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Abstract

Introduction

Previously irradiated tissue is characterized by changes including decreased vascularity, impaired cellular proliferation, and local hypoxia consistent with fibroblastic atrophy which can persist long after radiation therapy. Hyperbaric oxygen therapy has been shown to be beneficial in the treatment of complications arising from these late effects of radiation on normal tissue through enhancing fibroblast proliferation, collagen maturation, stem cell recruitment, and angiogenesis.

Methods

We report on three patients with debilitating radiation enterocolitis causing issues including recurrent bowel obstruction, anorexia requiring total parenteral nutrition, pain, diarrhea, fecal incontinence, dehydration, and malnutrition.

Results

In all three cases marked improvement was the outcome with hyperbaric treatment.

Conclusion

Hyperbaric oxygen therapy should be routinely considered in the treatment of radiation-induced enteritis or colitis.

Keywords

late radiation effects; radiation colitis; radiation enteritis; hyperbaric oxygen

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Successful Treatment of Radiation-Induced Colitis and Enteritis With Hyperbaric Oxygen Therapy

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Abstract

Introduction: Previously irradiated tissue is characterized by changes including decreased vascularity, impaired cellular proliferation, and local hypoxia consistent with fibroblastic atrophy, which can persist long after radiation therapy. Hyperbaric oxygen therapy has been shown to be beneficial in the treatment of complications arising from these late effects of radiation on normal tissue through enhancing fibroblast proliferation, collagen maturation, stem cell recruitment, and angiogenesis.

Methods: We report on three patients with debilitating radiation enterocolitis causing issues including recurrent bowel obstruction, anorexia requiring total parenteral nutrition, pain, diarrhea, fecal incontinence, dehydration, and malnutrition.

Results: All three cases demonstrated marked improvement in outcomes with hyperbaric treatment.

Conclusion: Hyperbaric oxygen therapy should be routinely considered in the treatment of radiation-induced enteritis or colitis.

Introduction

Previously irradiated tissue is characterized by changes including decreased vascularity, impaired cellular proliferation, and local hypoxia consistent with fibroblastic atrophy which can persist long after radiation therapy. In addition, radiation can induce progressive obliterative endarteritis that likewise leads to the same loss of vascularity, hypoxia, and apoptosis. Hyperbaric oxygen therapy (HBO₂) has been shown to be beneficial in the treatment of complications arising from these late effects of radiation on normal tissue. The enhancement of these mechanisms is a result of the increased oxygen availability via plasma saturation. This is due to increased oxygen dissolved in the serum. This serum oxygen can get to areas where red blood cells are not due to damaged vasculature. The high partial pressures of oxygen achievable with HBO₂ increase the diffusion gradient leading to an over ten-fold increase in cross-sectional area from the capillary. This intermittent alleviation of local tissue hypoxia acts as a stimulus for enhancing fibroblast proliferation,

collagen maturation, stem cell recruitment, and angiogenesis.¹ With these changes in place, tissue healing can occur.

Description of Cases

Between 2013 and 2017, three female patients, ages 70 (Patient A), 45 (Patient B), and 37 (Patient C) developed radiation-induced colitis and enteritis following ionizing radiation therapy for cervical cancer, endometrioid endometrial cancer, and adenocarcinoma of the rectum respectively. All three women gave their permission to present their cases in this paper.

Patient A is a 70-year-old female with a history of cervical cancer treated with hysterectomy and adjuvant radiation therapy (unknown dosage) at the age of 32. She was referred for evaluation of delayed radiation-induced sigmoid stricture. She first noted a change in bowel habits and described her stools as loose, with episodes of diarrhea and intermittent incontinence at age 70. Full gastrointestinal workup was performed as well as lifestyle changes without significant improvement of her symptoms. Colonoscopy showed severe narrowing of the sigmoid colon with granulomatous and erythematous mucosa surrounding the stricture consistent with delayed effects of radiation therapy without evidence of malignancy. The stricture was so severe that a pediatric scope could not pass through. She underwent 40 sessions of hyperbaric oxygen therapy, at 2.0 atmospheres absolute (ATA) for 90 minutes. She tolerated each treatment well without any unexpected complications, although she developed hyperbaric oxygen therapy associated transient myopia, which is an expected complication that resolved spontaneously within weeks. She noted markedly improved symptoms with firmer and less frequent stools and a cessation of tenesmus and urgency. Following HBO₂, repeat colonoscopy showed marked improvement in inflammation and granulomatous tissue. In addition, we noted a resolution of the stricture that allowed the passage of an adult colonoscope.

Patient B is a 45-year-old female with a history of IIIC1 grade 1 endometrioid endometrial cancer treated with total abdominal hysterectomy and bilateral salpingectomy, followed by adjuvant chemotherapy and radiation therapy (4500

cGy) at the age of 44. Approximately nine months following treatment, she began developing symptoms of intermittent partial small bowel obstruction with dehydration and malnutrition that were managed without operative intervention. MRI and CT scans were obtained which showed diffuse areas of thickened mucosa in the distal small bowel and the rectosigmoid junction within her previously irradiated field consistent with post radiation changes. She was placed on total parenteral nutrition (TPN) with bowel rest. At the time, it was unknown whether her symptoms were due to her radiation induced enteritis and/or adhesive disease from her previous abdominal surgery. She was scheduled for adhesiolysis and right hemicolectomy with high likelihood of temporary loop ileostomy given the extent of her radiation injury. In preparation for surgery, she underwent 31 (30 pre-op, 1 post-op and discontinued at surgeon's request) HBO₂ treatments of 90 minutes at 2.4 ATA to help reduce the risk of a tenuous anastomosis with irradiated tissue requiring loop ileostomy. She had no complications of HBO₂ therapy. Operative reports confirmed intestinal changes consistent with radiation-induced enteritis in addition to extensive adhesions. This area was resected with ileocolonic anastomosis without the need for temporary loop ileostomy given the improvement of her upstream small bowel radiation injury. She recovered well and was transitioned off TPN with improvement of her gastrointestinal symptoms following surgery. Three years later she had a colonoscopy showing normal mucosa and healthy appearing anastomosis without evidence of radiation enteritis.

Patient C is a 37-year-old female with a history of T3N1M1 moderately differentiated rectal adenocarcinoma with single metastasis to the liver, treated with neoadjuvant chemotherapy and radiation therapy (5040 cGy) followed by low anterior resection of the rectal carcinoma with coloanal anastomosis and liver metastasectomy at the age of 36. Nine months following radiation therapy, she reported symptoms of severe foul-smelling flatulence, chronic loose stools (approximately 4-5 per day), anorexia, weight loss and inability to tolerate oral intake, which are consistent with radiation induced enteritis. She required TPN for nutritional support for 8 months while attempting to control her symptoms via lifestyle changes. She

underwent an initial 40 sessions of HBO₂, at 2.4 ATA for 90 minutes with marked improvement of her symptoms. She was given an additional 20 HBO₂ treatments. She had minimal ear barotrauma during sessions 18-19 that resolved by session 22 with prophylactic Afrin, but otherwise tolerated each session well. The patient discontinued TPN by session 48 and, after a total of 60 treatments, she was taking 1500 calories per day orally with complete resolution of symptoms. She remained symptom free for three years until local recurrence of her carcinoma was discovered on routine surveillance, requiring abdominoperineal resection with gracilis myocutaneous flap.

Discussion

Currently, most radiation induced enteritis and colitis treatments are directed towards symptomatic relief, such as dietary modification, antidiarrheal medications, or even surgical resection of ischemic tissue, but are not rooted in treating the underlying cause. However, numerous studies and case reports have shown the benefit of HBO₂ therapy in the healing of radionecrotic soft tissues. A systematic literature review conducted in 2002 concluded, of the 74 publications reviewed, 90% reported positive results in the treatment and prevention of an assortment of radiation-induced injuries.² A case series conducted in 2007 concluded that 67% of patients with chronic gastrointestinal radiation injury treated with HBO₂ showed clinically significant improvement after 30 daily treatments at 2.36 ATA.³ Perhaps the most rigorous study on the topic was a double-blind randomized controlled study of HBO₂ in radiation proctitis (n=120) showing marked improvement over sham control.⁴

Conclusion

Although other therapies such as bowel rest with TPN, anti-diarrheal agents, proton pump inhibitors, and antacids were involved, the patients presented in this case report highlight and reaffirm that the use of HBO₂ therapy in radiation-induced enteritis and colitis. HBO₂ continues to show positive results by allowing patients to return to an improved level of functioning, improve surgical outcomes, or avoid surgery, and ameliorate pain among other symptoms. It should be routinely considered in the treatment of radiation-induced enteritis or colitis. ■

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