International Journal of Radiation Oncology biology • physics

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Clinical Investigation: Central Nervous System Tumor

Treatment of Head and Neck Paragangliomas With External Beam Radiation Therapy

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Received Nov 23, 2013, and in revised form Feb 5, 2014. Accepted for publication Feb 6, 2014.

Summary

Today first-line surgery and/or external beam radiation therapy are the main options for the management of head and neck paraganglioma, and recently radiosurgery has been presented as an alternative. We retrospectively evaluated 81 head and neck paragangliomas treated with external beam radiation therapy with conventional fractionation. Only 1 recurrence was observed, but 2 toxic deaths occurred in patients with bulky disease. External beam radiation therapy is an excellent option in head and neck paragangliomas.

Purpose: To retrospectively assess the outcomes of radiation therapy in patients with head and neck paragangliomas.

Methods and Materials: From 1990 to 2009, 66 patients with 81 head and neck paragangliomas were treated by conventional external beam radiation therapy in 25 fractions at a median dose of 45 Gy (range, 41.4-68 Gy). One case was malignant. The median gross target volume and planning target volume were 30 cm^3 (range, 0.9-243 cm^3) and 116 cm^3 (range, 24-731 cm^3), respectively. Median age was 57.4 years (range, 15-84 years). Eleven patients had multicentric lesions, and 8 had family histories of paraganglioma. Paragangliomas were located in the temporal bone, the carotid body, and the glomus vagal in 51, 18, and 10 patients, respectively. Forty-six patients had exclusive radiation therapy, and 20 had salvage radiation therapy. The median follow-up was 4.1 years (range, 0.1-21.2 years).

Results: One patient had a recurrence of temporal bone paraganglioma 8 years after treatment. The actuarial local control rates were 100% at 5 years and 98.7% at 10 years. Patients with multifocal tumors and family histories were significantly younger (42 years vs 58 years [$P = .002$] and 37 years vs 58 years [$P = .0003$], respectively). The association between family predisposition and multifocality was significant ($P < .001$). Two patients had cause-specific death within the 6 months after irradiation. During radiation therapy, 9 patients required hospitalization for weight loss, nausea, mucositis, or ophthalmic zoster. Two late vascular complications occurred (middle cerebral artery and carotid stenosis), and 2 late radiation-related meningiomas appeared 15 and 18 years after treatment.

Conclusion: Conventional external beam radiation therapy is an effective and safe treatment option that achieves excellent local control; it should be considered as a first-line treatment of choice for head and neck paragangliomas.

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Conflict of interest: none.

Supplementary material for this article can be found at www.redjournal.org.

Int J Radiation Oncol Biol Phys, Vol. 89, No. 2, pp. 353–359, 2014
0360-3016/$ - see front matter
http://dx.doi.org/10.1016/j.ijrobp.2014.02.010

Introduction

Head and neck paragangliomas are rare tumors whose incidence is estimated at 1-10 cases per million people per year (1). The tumors originate in the head and neck paraganglia, and they are benign in 90%-95% of cases (2). Genetic susceptibility has been found in 15% of cases with mutations in the *SDHB*, *SDHC*, and *SDHD* genes (succinate dehydrogenase complex, subunit B, C, and D, respectively) (2). The medical challenge for these slow-growing tumors with a good prognosis is to achieve the best local control with the least toxicity. The 2 main treatment options are surgery and radiation therapy.

Conventional fractionated external beam radiation therapy (EBRT) has been performed since 1950, with local control rates of 95% (3), and it is usually proposed as an alternative to surgery. Radiation therapy does not usually eliminate the radiologic tumor, and thus the aim is to stop the progression of symptomatic disease (4). No randomized trials have compared these 2 treatments, which have different toxicities, owing to the rarity of the disease and the different characteristics of these 2 populations (5).

The main objective of this retrospective, single-center study was to report the results of EBRT for head and neck paragangliomas.

Methods and Materials

All patients irradiated at Pitié Salpétrière Hospital (Paris, France) for head and neck paragangliomas from January 1990 to December 2009 were included. The diagnosis was defined radiologically by angiography or magnetic resonance (MR) angiography (46 patients) or histologically (20 patients). No patient was excluded from the study.

Patient and disease characteristics

Sixty-six patients were included for the treatment of 81 paragangliomas. Patient and treatment characteristics are summarized in Table 1. Characteristics of the paragangliomas are summarized in Table 2. The median and mean follow-up durations were 4.1 years and 5.9 years (range, 0.1-21.2 years), respectively.

Neurologic involvement before EBRT was the same for exclusive and postoperative radiation therapy. Only facial palsy was more common before postoperative radiation therapy (50%) than before exclusive radiation therapy (9%) (Fig. 1).

Radiation therapy indications

Forty-six patients had radiation therapy alone because of advanced age, risk of postoperative sequelae, and an elective indication for tympanic paragangliomas. Three patients had postoperative radiation therapy because of incomplete resection and 17 patients for recurrence after surgery.

Radiation therapy

All patients were immobilized with a thermoplastic head mask. Helical CT simulation was performed in all patients and merged with the previously generated thin-slice MR images from 2001. Target volumes were defined according to International Commission for Radiation Units and Measurements report 50 definitions (6); gross target volume was defined according to the area of contrast enhancement on CT and MRI T2 fat sat or contrast enhancement on MRI T1. Clinical target volume was defined by adding a 7-mm margin to the gross target volume along the main vessels. Clinical target volumes were expanded by a 3-mm margin to form the planning target volumes (PTVs). The median prescribed dose was 45 Gy (range, 45-46 Gy) to the PTV except for 2 patients. The first had a sellar localization (67 Gy) and the second a malignant paraganglioma (68 Gy). The median dose per fraction was 1.8 Gy (range, 1.8-2.0 Gy). The median treatment duration was 36 days (range, 32-52 days). Irradiation was performed with either a ^{60}Co machine or

Table 1 Patient characteristics

Characteristic	All patients (n=66)	Exclusive RT (n=46)	Postoperative RT (n=20)
Follow-up (y), median (range)	4.1 (0.1-21.2)	4.0 (0.1-21.0)	4.1 (0.4-21.2)
Age (y), median (range)	57.4 (15.1-83.7)	60.8 (24.4-83.7)	52.1 (15.1-78.1)
Sex ratio (no. female/no. male)	3.7 (52/14)	2.8 (34/12)	9 (18/2)
Cases with family histories, n (%)	8 (12)	4 (9)	4 (20)
Malignant cases, n	1	0	1
Multifocal paragangliomas, n (%)	11 (17)	7 (15)	4 (20)
GTV (cm^3), median (range)*	30 (0.9-243)	17 (1.4-243)	19 (0.9-34)
PTV (cm^3), median (range)*	116 (24-731)	113 (29.4-731)	119 (24-224)
Dose (Gy), median (range)	45.0 (41.4-68.0)	45.0 (41.4-67.0)	45.0 (43.2-68.0)

Abbreviations: GTV = gross target volume; PTV = planning target volume; RT = radiation therapy.
* Data available for 39 patients.