ELSEVIER

CrossMark

BRACHYTHERAPY

Brachytherapy 13 (2014) 225–232

CT-based interstitial brachytherapy in advanced gynecologic malignancies: Outcomes from a single institution experience

David D'Souza[1,2,*], Ericka Wiebe[3], Nikhilesh Patil[4], Akira Sugimoto[2,5], Michel Prefontaine[2,5], Simran Aulakh[6], Frances Whiston[7], Larry Stitt[7], Kathleen Surry[2,6,8]

[1]*Department of Radiation Oncology, London Health Sciences Centre, London, Ontario, Canada*
[2]*Department of Oncology, Western University, London, Ontario, Canada*
[3]*Department of Radiation Oncology, Cross Cancer Institute, Edmonton, Alberta, Canada*
[4]*Department of Radiation Oncology, Nova Scotia Cancer Centre, Dalhousie University, Halifax, Nova Scotia, Canada*
[5]*Department of Obstetrics and Gynecology, London Health Sciences Centre, London, Ontario, Canada*
[6]*Department of Medical Biophysics, Western University, London, Ontario, Canada*
[7]*Clinical Research Unit, London Regional Cancer Program, London, Ontario, Canada*
[8]*Department of Medical Physics, London Regional Cancer Program, London, Ontario, Canada*

ABSTRACT

PURPOSE: To evaluate the clinical outcomes of women receiving a "short" course of high-dose-rate gynecologic interstitial brachytherapy (HDR-ISBT) boost with CT-based 3D planning.

METHODS AND MATERIALS: Forty-seven women with no prior radiation received HDR-ISBT from August 2004 to February 2012. The mean external beam radiotherapy dose was 45 Gy. A mean HDR-ISBT boost dose of 18.4 Gy was delivered over 2–4 fractions. Dose volume histograms (DVHs) were computed for organs at risk and clinical target volume.

RESULTS: With a median followup of 34.8 months, the 3-year local control rate was 68%. Sixteen patients were identified to have tumor recurrence (including eight local). The median time to any recurrence was 26.8 months. Relapse-free survival and overall survival at 3 years was 65% and 73%, respectively. Ten patients experienced Grade 3 late toxicity, mainly vaginal (5) and proctitis (3). The mean prescription volume (V_{100}) was 85 cc and the mean D_{90} to CTV was 98%. The mean cumulative dose to tumor was 69.9 Gy (equivalent dose in 2 Gy). The mean cumulative equivalent dose in 2 Gy to D2cc of bladder and rectum was 60.9 Gy and 63.0 Gy, respectively.

CONCLUSION: A "short" course HDR-ISBT is effective, safe, and convenient with acceptable local control and toxicity. Higher dose per fraction is similar to an external beam radiotherapy stereotactic boost with the inherent advantages of brachytherapy. A shorter overall time for HDR-ISBT means less time that patients are immobilized and in hospital, making it less resource intensive than a longer course.

Keywords: Interstitial brachytherapy; Gynecologic

Introduction

Patients with locally advanced gynecologic malignancy are a heterogeneous group for whom few guidelines exist to direct therapeutic management. Treatments such as pelvic exenteration carry a high risk of morbidity that affect quality of life and frequently long-term survival rates are poor (1, 2). Although forms of radiation therapy, including intracavitary brachytherapy, are useful, there are often limitations to the delivery of a radiotherapy boost that is essential in eradicating local disease. Extensive disease or distortion of anatomy may preclude the use of standard intracavitary brachytherapy applicators. External beam radiation therapy (EBRT) is limited by higher doses to organs at risk (OARs). Even with the use of intensity-modulated radiation therapy, consideration must be given to interfraction movement by placing appropriate margins for the planning target volume, which significantly increases doses to nearby normal organs (3–5) or the ability to adapt and re-plan for each fraction. As a result, such patients may be considered for palliative radiotherapy to mitigate symptoms from local disease.

Received 6 September 2013; received in revised form 29 January 2014; accepted 5 February 2014.

* Corresponding author. Department of Radiation Oncology, Victoria Hospital, London Health Sciences Centre & Western University, London, ON, N6A 4L6, Canada. Tel.: +1-519-685-8650; fax: +1-519-685-8627.

E-mail address: David.DSouza@lhsc.on.ca (D. D'Souza).

1538-4721/$ - see front matter
http://dx.doi.org/10.1016/j.brachy.2014.02.001

Interstitial brachytherapy (ISBT) is a radiotherapy modality that can overcome some of these challenges by delivering high doses of radiation to tumor, while better sparing adjacent OARs (6–10). An individualized radiation treatment plan can be achieved through implanting interstitial catheters directly into the designated tumor target area, with 3D-based imaging for treatment planning and dose optimization by manipulating dwell positions and dwell times of a high-dose-rate (HDR) source. However, there is a paucity of published experience in HDR-ISBT for gynecologic malignancy. The optimal dose and fractionation schemes have not been defined but have been adapted from the use of low-dose-rate brachytherapy where treatment is delivered over 4–5 days over which time the patient must be limited to bed rest with restricted mobility. There is little evidence regarding the appropriate dose constraints for bowel and bladder with a wide variation in dose and dose fractionation used (11). Furthermore, ISBT has limited availability; few institutions have the expertise and resources to deliver this treatment.

The development of ISBT target definition and radiation prescription reflects the evolution of intracavitary brachytherapy practices (9, 10). An adaptive target concept for brachytherapy boost doses in locally advanced cervical cancer has resulted in excellent dosimetric and clinical results (12–15).

Despite the lack of randomized evidence for gynecologic ISBT due to insufficient patient numbers, consensus guidelines have been derived from institutional series and expert opinion (16). Using modern imaging, published series of transperineal ISBT demonstrate excellent local control rates in primary tumor treatment of 85–92% (9, 10). However, in one series, the rate of late Grade 3–4 toxicity was 28% (median followup of 19 months) (9), whereas the other saw only one Grade 3 and no late Grade 4 events in a series of 28 patients (4%) treated for locally advanced primary vaginal or recurrent endometrial or cervical cancer (10). The success in attaining local control and limited toxicity in this challenging group of patients with aggressive disease and poor outcomes supports further investigation in optimizing ISBT. There is variability of high-dose-rate gynecologic ISBT (HDR-ISBT) practice in published institutional series and guidelines, and questions remain regarding adequate total dose, the optimal number of implants, and the number of fractions per implant.

The purpose of this study was to report the clinical outcomes in a series of patients receiving CT-guided HDR-ISBT boost for advanced gynecologic malignancy. All cases were guided by CT-based 3D planning. Because of constrained institutional resources, patient demographics (travel distance from institution) and our experience using a similar fraction size for HDR cervix intracavitary brachytherapy, a shorter fractionation course (typically three fractions) was used. This article describes the clinical outcomes for this cohort of women with primary or recurrent gynecologic malignancy with no prior radiotherapy who received HDR-ISBT as part of their treatment.

Methods and materials

Patient population

Research Ethics Board approval was obtained for review of medical records of patients undergoing HDR-ISBT. Patients were identified through operating room records of brachytherapy procedures. All patients had malignancy involving gynecologic organs. Data for patients treated with interstitial gynecologic brachytherapy from August 2004 to 2009 were collected retrospectively from patient records, whereas data for patients treated subsequently were extracted from an ongoing prospective database.

Database creation

A secure database was created for collection of the following details: patient demographics (age), diagnosis (site of origin, pathology), extent of disease (initial stage, amount of recurrent disease), previous treatment (surgery, chemotherapy, EBRT, brachytherapy), and brachytherapy parameters (volume of ISBT coverage, tumor and OAR doses, conformity index, and homogeneity of dose achieved). Followup data including acute toxicity (bleeding, bowel/bladder puncture, infection), late toxicity occurring >90 days after treatment (scored using Common Toxicity Criteria Adverse Events, version 3) (17), and efficacy of disease control (complete or partial response, recurrence, progression of disease, death: disease or other cause) was collected and recorded. Response was evaluated mainly by clinical examination with select use of MRI. Local recurrence was considered in the area of original disease before treatment and regional recurrence to pelvis and/or groin if involving the lower vagina. Patients were seen every 3 months for 2 years followed by twice yearly visits out to Year 5. At each visit, history and physical (including pelvic) examination was performed. Imaging (CT, MRI) was done for suspected recurrences. Pathologic confirmation of local recurrence was obtained in all cases. For regional/distant recurrences, a biopsy was obtained for isolated or atypical presentations.

Brachytherapy procedure

A single implant was performed under general anesthesia by an experienced brachytherapist (DD). Laparoscopic guidance was used in patients with prior hysterectomy and disease involving the upper vagina. A perineal implant template was used with a 4-channel vaginal cylinder (offset from vaginal surface). The template was sutured to the perineum to secure the catheter placement.

A planning CT scan encompassing the perineal template with 3 mm overlapping slices was performed with the vaginal cylinder and interstitial catheters in place. Implant