool frequency, hematochesia and pain. The presentation of others with cerebral radiation necrosis were headache, vertigo and dizziness. Hyperbaric oxygen of 2.4 Atmosphere Absolute was delivered for 5 patients.

**Results:** Stool frequency and pelvic pain in patients with proctitis was decreased after hyperbaric oxygen therapy. Symptoms of headache, vertigo and dizziness were better after hyperbaric oxygen. Also perinecrosal edema was limited and decreased with hyperbaric oxygen therapy.

**Conclusion:** Hyperbaric oxygen is an effective and useful therapy for radiation necrosis and proctitis.

**Keywords:** Hyperbaric oxygen; Radiation proctitis; Radiation necrosis

### Introduction

Hyperbaric Oxygen (HBO<sub>2</sub>) therapy has been delivered for wide range of diseases in the literature. Firstly in 1950's, cervical cancer and head and neck tumors were the first usage of HBO in addition to radiotherapy (RT). Tumor hypoxia is a major problem for radiotherapy management. It aggravates radio resistance and oxyic tumor cells are more radio sensitive compared to hypoxic ones. HBO<sub>2</sub> is eminently known agent that increasing tumor oxygenation and it improves radiation results in many tumors. Brain necrosis, proctitis, layngeal radio necrosis, optic neuropathy, soft tissue and bone injuries are the challenging issues of HBO management in the cancer treatment era. Also HBO was concomitantly used with photodynamic therapy and there was better tumor response at the end of this combination. Claustrophobia, cardiac and lung problems, pancitopenia etc. are the possible contraindications for HBO management [1].

### Materials and Methods

This original retrospective article enrolls twenty five patients of radiation necrosis and proctitis treated with HBO between January 2013 and December 2014. 15 of all had a radiation proctitis and cerebral necrosis was diagnosed after RT in 10 patients. The patients with proctitis had stool caliber changes, diarrhea, stool frequency, hematochesia and pain. Vertigo, dizziness, headache were the major symptoms of the group of radiation necrosis. 15 patients were diagnosed with rectum adeno carcinoma and they were treated with pelvic IGRT. 45 Gy was given for 14 patients in 1.8 Gy per fraction and 50.4 Gy was delivered just for one patient in same daily fraction dose. One patient was treated with stereotactic surgery in the dose of 18 Gy. This patient had a radiological diagnosis of arteriovenous malformation. Other last 9 patient had a grade 2 astrocytoma and treated with 54 Gy per 200 cGy fraction after surgery. 2.4 Atmosphere Absolute (ATA) was given with multiplace hyperbaric chamber in 120 minutes for 25 patients.

### Results

24 patients of all were man and 1 of them was female. Mean age was 30.6 (22-54). Stool frequency

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Received Date: 09 Sep 2017

Accepted Date: 27 Nov 2017

Published Date: 06 Dec 2017

#### Citation:

Uysal B, Gamsız H, Dincoglan F, Demiral S, Sager O, Beyzadeoglu M. Hyperbaric Oxygen in the Treatment of Radiation Proctitis and Cerebral Necrosis. *Clin Surg*. 2017; 2: 1803.

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and pelvic pain was decreased and normalized after HBO in the patients with radiation proctitis. Symptoms of headache, vertigo and dizziness were got better in 10 patients of cerebral necrosis. Perinecrosal edema was decreased and limited after HBO.

## Discussion

Radiation complications are categorized in acute, early-delayed and late-delayed injuries. Late injury enrolls radiation necrosis and leukoencephalopathy. Cytokines, reactive oxygen species and vascular endothelial growth factors are leaked to the cell membrane by inflammatory activation [2]. Chemoradiotherapy combination and the increased usage of radiosurgery caused few more cases of radiation necrosis in brain tumors. It is hard to differentiate necrosis and recurrence with conventional Magnetic Resonance (MR) but MR Spectroscopy can be used for it. Bevacizumab is a novel agent to treat radiation necrosis [3]. Temporal lobe necrosis is unusual late complication of RT in nasopharyngeal carcinoma but IMRT and helical therapies decreased its incidence. Steroids, vitamins, surgery, anticolagulants, hyperbaric oxygen, bevacizumab are the major treatment methods for radiation necrosis [4]. In an article of 2012 update by Feldmeier et al. [5], one-third of patients with delayed radiation injuries get HBO in United States. Supportive prophylactic usage of HBO in high-risk patients was also discussed in this article. Gynecologic malignancies are one of the potential indications for the RT treatment. Late radiation effects and HBO were reviewed in literature. Radiation proctitis, cystitis and necrosis should be managed with HBO. The effect of HBO is decreased with the delaying time [6]. Retrospective series showed that not all but some patients with radiation necrosis of central nervous system were lead to improvement in their clinical or radiological findings. This result is conflictive and inconsistent but it shows that differential diagnosis should be made accurately and treatment algorithm could be started as soon as possible [7]. Preventive usage of HBO in the management of radiation necrosis is discussed and it is clear to start HBO before or after symptoms or clinical findings of necrosis [8]. In a series of 14 patients with gynecologic malignancy, it was shown that HBO is effective, safe and well-tolerated management for soft tissue necrosis associated with radiation [9]. So important issue to be known is complications and side effects of HBO. These are ocular barotrauma, ear barotrauma, dental complications and myocardial infarction [10]. Radiation proctitis is a different and challenging topic. Topical medications and oral steroids should be recommended but HBO and surgical interventions can be used after radiation proctitis. Improvements in radiation oncology techniques like IMRT and proton therapy lead to prevent rectal structures from radiation treatment. Also rectum spacers and balloons are still used by experts in some centers in the World [11]. Necrosis or proctitis after radiation possibly caused by decreased vascularity, hypoxia problems and leukocyte dysfunction [12]. Treatment indications of HBO are radiation necrosis, osteoradionecrosis, diabetic foot ulcer, osteomyelitis, failed flap or skin graft. One single center experience showed that nearly 82% of patients had better outcomes after HBO [13].

In a study of 105 patients by Bui et al. [14], HBO response rate was lower for salivary, neurologic, laryngeal and upper gastrointestinal symptoms compared to mucous membrane or soft tissue necrosis. High-dose steroids have been still used for radiation induced brain necrosis. HBO treatment decreases steroid usage and clinical, symptomatic and radiological improvements were shown

after HBO in similar case studies [15,16]. HBO decreases symptoms of cerebral necrosis, radiation proctitis and also improves life quality. Therapeutic role of HBO was shown in the literature and randomized and multicenter studies are needed for future perspective of radiation complications and side effects.

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