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Interstitial pulsed-dose-rate brachytherapy for the treatment of squamous cell anal carcinoma: A retrospective single institution analysis

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ABSTRACT

OBJECTIVE: To examine the outcome of patients receiving interstitial pulsed-dose-rate brachytherapy (PDR-BT) after pelvic radiation therapy for treatment of an anal squamous cell carcinoma.
METHODS AND MATERIALS: Twenty-one patients were identified: 13, six, and two with stages I, II, and III tumors, respectively. After receiving received pelvic irradiation +/− concurrent chemotherapy, patients were delivered a PDR-BT boost to the residual tumor, with intention to deliver a minimal total dose of 60 Gy. The greatest dimension of residual tumor at the time of brachytherapy procedure was 12.5 mm (range: 0–20 mm). Brachytherapy implantation was performed according to the Paris system, only one plane implant being used.
RESULTS: Median dose delivered through BT was 20 Gy (range: 10–30 Gy). Median number of pulses was 48 (range: 20–80 pulses). Median treated volume was 9 cm^3 (range: 5–16 cm^3). Median dose per pulse was 40 cGy (range: 37.5–50 cGy). No Grade 3 or more acute toxicity was reported. No Grade 3 or more delayed toxicity was seen among 18 patients with more than 6 months follow-up. Median followup was 47 months (range: 6–73 months). Twenty patients (95%) were alive at last follow-up. Tumor relapses were experienced in four patients (19%), including local relapse in three patients (14%).
CONCLUSION: With almost 4 years median followup, this study confirms previous data suggesting that PDR-BT is effective and safe in this indication. Local control rate and toxicity were in the range of what was seen with continuous low-dose-rate BT.

Keywords: Anal squamous cell carcinoma; Brachytherapy; Pulsed-dose-rate

Introduction

The ability of brachytherapy to deliver a high dose to the primary tumor, while sparing surrounding normal tissues, makes it an appropriate technique for treatment of anal squamous cell carcinoma (SCC). It is delivered as part of global therapy and applied as a boost following response to external radiation or chemoradiation (1). High local control and relatively low toxicity rates have been reported in retrospective studies using low-dose-rate brachytherapy (LDR-BT) boosts (2–5).

Pulsed-dose rate brachytherapy (PDR-BT) delivers irradiation through pulses and therefore has the advantage of providing a safer irradiation than LDR-BT in terms of radioprotection of the medical staff. Despite lack of prospective clinical comparison, preclinical data examining PDR and LDR-BT have suggested that both techniques had equivalent radiobiological properties (6).

There are only few data available on the treatment of anal SCC with PDR-BT. Retrospective multicenter studies specifically examining PDR-BT have suggested that the use of this technique would not compromise local control (7, 8). With longer follow-up, this single-center study examines the outcome of patients receiving PDR-BT boost for treatment of anal carcinoma.

Methods and materials

Patients

We conducted a retrospective analysis of a prospective database and identified 21 patients with histologically confirmed diagnosis of invasive anal SCC. All patients

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were treated in our institution (Gustave Roussy, Villejuif, France) with a PDR-BT boost, from May 2008 to March 2014. The local institutional ethic committee approved the study design and analysis. Median age at the time of PDR-BT was 69 years (range: 49.5–84 years). All patients had performance status of 0–1 according to the World Health Organization. There were 19 females (90%) and two males (10%) (Table 1).

Tumors

Staging of primary tumors included clinical examination, a computed tomodensitometry and magnetic resonance imaging. At the time of diagnosis, all tumors were localized or locally advanced, with tumor stages according to the Union for International Cancer Control (UICC) as following: stage I in 13 patients (62%), stage II in six patients (28%), stage III in two patients (10%) (Table 1).

Treatments

All patients received pelvic external beam radiation therapy (EBRT) irradiating the whole pelvis and inguinal nodes, as recommended by the Radiation Therapy Oncology Group, using a 3D conformational EBRT technique or intensity-modulated radiation therapy with high megavolt photons (9). Mean and median total physical doses delivered by EBRT were 42.5 and 44 Gy (range: 27–54 Gy), respectively, in fractions of 1.8–2 Gy, five consecutive days per week, excepted in one patient who received bifractionated radiation therapy at a dose of 30 Gy, two daily fractions of 1.5 Gy because of a previous history of postoperative brachytherapy for cervical cancer (60 Gy in LDR-BT). EBRT was delivered in another institution in 12 patients. Median duration of EBRT course was 32 days (range: 24–44 days). Concomitant chemotherapy was delivered in seven patients (33%), all of them presenting with stage II to III tumors: cisplatin plus 5-fluorouracil in five patients and mitomycin C plus 5-fluorouracil in two patients (Table 1).

Brachytherapy procedure

Patients were eligible to PDR-BT if the tumor did not exceed the half of the circumference of the anal canal at diagnosis and if thickness of residual tumor did not exceed 5 mm at the time of brachytherapy. The implantation procedure has been reported in detail elsewhere (10). Briefly, the brachytherapy implantation was performed under general anesthesia. The number of needles was determined to properly cover the residual gross tumor volume plus a safety margin ranging from five to 10 mm, as determined by clinical examination. Implantation followed the rules of the system of Paris. Needles were implanted and secured equidistant and parallel using a ring Papillon's template perforated at 1 cm intervals, which was sutured to the perineum. An anal dilatator was placed at the end of the brachytherapy procedure and maintained during all the brachytherapy. This intraanal tube aims at separating the contralateral side of anal canal and the normal rectal mucosa away from the needles and thus spares them from irradiation (Fig. 1). In one patient, two brachytherapy procedures were performed because of an inappropriate needle position.

Treatment planning

Patients were scanned in the supine position, slice thickness of 1.5 mm. Axial images were imported to the Plato BPS (Nucletron, Veenendaal, The Netherlands) or to Oncentra Brachytherapy planning system (Nucletron) (17 and five patients, respectively). A 3D set was reconstructed. Dwell positions in the implant catheters were digitized on each axial computed tomography slice. Dose was prescribed to 85% of the minimal dose rate between the planes, according to the Paris system rules. Prescription dose was decided to deliver a minimal total dose of

Table 1
Characteristics of patients and tumors

Characteristics	
Number of patients	21
Median age (range)	69 y (49.5–84)
Gender	
Female	19
Male	2
Stage	
T1	13
T2	6
T3	2
N0	19
N1	0
N2	1
N3	1
Median greatest dimension[a]	18.5 mm (7–57)

[a] At diagnosis.

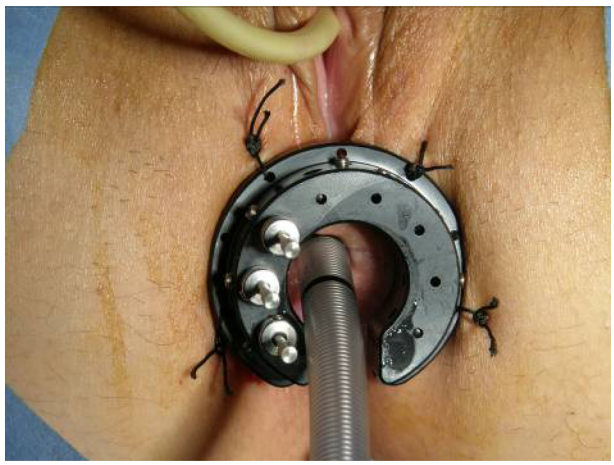

Fig. 1. Brachytherapy implantation.