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Interstitial high-dose-rate brachytherapy in eyelid cancer

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ABSTRACT

PURPOSE: To report the experience and the outcomes of interstitial high-dose-rate (HDR) brachytherapy (BT) of eyelid skin cancer at the Department of Radiotherapy of Hospital de Santa Maria in Lisbon.

METHODS AND MATERIALS: Seventeen patients (pts; mean age, 73.75 years) who underwent eyelid interstitial HDR BT with an ^{192}Ir source between January 2011 and February 2013 were analyzed. Lesions were basal (94%) and squamous (6%) cell carcinomas, on lower (88%) or upper (6%) eyelids, and on inner canthus (6%). T-stage was Tis (6%), T1 (46%), T2 (36%), and T3a (12%). The purpose of BT was radical (12%), adjuvant to surgery (71%), or salvage after surgery (18%). The BT implant and treatment planning were based on the Stepping Source Dosimetry System. The median total dose was 42.75 Gy (range, 32−50 Gy), with a median of 10 fractions (range, 9−11 fractions), twice daily, 6 h apart. The median V_{100} was 2.38 cm^3 (range, 0.83−5.59 cm^3), and the median V_{150} was 1.05 cm^3 (range, 0.24−3.12 cm^3).

RESULTS: At a median followup of 40 months (range, 7−43 months), the local control was 94.1%. There was one local recurrence and one non-related death. The BT was well tolerated. Madarosis was the most common late effect (65% of pts) and was related with higher values of V_{100} ($p = 0.027$). Cosmetic outcomes were good and excellent in 70% of pts.

CONCLUSIONS: Interstitial HDR BT is a feasible and safe technique for eyelid skin cancers, with good local control. Recurrent lesions and higher volumes receiving the prescribed dose were associated with worse outcomes.

Keywords: Eyelid; Skin cancer; Interstitial high-dose-rate brachytherapy; HDR

Introduction

Eyelid skin malignancies present 5−9% of all skin cancers. Surgery has been the main option of treatment, but radiation therapy is important in adjuvant setting and might be an alternative approach in selected cases.

Low-dose-rate (LDR) brachytherapy (BT) has been the type of BT most commonly used to treat eyelid cancer (1,2). Because of the recent implementation, there are only four reports in the literature describing the use of high-dose-rate (HDR) BT in eyelid carcinoma (3−6). The aim of this article was to report the results of the Department of Radiotherapy of Hospital de Santa Maria, in Lisbon, with interstitial HDR BT in the treatment of eyelid skin cancers; assess the tumor control, cosmesis, and toxicity; and compare them with other published series.

Methods and materials

Patient selection

Between January 2011 and February 2013, 19 immunocompetent patients (pts) were submitted to interstitial ^{192}Ir HDR BT of the eyelid in the Department of Radiotherapy.

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Two pts were excluded from the analysis because the eyelid tumor was an extension of a lesion of the nose. Tumors arising in the canthi were included in this study. Therefore, 17 lesions were analyzed (Tables 1 and 2).

There was a male predominance (88%), and the majority of the tumors arose in the lower eyelid (88%). Only one tumor (basal cell carcinoma [BCC]) had its origin from the internal canthus. All tumors were proven by histology: 16 pts (94%) presented BCC and 1 pt (6%) had a recurrent squamous cell carcinoma (SCC) *in situ* on the lower eyelid. Pathologic information from the first surgery of SCC eyelid cancer was not available. Biopsy of recurrence (tumor of 3 mm) showed a SCC *in situ*, but repetition of biopsy would have provided no useful information.

The staging at time of presentation in the Department of Radiotherapy was according to the *seventh edition of the American Joint Committee on Cancer* (Table 3) (7). Indications for primary BT included tumor stage ≤T3aN0M0, medical comorbidities, and tumor location that would have result in poor functional and cosmetic outcomes after surgery. Indications for postoperative BT were close or positive margins and tumor recurrence.

Fifteen pts (88%) had undergone previous surgical treatment, and 5 pts (29%) presented with recurrent local disease after at least two surgical interventions (Table 2). Of these 5 pts, 3 pts (17%) underwent salvage BT and the remaining 2 pts (12%) were submitted to new salvage surgery and adjuvant BT. A total of 12 pts (71%) were submitted to BT in adjuvant setting, including the internal canthus tumor. Two pts (12%) underwent radical BT.

Table 1
Patient and tumor characteristics[a]

Age (yr)	
Mean ± SD (range)	73.75 ± 14.65 (44–96)
Median	76
Gender, *n* (%)	
Male	15 (88)
Female	2 (12)
Tumor location, *n* (%)	
Lower eyelid	15 (88)
Upper eyelid	1 (6)
Inner canthus	1 (6)
Tumor stage[b], *n* (%)	
Tis	1 (6)
T1	8 (46)
T2a	3 (18)
T2b	3 (18)
T3a	2 (12)
Histology, *n* (%)	
SCC	1 (6)
BCC	
Metatypical	3 (18)
Nodular	2 (12)
NA	11 (64)

SD = standard deviation; SCC = squamous cell carcinoma; BCC = basal cell carcinoma; NA = not available.

[a] Data for a total of 17 patients and 17 eyelid lesions.

[b] Staging at time of presentation in the Department of Radiotherapy.

Table 2
Purpose of the BT by cancer history, number of patients (%)[a]

Purpose of the BT	BT radical	BT adjuvant to surgery	Salvage BT after surgery	Total
De novo diagnosis	2	10	0	12 (71)
Recurrent disease after surgery	0	2 (salvage combined surgery and BT)	3	5 (29)
Total	2 (12)	12 (71)	3 (18)	17 (100)

BT = brachytherapy.

[a] Data for a total of 17 patients and 17 eyelid lesions.

Implant

Implant and treatment planning were based on the "modified" Paris System, the so-called Stepping Source Dosimetry System (1,6,8–10), that provides a method of implant and dosimetry to accomplish target dose coverage without excessive dose inhomogeneity, specifically in stepping source systems. According to ICRU (International Commission on Radiation Units and Measurements) 58 (11), prescription dose and volume, total reference air KERMA (kinetic energy released per unit mass) (TRAK), and high-dose volumes were recorded. From 2012, CT (computed tomography) was used to allow for target and organs-at-risk volume record and full compliance with ICRU 58. The treatment areas were defined in the pt skin according to visible lesions and other clinical or surgical information. Under local anesthesia and aseptic conditions, rigid hollow stainless steel needles were inserted into the treatment area, parallel and equidistant to each other in a single plan. A saline solution was injected to increase the thickness of the eyelid. When applicable, the space between two needles was 1 cm (Fig. 1). Afterloading, 6 F (French catheter scale) flexible catheters (Nucletron Comfort Catheter System, Nucletron, Veenendaal, the Netherlands, an Elekta Medical company) were then inserted into these hollow needles and left in place with subsequent removal of metal needles. The plastic tubes were then held in close proximity to skin with plastic buttons. The median of inserted catheters was 2 (range, 1–3). Distance measures of the catheters, treatment area, and buttons were taken.

Treatment planning and delivery

The treatment was planned in a computerized system (Nucletron PLATO or Oncentra MasterPlan, Nucletron, Veenendaal, the Netherlands, an Elekta Medical company) according to the implant distance measures. The active length was defined inside the treatment area with a step size of 2.5 mm and dwell time geometric optimization was used. Dose was prescribed at the periphery of the treatment area, typically 4 mm away from the catheter or to the isodose curve of 85% of the basal dose rate when more than one catheter was inserted (8).

Since January 2012, pts underwent CT after the implant to allow for CT-based treatment planning (2 pts in the present study). The same implant and dosimetry method, the