

Seed loss through the urinary tract after prostate brachytherapy: examining the role of cystoscopy and urine straining post implant

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This study describes one institution's experience with seed retrieval through the urinary tract and makes recommendations for cystoscopy and urine straining post prostate brachytherapy (PB). 1794 patients from two separate cohorts covering different time periods (early versus late) were analyzed. All patients were preplanned with a modified peripheral loading technique and implanted with preloaded needles (¹²⁵I or ¹⁰³Pd) under ultrasound guidance. A catheter was used to delineate the urethra during the volume study but was not used during the implant. All patients underwent post implant cystoscopy. All patients were instructed to strain their urine for seven days post implant and return any seeds to our center. In our experience, seed loss through the urinary tract is a common event after PB, occurring in 29.7% of patients and was more common in patients from the early cohort, those implanted with ¹²⁵I seeds or those patients with prior transurethral resection of the prostate. Average seed loss per case, however, represents only 0.58% of total activity. We continue to recommend routine post implant cystoscopy for seed retrieval and periprocedural management. We no longer recommend that patients strain their urine at home after documenting a low rate of seed loss after discharge. © 2003 American Association of Physicists in Medicine.

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I. INTRODUCTION

Transperineal ultrasound guided radioactive seed implantation is increasingly being used as a primary curative modality for prostate cancer. This therapy is still in evolution. There is a paucity of data in the literature on certain aspects of this procedure, including the rate of seed loss through the urinary tract, the precise role of cystoscopy to retrieve seeds from the urinary tract, and the need for patients to strain urine for seeds after discharge.

In a survey of brachytherapists by Prestidge *et al.*, 74% of respondents reported using cystoscopy following transperineal implant. In this report, an average of two seeds (range 1–5) were retrieved from the bladder in an average of 31% of the patients undergoing cystoscopy.¹ The American Brachytherapy Society states that cystoscopy may be performed after the procedure but its use is not mandatory.² Merrick *et al.* reports a 2% rate of seed loss from the pelvis over time, with only 10% of these seeds documented as embolizing to the lungs—“the fate of the majority of the missing pelvic seeds is not discernible via this study.”³ In an older study with retropubic seed implantation, Sommerkamp *et al.* reported seed loss in 90% of patients. This group documented an average seed loss of 8% per patient, with the majority of seeds lost through the urinary tract.⁴ In regard to care after discharge, the American Association of Physicists in Medicine (AAPM) Task Group 64 recommendation is that patients not strain their urine post implant.⁵ We conducted an informal survey of other high volume PB institutions and found that most institutions did not recommend that patients strain their urine after discharge.

We have reviewed our seed accountability log book to determine our experience with seed retrieval in the operating

room at the time of cystoscopy, in the recovery room, and at home and make recommendations for the cystoscopy and urine straining post implant.

II. METHODS AND MATERIALS

Two separate cohorts from a free standing outpatient permanent PB center were analyzed. The early cohort consisted of 994 consecutive patients undergoing PB between October 1997 and October 1999. The implant technique during the time period of the early cohort utilized a mechanical sector ultrasound probe and axial imaging with needle measurements for needle placement/seed deposition. The late cohort consisted of 800 consecutive patients treated with PB between January 2001 and January 2002. In January 2001, a new electronic linear array biplane ultrasound probe with improved sagittal imaging was used. The technique during this time period had evolved to use of sagittal imaging for needle placement/seed deposition in addition to axial imaging and needle measurements. The same five radiation oncologists performed 98% of the implants during both these time periods.

The patient population included those treated with ¹²⁵I or ¹⁰³Pd either as monotherapy or as a boost in conjunction with external beam ± androgen ablation. Patients with a prior history of TURP were implant candidates if the defect did not prohibit adequate dose/adequate placement of seeds. Adequate is defined here as greater than one centimeter of prostate tissue laterally and posteriorly to the TURP defect and a preplan V100 coverage of the prostate of greater than or equal to 97%. All patients were preplanned with a modified peripheral loading technique and implanted with preloaded needles under ultrasound guidance. A catheter was used to

TABLE I. Description of patient population.

	Early Cohort 1997–1999	Late Cohort 2001–2002	All patients
No. of patients	994	800	1794
Mean # seeds±SD used per implant	104±19	95±15	100±18
No. of patients with ¹²⁵ I implant	861	645	1506
No. of ¹²⁵ I seeds implanted	90,392	63,060	153,452
Mean # seeds±SD used per ¹²⁵ I implant	105±18	98±14	102±17
No. of patients with ¹⁰³ Pd implant	133	155	288
No. of ¹⁰³ Pd seeds implanted	13,203	13,104	26,307
Mean # seeds±SD used per ¹⁰³ Pd implant	99±21	85±14	91±19
No. of patients with prior TURP	82	63	145
Mean # seeds±SD used in TURP patients	104±21	87±17	96±21
Mean # seeds±SD used in non-TURP patients	104±18	96±15	101±17

localize the urethra during the preimplant volume study, but not during the implant procedure. Typically, four special needles were inserted in the center of the prostate/periurethral area and were loaded with one seed at the base and one seed at the apex. The strength per seed remained the same for both ¹²⁵I and ¹⁰³Pd over the time periods covered by both cohorts. For boost plans, the seed pattern and seed number remained the same as for a primary implant, but with a reduction in the strength per seed. Stranded ¹²⁵I seeds were used at the implanter's discretion—only in peripheral portions of the gland and never around the urethra. Once the implant had been completed, the urologist performed cystoscopy. The urethra and bladder were viewed with 25° and 70° lenses through a 21 French rigid scope. Any seeds visualized were removed with flexible grasping forceps. Seeds retrieved were not reinserted. A catheter was not placed routinely after the procedure—only at the request of the urologist based on findings at the time of cystoscopy or after a failed voiding trial in the recovery room.

The patient was typically observed for one and a half to two hours before being discharged home. In the recovery room, all urine was strained and any seeds found were documented. Patients were instructed to strain their urine for seven days. Patients were given tweezers, a urine strainer,

and a lead vial along with explicit verbal and written instructions on how to strain urine and return seeds to our center.

Our physics seed accountability log book documented seed loss as occurring in the operating room at the time of cystoscopy, in the recovery room, and at home. Mean seed loss was compared by the cohort (early versus late), TURP versus non-TURP, type of seed used (¹²⁵I versus ¹⁰³Pd) and the number of seeds implanted above the mean (>100) versus below the mean (<100). All chi-square tests and t-tests were calculated using SPSS 11.5 software (SPSS Inc., Chicago, IL). Statistical significance was set at $p < 0.05$.

III. RESULTS

The patient population is described in Table I. The two cohorts differed by the mean number of seeds per patient ($p = 0.001$) and the use of ¹²⁵I ($p = 0.001$), but not by number of patients with previous TURP ($p = 0.772$). Overall, 29.7% of patients had documented seed loss through the urinary tract with a mean seed loss of 0.58% per case (Table II). A total of 1044 seeds were recovered from the urinary tract. Here 943 seeds were recovered at the time of cystoscopy, 50

TABLE II. Description of seed loss and retrieval areas.

	Seed retrieval	Early Cohort 1997–1999	Late Cohort 2001–2002	All patients
Mean % seeds retrieved per patient	Cystoscopy	0.58	0.47	0.53
Total number of seeds		585	358	943
% of patients with seed loss		29.3%	24.8%	27.3%
Mean % seeds retrieved per patient	Recovery Room	0.03	0.02	0.03
Total number of seeds		32	18	50
% of patients with seed loss		2.4%	2.1%	2.3%
Mean % seeds retrieved per patient	Home	0.03	0.02	0.03
Total number of seeds		33	18	51
% of patients with seed loss		2.1%	2.0%	2.1%
Mean % seeds retrieved per patient	Total	0.64	0.52	0.58
Total number of seeds		650	394	1044
% of patients with seed loss		31.9%	27.0%	29.7%

TABLE III. Distribution of seeds retrieved.

% seeds retrieved per case	Early Cohort			Late Cohort			All patients		
	# of Pts	% of Pts	Cum. %	# of Pts	% of Pts	Cum. %	# of Pts	% of Pts	Cum. %
0	677	68.1	68.1	583	72.9	72.9	1260	70.2	70.2
0.001 to 0.999	84	8.45	76.6	43	5.38	78.3	127	7.08	77.3
1.0 to 2.99	183	18.4	95.0	136	17.0	95.3	319	17.78	95.1
3.0 to 4.99	33	3.32	98.3	32	4.0	99.3	65	3.62	98.7
5.0 to 6.99	11	1.1	99.4	5	0.63	99.9	16	0.89	99.6
7.0 to 8.99	4	0.40	99.8	0	0	99.9	4	0.22	99.8
9.0 to 10.99	2	0.20	100.0	1	0.13	100.0	3	0.17	100.0

seeds in the recovery room, and 51 seeds at home (Table II). Seed loss through the urinary tract ranged from 0–10.94% per case (Table III).

Mean seed loss percentage per patient for the early cohort versus the late cohort was 0.64% versus 0.52% ($p = 0.006$); ^{125}I versus ^{103}Pd was 0.61% versus 0.45% ($p = 0.009$); TURP versus non-TURP was 0.90% versus 0.56% ($p = 0.016$); the number of seeds implanted above the mean (>100) versus below the mean (<100) was 0.58% versus 0.59% ($p = 0.859$).

IV. DISCUSSION

Understanding and documenting seed loss through the urinary tract in PB patients is important from the standpoint of patient care, radiation safety, dosimetry, and technique. Along with internal seed migration,^{6,7} the urinary tract represents another quantifiable route for seed loss. Nearly 30% of patients in this study had documented seed loss through the urinary tract. However, only a small percentage of patients (1.3%) lost more than 5% of seed activity. In this study we document a low percentage of seed loss per case, compare favorably to Prestidge's report, and add another published reference point.

In this study we found a higher seed loss rate in the early cohort, ^{125}I cases and in TURP patients. In the early cohort, we speculate that more seeds were lost in the bladder as a result of technical inexperience and difficulty delineating the prostate/bladder interface on axial imaging. The late cohort reflects a more experienced implant team and the use of sagittal imaging. The average number of seeds inserted per patient decreased in the late cohort (we reduced the apical margin based on post-plan results), but on statistical analysis, reducing the number of seeds did not account for the decreased rate of seed loss through the urinary tract. The higher rate of ^{125}I seed loss may be due to the use of stranded products—if one ^{125}I strand is found in the bladder and removed, this will typically involve the loss of two to five seeds as opposed to one seed that was overinserted with ^{103}Pd -free seeds. Our data collection does not differentiate between free and stranded ^{125}I seeds, so this is difficult to prove. Merrick *et al.* posit that the physical shape of the ^{125}I seed (Amersham model 6711) compared to the ^{103}Pd seed (Theragenics model 200) (rounded versus cupped ends) may

be the cause of increased migration with ^{125}I seeds.³ Although TURP patients were carefully preplanned to avoid placing needles/seeds less than 5 mm from the defect, we find that the TURP defect is often irregular and difficult to fully visualize on ultrasound, which may lead to a higher rate of seed loss. In addition, our seed retrieval rates may be higher than other institutions due to the fact that we do not visualize the urethra at the time of the procedure. However, the larger point is that as a whole and in these specific subgroups, the rate of seed loss through the urinary tract, we believe, remains acceptably low.

We continue to recommend that a cystoscopy be performed after this procedure. Here 90%, or 943 of the 1044, seeds ultimately recovered were obtained at the time of cystoscopy. Recovering seeds in the operating room should reduce the probability of the patient discharging a seed at home. This decreases patient anxiety and lowers the radiation risk to the public, as these seeds may have ultimately ended up in the water/waste system. Discovering seeds in the bladder also provides immediate feedback on the technique and depth of needle placement. These seeds can be reinserted at the clinician's discretion. Others have reported using bladder irrigation under fluoroscopy to determine if there are seeds in the bladder,⁸ but we believe that cystoscopy may provide other valuable information. The amount of clots, degree of obstruction and general condition of the bladder noted at time of cystoscopy facilitates periprocedural management. We have also documented numerous incidental bladder cancers, as has been previously reported in the literature.⁹ Cystoscopy may determine which patient might need a catheter, closer surveillance, or extra interventions.

After documenting a very low rate of seed retrieval at home (2% of patients, or 0.0028% of all seeds inserted), we no longer recommend patients strain their urine after discharge. This follows and helps justify the recommendations of the AAPM.⁵

V. CONCLUSION

In our experience, seed loss through the urinary tract is a common event after prostate brachytherapy, occurring in 29.7% of patients analyzed. The percent activity lost through the urinary tract per case, however, is low—0.58% on average. Seed loss through the urinary tract in this study was

more common in patients with prior TURP and those implanted with ^{125}I seeds. Over time, we have observed decreased seed loss through the urinary tract. We continue to recommend cystoscopy post-prostate brachytherapy for seed retrieval and periprocedural management. We no longer recommend that patients strain their urine after discharge.

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