ELSEVIER

Brachytherapy 10 (2011) 331–339

BRACHYTHERAPY

A 17-year retrospective study of institutional results for eye plaque brachytherapy of uveal melanoma using ^{125}I, ^{103}Pd, and ^{131}Cs and historical perspective

Kara L. Leonard[1,*], Nolan L. Gagne[1], John E. Mignano[1], Jay S. Duker[2], Elizabeth A. Bannon[1], Mark J. Rivard[1]

[1]*Department of Radiation Oncology, Tufts Medical Center, Tufts University School of Medicine, Boston, MA*
[2]*New England Eye Center, Department of Ophthalmology, Tufts Medical Center, Tufts University School of Medicine, Boston, MA*

ABSTRACT

PURPOSE: To compare overall survival, local and distant failure rates, ocular toxicity, and vision preservation in patients treated with eye plaque brachytherapy at Tufts Medical Center with those in the published literature.

METHODS AND MATERIALS: Records were reviewed for 53 patients with the diagnosis of uveal melanoma treated with plaque brachytherapy at Tufts Medical Center over the past 17 years. American Joint Committee on Cancer staging (T1, T2, or T3) were 4, 39, and 10 patients, respectively. All the patients were treated using ^{125}I ($n = 37$), ^{103}Pd ($n = 5$), or ^{131}Cs ($n = 11$) to a dose of 85 Gy (documented as 100 Gy before 1996 for the same physical dose).

RESULTS: With a mean followup of 75 months, 38 of 53 patients were still alive. Five patients (all ^{125}I) developed liver metastases (9%) with no evidence of local failure. There were 10 definitive local failures and four additional transpupillary thermo-therapy procedures performed to ensure local control for lesions slow to respond. Twelve patients (23%) required enucleation. At most recent followup, 32 patients (71%) maintained 20/200 vision or better in the treated eye. In this first report of ^{131}Cs plaque therapy with a mean followup of 20 months, there were two transpupillary thermo-therapy procedures and one definitive failure requiring enucleation after 10 months.

CONCLUSIONS: Our disease control and ocular results were comparable to those in the literature given the extended followup. We are developing a multi-institutional, prospective clinical protocol for considering radionuclide selection and other prescriptive criteria.

Keywords: Uveal melanoma; Eye plaque; Brachytherapy; ^{125}I; ^{103}Pd; ^{131}Cs

Introduction

When compared with enucleation, eye plaque brachytherapy provides adequate control of primary uveal melanoma tumors, superior vision, and globe preservation (1–5). Brachytherapy, when compared to external beam radiotherapy techniques, allows for dose limitation to the retina, optic nerve, lacrimal gland, and eyelids. Since the 2001 publication of the Collaborative Ocular Melanoma Study (COMS) on 657 patients, many institutions have published their experiences. These studies primarily include the use of two radionuclides: iodine-125 (^{125}I) (6–17) and palladium-103 (^{103}Pd) (18–21). The literature also contains some reports of cobalt-60 (^{60}Co) (22), iridium-192 (^{192}Ir) (22, 23), and ruthenium-106 (^{106}Ru) (20, 24–30).

In 2003, the American Brachytherapy Society (ABS) published recommendations for the treatment of uveal melanoma using brachytherapy plaques (31). These recommendations covered appropriate patient selection, plaque design,

Received 9 December 2010; received in revised form 14 January 2011; accepted 17 January 2011.

This work was presented in part at the 52nd annual meeting of the American Society for Radiation Therapy on 1 November 2010 in San Diego, CA.

Conflicts of interest: Drs. Leonard, Gagne, Mignano, Duker, and Bannon have no conflicts of interest. Dr. Rivard is a consultant to GE HealthCare, Inc. and IsoRay Medical, Inc.

* Corresponding author. Department of Radiation Oncology, Tufts Medical Center, Box 359, 800 Washington Street, Boston, MA 02111. Tel.: +1-617-636-6161; fax: +1-617-636-6131.

E-mail address: kkerr@tuftsmedicalcenter.org (K.L. Leonard).

1538-4721/$ - see front matter
doi:10.1016/j.brachy.2011.01.006

treatment planning, and dose prescription and delivery. Radionuclides available for eye plaque brachytherapy were reviewed, but specific recommendations regarding radionuclide selection were not made. Existing literature contains limited results examining radionuclide choice.

In this article, results from our institutional experience using ^{125}I, ^{103}Pd, and uniquely cesium-131 (^{131}Cs) were analyzed, focusing on overall survival, local control, distant metastases, ocular toxicity, and visual acuity (32). Implicit in this analysis, we compared outcomes as a function of radionuclide. Also provided is a comprehensive literature review covering publications spanning the last two decades, and comparison of these results with our observations.

Methods and materials

Records were available for 53 patients treated at Tufts Medical Center (TMC) between January 29, 1992 and July 14, 2009. Patients were included in this retrospective study if they met the following criteria: at least 4 years followup postimplant, followup until the time of enucleation or death, or followup within 6 months of the study end date (March 22, 2010). Table 1 summarizes patient characteristics. American Joint Committee on Cancer (AJCC) staging (T1, T2, or T3) were 4, 39, and 10 patients, respectively. Mean apical lesion height was 5.8 mm for the entire cohort and 6.3, 2.7, and 5.4 mm for the ^{125}I ($n = 37$), ^{103}Pd ($n = 5$), and ^{131}Cs ($n = 11$) patients, respectively. Table 2 presents the radiologic characteristics of each of these radionuclides.

Table 1
Patient characteristics by radionuclide (^{125}I, ^{103}Pd, and ^{131}Cs) and for the entire cohort

Radionuclide	^{125}I	^{103}Pd	^{131}Cs	Total
Number of patients	37	5	11	53
Age (yr)				
Mean	62	63	56	61
Range	39–85	58–70	32–79	32–85
Gender				
Men	22	2	5	29
Women	15	3	6	24
Affected eye				
OD	22	4	3	29
OS	15	1	8	14
T stage				
T1 (COMS-I)	1	1	2	4
T2 (COMS-II)	30	4	5	39
T3 (COMS-III)	6	0	4	10
Mean apical tumor height (mm)	6.3	2.7	5.4	5.8
Range	2.0–10.3	2.3–3.3	2.1–9.4	2.0–10.3
Mean basal tumor length (mm)	12.3	10.6	12.6	12.2
Range	4.5–18.8	8.9–13.2	9.3–18.2	4.5–18.8
Treatment era				
1992–1999	18	0	0	18
2000–2009	19	5	11	35
Length of implant (d)				
7	34	2	0	36
5	3	3	11	17

OD = right eye; OS = left eye; COMS = Collaborative Ocular Melanoma Study.

All the patients were seen for initial consult at the New England Eye Center of TMC for history and physical examination. Ophthalmologic examination included dilated fundoscopic examination to determine lesion location and ultrasound A and B scans to determine lesion size. Systemic workup, most often composing liver function tests and CT scan of the chest and abdomen, was conducted to evaluate for synchronous metastatic disease. Referral was made to radiation oncology for patients for whom plaque radiotherapy was considered a treatment option. For patients who were lost to followup within the TMC system, the primary ophthalmologist or primary care physician was contacted.

Surgical implantation

Brachytherapy plaques were implanted by the ophthalmologist (JSD) under conscious sedation or general anesthesia. Extraocular muscles were immobilized and transillumination was used for tumor localization. A dummy plaque (clear plastic disk) was placed to determine plaque position. Radioactive plaque placement was confirmed by a radiation oncologist. Treatment lasted 7 days (all treatments before November 2007) or 5 days (all treatments in November 2007 and thereafter). All the patients were treated after having signed informed consent. Patient records were reviewed as per protocol #6797 approved by the TMC Institutional Review Board.

Brachytherapy dosimetry

Patients were treated to a total physical dose of 85 Gy (documented as 100 Gy before November 1996) prescribed to a height of 5 mm from the tumor base for tumors ≤5 mm in height or to the tumor apex for tumors >5 mm in height. The prescribed dose follows the recommendations set forth by the ABS (31).

For each treatment, the appropriate source strength was ordered to deliver 85 Gy over our standardized implant duration (7 days before November 2007 and 5 days thereafter). The most influential factor for radionuclide selection was availability of the appropriate source strength to deliver

Table 2
Radiologic characteristics of ^{125}I, ^{103}Pd, and ^{131}Cs eye plaque implants

Radionuclide	^{125}I	^{103}Pd	^{131}Cs
Average photon energy (MeV)	0.028	0.021	0.030
Half-life (d)	59.4	17.0	9.7
Decay constant (h^{-1})	0.0005	0.0017	0.0030
Initial dose rate (Gy/h) @ 5-mm depth			
7-d implant	0.53	0.58	0.64
5-d implant	0.73	0.78	0.84