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Radiotherapy using IMRT boosts after hyperbaric oxygen therapy with chemotherapy for glioblastoma

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ABSTRACT

The purpose of this study was to evaluate the feasibility and efficacy of radiotherapy (RT) using intensity-modulated radiotherapy (IMRT) boosts after hyperbaric oxygen (HBO) therapy with chemotherapy in patients with glioblastoma. Twenty-four patients with glioblastoma were treated with the combined therapy, which was RT using IMRT boosts after HBO with chemotherapy, and were retrospectively analyzed. The RT protocol was as follows: first, 3D conformal RT [40 Gy/20 fractions (fr)] was delivered to the gross tumor volume (GTV) and the surrounding edema, including an additional 1.5–2.0 cm. The IMRT boost doses were then continuously delivered to the GTV plus 5 mm (28 Gy/8 fr) and the surrounding edema (16 Gy/8 fr). Each IMRT boost session was performed immediately after HBO to achieve radiosensitization. The planned RT dose was completed in all patients, while HBO therapy was terminated in one patient (4%) due to Grade 2 aural pain. The toxicities were mild, no non-hematological toxicity of Grade 3–5 was observed. The 2-year overall survival (OS) and progression-free survival rates in all patients were 46.5% and 35.4%, respectively. The median OS time was 22.1 months. In conclusion, the combined therapy of RT using IMRT boosts after HBO with chemotherapy was a feasible and promising treatment modality for patients with glioblastoma. The results justify further evaluation to clarify the benefits of this therapy.

KEYWORDS: glioblastoma, hyperbaric oxygen, intensity-modulated radiotherapy, high-grade glioma, radiosensitization

INTRODUCTION

The prognosis for patients with glioblastoma remains poor, and the use of conventional radiotherapy (RT) at doses beyond 60 Gy has not led to a survival benefit. Modern RT planning techniques such as intensity-modulated radiotherapy (IMRT) allow for more accurate delivery of the radiation dose and the possibility of escalating the dose without increasing morbidity. Recently, several prospective Phase II studies have demonstrated that IMRT can be administered in combination with chemotherapy without increasing the toxicity, and that it is a feasible method of achieving a dose escalation in patients with high-grade glioma, although the overall survival (OS) rates in those studies were comparable with those of patients treated with conventional RT with chemotherapy [1–3]. Other previous experimental and clinical studies have indicated that hyperbaric oxygen (HBO) therapy could enhance the antitumor effect of RT due to the increased supply of oxygen to hypoxic tumor cells [4–6]. High-grade glioma commonly shows an extremely low oxygen tension [7]. Some Phase II trials in patients with high-grade glioma