

Original Article: Clinical Investigation**Hyperbaric oxygen therapy for refractory radiation-induced hemorrhagic cystitis**Tiago M Ribeiro de Oliveira,^{1,2} António J Carmelo Romão,² Francisco M Gamito Guerreiro¹ and Tomé M Matos Lopes²¹Underwater and Hyperbaric Medicine Center, Portuguese Navy, and ²Department of Urology, Hospital de Santa Maria, Lisbon, Portugal**Abbreviations & Acronyms**HBO = hyperbaric oxygen
RIHC = radiation-induced hemorrhagic cystitis
RT = radiotherapy**Correspondence:** Tiago M Ribeiro de Oliveira M.D., Rua Quinta da Formiga n°5, 3°esquerdo, 1495-170 Algés, Portugal. Email: tiagoribeirooliveira@sapo.ptReceived 12 March 2015;
accepted 3 June 2015.
Online publication 5 July 2015**Objectives:** To analyze the efficacy of hyperbaric oxygen for the treatment of radiation-induced hemorrhagic cystitis and to identify factors associated with successful treatment.**Methods:** Clinical records from 176 patients with refractory radiation-induced hemorrhagic cystitis treated at the Portuguese Navy Center for Underwater and Hyperbaric Medicine, during a 15-year period, were retrospectively analyzed. Evolution of macroscopic hematuria was used to analyze treatment efficacy and correlated with other external variables.**Results:** From a total of 176 treated patients, 23.9% evidenced other radiation-induced soft tissue lesions. After an average on 37 sessions, 89.8% of patients showed resolution of hematuria, with only 1.7% of adverse events. In our sample, hematuria resolution after treatment with hyperbaric oxygen was statistically associated to the need for transfusion therapy ($P = 0.026$) and the number of sessions of hyperbaric oxygen ($P = 0.042$). No relationship was found with the remaining variables.**Conclusions:** Refractory radiation-induced hemorrhagic cystitis can be successfully and safely treated with hyperbaric oxygen. Treatment effectiveness seems to be correlated with the need for transfusion therapy and the number of sessions performed.**Key words:** cystitis, hematuria, hyperbaric oxygenation, proctitis, radiation injuries.**Introduction**

RT is often used in the treatment of pelvic malignancies.^{1–7} Despite the latest technological advances, collateral soft tissue lesions are still relatively frequent.^{8–10} Because of its high morbidity and mortality, hemorrhagic cystitis is one of the most important late adverse effects of pelvic irradiation.^{11,12} Ionizing radiation limits cellular growth and is associated with progressive obliterating endarteritis, and hypocellular, hypovascular and hypoxic transformation of the vesical mucosa, with edema, ulceration, decreased regeneration and fibrosis, which are responsible for the symptoms of cystitis.^{10,13,14} Although conservative techniques are considered the first-line treatment for RIHC, because of their low long-term effectiveness, most patients ultimately depend on more aggressive surgical procedures to control hematuria.^{12,15–17}

Through the increase of tissue oxygenation, HBO is able to stimulate angiogenesis, leukocyte activity, fibroblastic proliferation and collagen formation, and has therefore been effectively used to treat hypoxic tissues, with a significant increase in tissue regeneration.^{10,13,18–22} Despite growing evidence in favor of HBO use as a treatment modality for RIHC, due to reduced patient samples, its global effectiveness and the influence of external variables have not yet been properly analyzed.^{21–27}

We aimed to analyze the effectiveness of HBO in the treatment of RIHC and to verify the influence of a number of external variables.

Methods**Study population**

Clinical records from patients treated at the Portuguese Navy Center for Underwater and Hyperbaric Medicine, from August 1994 to September 2009, were retrospectively analyzed, in accordance with the ethics committee's regulations. This study was a case-control analytic