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Iodine-125 brachytherapy alone for advanced primary parotid gland carcinoma

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Abstract. This study aimed to evaluate the efficacy of iodine-125 (^{125}I) brachytherapy alone for the treatment of advanced parotid gland carcinoma and to identify predictors of tumour control and patient survival. Primary parotid gland carcinoma patients ($n = 23$) treated with ^{125}I brachytherapy alone between 1 October 2005 and 31 July 2013 at Peking University Stomatology Hospital were enrolled in this retrospective study. All had clinical stage IV disease. The prescribed dose was 60–160 Gy. The local control rate, survival rate, and predictors of the prognosis were evaluated. Adverse events related to treatment were also noted. The average follow-up time was 29 months (range 9–74 months). Among the 23 patients, six had local failure and 11 died during the follow-up period. The 1-, 3-, and 5-year overall survival rates were 87.0%, 55.4%, and 47.5%, respectively. The 1-, 3-, and 5-year progression-free survival rates were 73.9%, 47.0%, and 39.2%, respectively. The 1-, 3-, and 5-year local control rates were 82.1%, 73.9%, and 73.9%, respectively. Age and distant metastasis were independent predictors of survival, while the preoperative duration of the disease was an independent predictor of local control. The use of ^{125}I seed brachytherapy alone for the treatment of primary parotid gland carcinoma can provide good short-term results without causing any severe side effects.

Key words: parotid gland carcinoma; ^{125}I seed; brachytherapy.

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Parotid gland carcinoma is relatively uncommon, accounting for only about 5% of all head and neck cancers. The annual incidence rate is 1.0/100,000[1]. Surgical excision forms the mainstay of treatment, with postoperative radiotherapy used to supplement surgery. Some oncologists recommend the use of radiotherapy alone for the treatment of inoperable tumours.

The 2005 World Health Organization classification recognizes 24 subtypes of salivary gland cancer. Different pathological types have different biological behaviour. Low-grade malignant tumours are characterized by slow progression, a low metastasis rate, and good prognosis, while high-grade tumours show invasive growth, relatively high local recurrence rates, a high metastasis rate, and poor prognosis.

The clinical stage of disease is also related to the prognosis. However, the outcomes observed in some studies may have been influenced by imbalances in the proportions of patients at different stages of disease. The prognosis is generally poor in patients with advanced disease.

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Radiotherapy is recommended for some advanced tumours when radical surgery cannot be performed due to the proximity of the tumour to vital structures, medical contraindications to surgery, or refusal of patient consent. However, due to poor normal-tissue sparing, the side effects of radiotherapy can be severe.

Iodine-125 (^{125}I) seed brachytherapy is a treatment strategy in which radionuclide particles wrapped in titanium shells are implanted into the tumour target region according to preoperative treatment planning, enabling a high dose of radiation to be delivered directly to the tumour. Brachytherapy has been shown to be highly conformal and minimally invasive, with the ability to provide good local control and to cause few side effects[2,3].

The purpose of this retrospective study was to evaluate the short-term effects, survival rate, side effects, and predictors of the prognosis following the use of radioactive ^{125}I brachytherapy alone for the treatment of inoperable malignant primary parotid tumours.

Methods

The study was approved by the Ethics Committee of Peking University School and Hospital of Stomatology.

This retrospective study included 23 patients with primary parotid gland carcinoma (12 males and 11 females) who were treated with ^{125}I brachytherapy alone at Peking University School and Hospital of Stomatology between 1 October 2005 and 31 July 2013. The patients ranged in age from 2 months to 76 years (median age 47 years). The characteristics of the study patients are shown in Table 1. All patients had primary parotid gland carcinoma classified as clinical stage IV according to the Union for International Cancer Control (UICC) 2010 classification. The histological diagnosis was established in all cases by incisional biopsy or core needle biopsy before brachytherapy. None of the patients had undergone resection of the tumour before radiotherapy.

Table 1. Patient characteristics.

Characteristics	Number of patients (%)
Age, years	
Median (range)	47 (0.17–76)
≤40 years	5 (21.7)
40–60 years	14 (60.9)
>60 years	4 (17.4)
Sex	
Male	12 (52.2)
Female	11 (47.8)
Histological subtype	
High-grade	17 (73.9)
Adenoid cystic carcinoma	12
Adenocarcinoma	2
Salivary duct carcinoma	2
Oncocytic adenocarcinoma	1
Intermediate-grade	3 (13.0)
Intermediate-grade mucoepidermoid carcinoma	1
Papillary cystadenocarcinoma	1
Mucinous adenocarcinoma	1
Low-grade	3 (13.0)
Low-grade mucoepidermoid carcinoma	1
Cribriform cystadenocarcinoma	1
Sialoblastoma	1
T stage	
T1	0
T2	1 (4.3)
T3	0
T4	22 (95.7)
N stage	
N0	23 (100)
M stage	
M0	22 (95.7)
M1	1 (4.3)
Clinical stage	
I, II, III	0
IV	23 (100)
Facial nerve paralysis	
Yes	12 (52.2)
No	11 (47.8)
Prescription dose (Gy)	
60–80	1 (4.3)
80–120	16 (69.6)
120–160	6 (26.1)

^{125}I seed implantation

A treatment planning system was used for pre-treatment planning (TPS; Beijing Atom and High Technique Industries Inc., Beijing, China). Planning was based on computed tomography (CT) images and took the pathological grade of the tumour into consideration. The planning target volume (PTV) was defined to cover the lesion with a 1–1.5 cm margin beyond the tumour. TPS displayed the dose distribution curves and determined whether the prescription dose covered all target areas and whether the dose distribution in the target region was uniform.

^{125}I seeds (model 6711) were obtained from Beijing Atom and High Technique Industries Inc. The seeds had a half-life of 59.4 days and energy level of 27.4–31.4 KeV; the activity was 25.9–29.6 MBq (0.7–0.8 mCi). Implantation was performed under general anaesthesia and with CT guidance according to the preoperative treatment plan. Hollow interstitial needles (18-gauge, 150 mm) were inserted into the target area, making sure that the direction and depth of the needle insertion followed the treatment plan. An applicator was then sequentially attached to the distal ends of the needles to place the ^{125}I seeds into the target area; the injector was stepped back 1–1.5 cm each time, thus the ^{125}I seeds were distributed three-dimensionally in the gross tumour volume.

Follow-up

Patients were followed up at 2, 4, and 6 months after treatment, and every 6 months thereafter. Each follow-up examination included the following: (1) a search for local and regional recurrence of the tumour: a physical examination was performed at each visit, including a visual examination and palpation, and a CT scan was performed at 2 months, 6 months, and 1 year after treatment, and annually thereafter. (2) A search for distant metastasis: routine chest radiography was performed every year, with positron emission tomography (PET)–CT when distant organ metastasis was suspected. (3) A search for radiation-induced damage: complications

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