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Ureteral stent insertion for gynecologic interstitial high-dose-rate brachytherapy

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ABSTRACT

PURPOSE: To determine the utility of ureteral stents in interstitial gynecological brachytherapy.

METHODS AND MATERIALS: We reviewed 289 patients with cervix cancer treated with high-dose-rate interstitial brachytherapy who did not have pretreatment hydronephrosis to determine the relative incidence of benign ureteral strictures after treatment. We also did comparative dosimetry analysis in five cases of high-dose-rate brachytherapy. Bilateral ureteral stents were placed during the procedure. Three dosimetry plans were created to determine the impact of modifying clinical target volume (CTV) and applying ureteral dose constraints. In Plan 1, the ureters were contoured and excluded from the CTV and 120% dose constraints were applied. In Plan 2, the ureters were contoured and excluded, but no dose constraints were applied to the ureter. In Plan 3, the CTV was created as if the location of the ureters was unknown and then ureteral dose was determined.

RESULTS: There were 11 ureteral strictures observed in 255 nonstented cases and 0 ureteral strictures in 34 stented cases. Plan 1 reduced the ureter dose ($D_{0.1cc}$) by a median 22% (7.0–53.8%) compared with Plan 2 and by a median of 30.9% (12.3–65%). compared with Plan 3.

CONCLUSIONS: Placement of stents and ureteral dose constraints facilitates dosimetry and reduces the dose to ureters. Temporary ureteral stents prevent obstruction during interstitial gynecologic brachytherapy and allows the ureters to be addressed as an organ at risk. © 2015 Published by Elsevier Inc. on behalf of American Brachytherapy Society.

Keywords: Brachytherapy; High-dose-rate; HDR; Interstitial; Ureteral stent; Ureter; Gynecologic malignancy; Cervix cancer; Endometrial cancer; Stricture

Introduction

Good dosimetry is achieved when the brachytherapy applicator fits the anatomy and encompasses the disease. Interstitial (IS) brachytherapy can provide better dosimetry than intracavitary (IC) brachytherapy in properly selected cases, via the insertion of needles or catheters directly into and around the tumor (1–5). The quality of the radiation dosimetry can be further improved by coupling IS brachytherapy with high-dose-rate (HDR) treatment planning by applying dwell time modulation (varying the time the source spends at each location within the catheters).

The ureters often are overlooked as organs at risk (OARs) during radiation treatment planning because they are invisible on noncontrast computed tomography (CT). The literature regarding ureteral injury after low-dose-rate (LDR) IC brachytherapy suggests that clinically apparent radiation damage is relatively uncommon (1–4%) (6–8). The actual incidence, however, may be greater because occult damage or even hydronephrosis and substantial kidney dysfunction can occur before clinical recognition. IS brachytherapy, on the other hand, may pose an even greater risk of ureteral injury because the brachytherapy catheters can be inserted into the parametria immediately adjacent or even penetrate the ureter. The result may be traumatic injury, obstruction, or delivery of excessively high doses of radiation. We incorporated the placement of temporary stents into the IS-HDR procedure to ensure patency during

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the implant and make the ureters are visible on simulation radiography. We believe the placement of stents and the application of dose constraints during treatment planning reduce the risk of ureteral injury. We describe stent placement method, present data on 289 cervical cancer patients without hydronephrosis, and provide dosimetry analysis of five cases treated with IS-HDR.

Methods and materials

First, we reviewed the records of 354 patients from our prospective brachytherapy registry with previously untreated cervical cancer who underwent IS gynecologic template brachytherapy. We analyzed the 289 patients who presented without hydronephrosis and excluded 65 with hydronephrosis whose pathophysiology of disease may have contributed to ureteral injury and therefore could have been a confounding variable. We determined whether the patient had ureteral stenosis or hydronephrosis after radiation therapy by reviewing his or her medical records and imaging reports, interviewing the patient, and contacting his or her other physicians. Ureteral obstruction was assumed to be benign if there was no evidence of recurrent disease (at any site) during the entire period of follow-up (median of 43 months and mean of 60 months). We recognized that strictures can present late in the course of follow-up (benign more likely than malignant), and we believe the duration and nature of the study was sufficient to determine the rate and etiology of ureteral obstruction. Our study methods did not permit (radiologic) identification of subclinical ureteral injury.

Second, five consecutive patients with locally advanced gynecologic cancer treated at University of California, Los Angeles, with IS HDR brachytherapy were selected for dosimetry analysis. These cases were not suitable for IC brachytherapy based on the extent of disease and vaginal anatomy. There were four cases of locally advanced (T3 or T4) cancer with extensive invasion of the parametrium and one case of bulky 1B2 cervical cancer in an elderly patient with a narrow vagina, which was not suitable for an IC device.

Ureteral stent technique

Rigid cystoscopy and placement of the stent was performed at the beginning of the brachytherapy procedure (usually by the radiation oncologist at our institution) to evaluate the condition of bladder and to identify the ureteral orifices. Stent placement takes approximately 5–10% of the total procedure time and constitutes a small fraction of the total cost of the brachytherapy. Size five French open-ended ureteral stents (Pollack–Cook Medical Inc., Bloomington, IN) were placed in each of the ureters with rigid cystoscopy (Fig. 1). Retrograde pyelography was used to confirm stent placement and adjust the position as necessary. The stents exited the urethra along with an 18-French

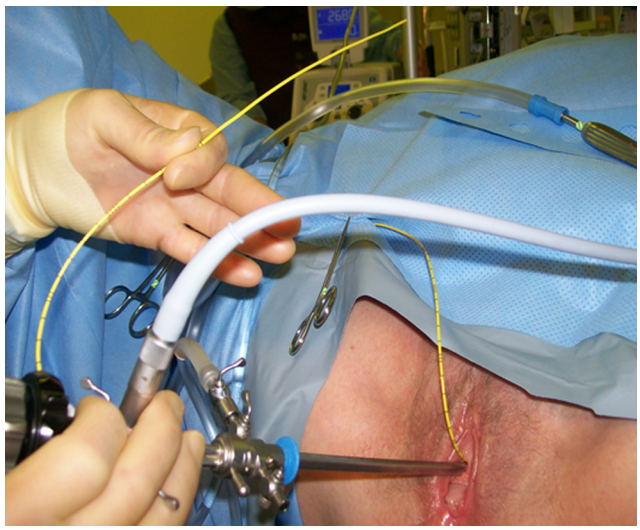

Fig. 1. Insertion of open ended five French ureteral stents (Pollack–Cook Medical Inc.) during rigid cystoscopy performed just before the interstitial implant.

urinary catheter (usually a red Council radio-opaque type), or in the case illustrated in Fig. 1, a clear latex-free urinary catheter (C.R. Bard Inc., Covington, GA). The stents were individually embedded, at the end of the IS implant, into the side of the urinary catheter through tiny staggered incisions in the catheter (11-blade scalpel) 3–5 cm distal to the urethra. This technique is a convenient way to drain the stents without the need for a separate urine collection system. On completion of the IS implant, flexible cystoscopy was performed to adjust or remove any brachytherapy catheters that may have penetrated the bladder lumen. The stents were secured at the urethral meatus by sliding them under a stainless-steel washer (outer diameter 13 mm, inner diameter 7 mm) that was placed on the urinary catheter before its insertion. The stents also were secured to the urinary catheter distal to the washer with one silk drain ties (Fig. 2).

IS brachytherapy

The gynecologic template procedure, described in our previous report, was performed under spinal-epidural block with sedation or general anesthesia (9). It consisted of insertion a tandem, vaginal cylinder, and multiple flexible plastic catheters with metal obturators (Flexiguides; Best Medical International, Inc., Springfield, VA) through a Syed-Neblett template (Alpha-Omega Services, Inc., Bellflower, CA). Transrectal ultrasound, cystoscopy, proctosigmoidoscopy, and fluoroscopy guidance were used. The ureteral stents often were visible on transrectal ultrasound and on fluoroscopy, which was helpful in guidance of the IS implant. Brachytherapy catheters (six) were inserted along the grooves in the outer edge of the vaginal cylinder directly into the cervix and advanced superiorly into the uterus parallel to the tandem. Additional catheters were