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INFLUENCE OF PRO-QURA–GENERATED PLANS ON POSTIMPLANT DOSIMETRIC QUALITY: A REVIEW OF A MULTI-INSTITUTIONAL DATABASE

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Abstract—The influence of Pro-Qura–generated plans vs. community-generated plans on postprostate brachytherapy dosimetric quality was compared. In the Pro-Qura database, 2933 postplans were evaluated from 57 institutions. A total of 1803 plans were generated by Pro-Qura and 1130 by community institutions. Iodine-125 (^{125}I) plans outnumbered Palladium 103 (^{103}Pd) plans by a ratio of 3:1. Postimplant dosimetry was performed in a standardized fashion by overlapping the preimplant ultrasound and the postimplant computed tomography (CT). In this analysis, adequacy was defined as a V_{100} > 80% and a D_{90} of 90% to 140% for both isotopes along with a V_{150} < 60% for ^{125}I and < 75% for ^{103}Pd. The mean postimplant V_{100} and D_{90} were 88.6% and 101.6% vs. 89.3% and 102.3% for Pro-Qura and community plans, respectively. When analyzed in terms of the first 8 sequence groups (10 patients/sequence group) for each institution, Pro-Qura planning resulted in less postimplant variability for V_{100} (86.2–89.5%) and for D_{90} (97.4–103.2%) while community-generated plans had greater V_{100} (85.3–91.2%) and D_{90} (95.9–105.2%) ranges. In terms of sequence groups, postimplant dosimetry was deemed "too cool" in 11% to 30% of cases and "too hot" in 12% to 27%. On average, no clinically significant postimplant dosimetric differences were discerned between Pro-Qura and community-based planning. However, substantially greater variability was identified in the community-based plan cohort. It is possible that the Pro-Qura plan and/or the routine postimplant dosimetric evaluation may have influenced dosimetric outcomes at community-based centers. © 2008 American Association of Medical Dosimetrists.

Key Words: **Prostate brachytherapy, Dosimetry, ^{103}Pd, ^{125}I.**

INTRODUCTION

Following permanent prostate brachytherapy, favorable biochemical control rates and morbidity profiles are highly dependent on implant quality, with multiple investigators documenting that dosimetric quality is directly related to brachytherapist experience, patient selection, treatment planning, and intraoperative execution.[1–7] Despite uniform prescribed doses, the absence of defined preimplant dosimetric criteria has resulted in substantial variability in target volume, seed strength, dose homogeneity, urethral doses, and treatment margins.[7] Standardization of preimplant dosimetry may result in more consistent postimplant dosimetric outcomes.[8] The American Brachytherapy Society (ABS) has strongly recommended postimplant dosimetric evaluation to include the volume of the target area receiving 100% of the dose (V_{100}) and the dose received by 90% of the target volume (D_{90}).[8]

A group of highly experienced brachytherapists established Pro-Qura to provide uniform and consistent planning and postimplant dosimetry. Institutions submitted postimplant computed tomography (CT) scans to Pro-Qura for dosimetric evaluation, but were free to generate their own plans (community-based plans) or utilize Pro-Qura planning services. In our initial Pro-Qura analysis, brachytherapy quality was considered acceptable in approximately 75% to 80% of cases treated at community centers.[9] That study, however, did not evaluate the role of standardized planning. To test the hypothesis that standardization of preimplant dosimetric parameters may improve postimplant quality, we evaluated the influence of Pro-Qura generated plans vs. community-generated plans on postimplant brachytherapy dosimetry.

METHODS AND MATERIALS

In the Pro-Qura database, 2833 patients from 75 institutions implanted between June 1999 and September 2005 were analyzed for postimplant dosimetric quality. Patients implanted at the authors' institutions are not part of the Pro-Qura database. Patients were numbered according to the chronologic order of their treatment by each brachytherapist and then into sequence groups of 10.[9] All patients treated by brachytherapists who implanted fewer than 10 patients comprised group 0. The

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Table 1. Categorical treatment parameters stratified by sequence group of 10 patients per group for Pro-Qura–generated plans

			^{125}I				^{103}Pd			
			Monotherapy		Boost		Monotherapy		Boost	
Sequence Group	Patients *n*	No. of Brachytherapists	Count	(%)	Count	(%)	Count	(%)	Count	(%)
0*	37	17	27	73.0	1	2.7	9	24.3	0	0.0
1	373	41	226	60	62	16.6	37	9.9	48	12.9
2	344	39	208	60.5	40	11.6	32	9.3	64	18.6
3	262	28	162	61.8	37	14.1	23	8.8	40	15.3
4	219	23	131	59.8	36	59.8	19	8.7	33	15.1
5	206	21	117	56.8	31	56.8	30	14.6	28	13.6
6	155	19	88	56.8	20	13.0	27	17.4	20	12.9
7	140	16	87	62.1	12	8.6	18	12.9	23	16.4
8	104	14	63	60.6	9	8.7	15	14.4	17	16.3
1–8	1803	43	1082	60.0	247	13.7	201	11.1	273	15.1
Overall†	2820	61	1627	57.7	289	10.2	483	17.1	421	15.0

*Sequence group 0 consists of patients treated by radiation oncologists with a total number of patients less than 10.
†Includes patients beyond sequence group 8 implanted at high-volume centers.

analysis was limited to the first 8 sequence groups because only 16 institutions contributed more than 80 patients. These high-volume institutions implanted an additional 1781 patients beyond group 8 who were included in this analysis only in the aggregate for each planning location. The distribution stratified by sequence group and isotope for Pro-Qura–generated plan cases is detailed in Table 1, while the distribution for those cases with plans generated at each local institution is detailed in Table 2.

Of the 2833 analyzed postimplant dosimetric evaluations, 1803 were planned by Pro-Qura and 1030 by community-based institutions. Of the Pro-Qura plans, Iodine-125 (^{125}I) was used in 1329 patients (1082 monotherapy and 247 boost) and Palladium-103 (^{103}Pd) in 474 (201 monotherapy and 273 boost). Of the community-based plans, ^{125}I was used in 792 (603 monotherapy and 189 boost) and ^{103}Pd in 238 (168 monotherapy and 70 boost) patients. For Pro-Qura plans, the mean ^{125}I seed activity was 0.32 ± 0.02 mCi and 0.25 ± 0.02 mCi for monotherapy and boost, while for ^{103}Pd, the mean seed activity was 1.61 ± 0.17 mCi and 1.30 ± 0.17 mCi, respectively. For the community plans, the mean ^{125}I seed activity was 0.32 ± 0.03 mCi and 0.27 ± 0.04 mCi for monotherapy and boost, while for ^{103}Pd, the mean seed activity was 1.68 ± 0.24 mCi and 1.37 ± 0.24 mCi, respectively. The strength used for each radionuclide for either monotherapy or boost was statistically significantly different between Pro-Qura and community plans, but the magnitudes of the differences are probably not clinically significant.

All patients underwent postimplant CT-based dosimetry at a mean and median of 31.0 days and 30 days for Pro-Qura (range 0 – 332 days) and 30.3 days and 30 days for community plans (range 0 – 181 days), respectively. Postimplant dosimetry was performed by a standardized technique developed by Pro-Qura.[9] For this analysis, postimplant dosimetric adequacy was defined

Table 2. Categorical treatment parameters stratified by sequence group of 10 patients per group for community-generated plans

			^{125}I				^{103}Pd			
			Monotherapy		Boost		Monotherapy		Boost	
Sequence Group	Patients *n*	No. of Brachytherapists	Count	(%)	Count	(%)	Count	(%)	Count	(%)
0*	100	35	66	66.0	11	11.0	4	4.0	19	19.0
1	197	23	118	59.9	34	17.3	26	13.2	19	9.6
2	144	20	78	54.2	37	25.7	19	13.2	10	6.9
3	124	17	75	60.5	24	19.4	22	17.7	3	2.4
4	123	14	78	63.4	15	12.2	24	195	6	4.9
5	124	16	67	54.0	23	18.5	24	19.4	10	8.1
6	118	12	62	52.5	25	21.2	23	19.5	8	6.8
7	106	12	61	57.5	21	19.8	14	13.2	10	9.4
8	94	10	64	68.1	10	10.6	16	17.0	4	4.3
1–8	1030	32	603	59.2	189	17.7	168	15.2	70	7.9
Overall†	1794	58	905	50.4	249	13.9	455	25.4	185	10.3

*Sequence group 0 consists of patients treated by radiation oncologists with a total number of patients less than 10.
†Includes patients beyond sequence group 8 implanted at high-volume centers.