Safety, Minimization, and Awareness Radiation Training Reduces Fluoroscopy Time During Unilateral Ureteroscopy

Lancaster R. Weld, Uzoamaka O. Nwoye, Richard B. Knight, Timothy S. Baumgartner, James S. Ebertowski, Matthew T. Stringer, Matthew C. Kasprenski, and Kyle J. Weld

OBJECTIVE To determine the impact of Safety, Minimization and Awareness Radiation Training (SMART) on fluoroscopy time during unilateral uncomplicated ureteroscopy for urolithiasis performed by urology residents.

MATERIALS AND METHODS All consecutive ureteroscopy cases for urolithiasis meeting inclusion criteria and performed by first-year urology residents over a 2-year period were reviewed. Fluoroscopy times during SMART and without SMART were compared.

RESULTS A total of 202 ureteroscopy cases were reviewed. The mean patient age was 48.7 years. The mean stone diameter was 7.6 ± 3.3 mm. The mean operating time was 79.8 ± 34.3 minutes. The mean cumulative fluoroscopy time was 85.6 ± 36.9 seconds per case. A Spearman rank correlation identified 8 variables significantly correlated with fluoroscopy time, with the most significant correlation between shorter fluoroscopy time and SMART exposure (rho = 0.532; $P < .001$). Multivariate regression analysis (r = 0.701) revealed that fluoroscopy time was significantly shorter with SMART ($P < .001$). Post hoc comparisons revealed the fluoroscopy time of the cases performed during SMART (mean, 45 seconds) to be significantly shorter than the fluoroscopy time of cases performed by the same residents before SMART (mean, 102 seconds; $P = .005$), and the fluoroscopy time of cases performed by residents the previous year with similar ureteroscopic experience but without SMART (mean, 78 seconds; $P < .001$).

CONCLUSION SMART reduces fluoroscopy time during unilateral uncomplicated ureteroscopy for urolithiasis performed by urology residents by 56%. UROLOGY 84: 520–525, 2014. Published by Elsevier Inc.

Multiple authors have proposed a linear no-threshold model supporting an increasing cancer risk with increasing exposure to nonionizing radiation.[1-4] Fluoroscopy is used during ureteroscopy, but the literature is sparse with data regarding fluoroscopy time during ureteroscopy.[5-10] Although the radiation exposure from a single, fluoroscopically-guided endoscopic case may be relatively low compared to radiation levels during CT scan, the effects are cumulative.[11,12] Patients with stone disease often have recurrences requiring multiple endourologic procedures and CT scans. A public health advisory issued by the US Food and Drug Administration encourages physicians to limit the use of fluoroscopy[13] and adhere to the "as low as reasonably achievable" principle to reduce the risks to themselves and to their patients.[14,15] Reduced radiation exposure can be accomplished simply by decreasing fluoroscopy time during ureteroscopy.[16]

An increased focus on quality improvement and patient safety is emerging in graduate medical education.[17,18] In addition to honing the specific technical skills needed to perform ureteroscopy, urology residents are also now being encouraged to broadly consider how the quality of the procedure or patient safety might be improved. Patient and provider safety can be improved by reducing radiation exposure during procedures performed by urology residents. Multiple authors have recently presented techniques to reduce fluoroscopy time during ureteroscopy.[5,8-10] We have attempted to combine these techniques into one program for urology residents, referred to as Safety, Minimization, and Awareness Radiation Training (SMART). The purpose of this study was to determine the impact of SMART

Financial Disclosure: *The authors declare that they have no relevant financial interests.*

The views expressed herein are those of the authors and do not reflect the official policy or position of the San Antonio Military Medical Center, the US Army Office of the Surgeon General, the US Air Force Office of the Surgeon General, the Department of the Army, the Department of the Air Force, the Department of Defense, or the US government.

From the Department of Urology, San Antonio Military Medical Center, Fort Sam Houston, San Antonio, TX

Reprint requests: Kyle J. Weld, M.D., Department of Urology, San Antonio Military Medical Center, 3551 Roger Brooke Drive, Fort Sam Houston, TX 78234. E-mail: Kyle.j.weld.mil@mail.mil

Submitted: January 15, 2014, accepted (with revisions): March 4, 2014

0090-4295/14/$36.00
http://dx.doi.org/10.1016/j.urology.2014.03.035

Table 1. Patient demographics, stone parameters, operative characteristics, and outcomes

Variables	All Residents	2012-2013 Residents	2011-2012 Residents	*P*
Number of patients	202	97*	105	
Mean age ± SD, y	48.7 ± 15.4	50.2 ± 14.9	47.2 ± 15.8	.190
Race, n (%)				.538
Caucasian	141 (69%)	62 (64%)	79 (75%)	
Black	33 (16%)	18 (19%)	15 (14%)	
Hispanic	23 (11%)	13 (13%)	10 (10%)	
Asian	5 (2%)	4 (3%)	1 (1%)	
Mean BMI ± SD, kg/m^2	25.7 ± 3.8	25.6 ± 3.6	25.8 ± 4.1	.753
Male gender, n (%)	114 (56%)	58 (60%)	56 (53%)	.265
Mean stone diameter ± SD, mm	7.6 ± 3.3	8.2 ± 3.4	7.0 ± 3.2	.158
Mean number of stones (range)	1.3 (1-4)	1.4 (1-4)	1.3 (1-3)	.098
Left side laterality, n (%)	102 (50%)	47 (48%)	55 (52%)	.438
Stone location, n (%)				.067
Renal	92 (45%)	51 (53%)	41 (39%)	
Ureteral	110 (55%)	46 (47%)	64 (61%)	
Grade of hydronephrosis, n (%)				.683
None	127 (63%)	66 (68%)	61 (58%)	
Mild	52 (26%)	23 (24%)	29 (28%)	
Severe, n (%)	23 (11%)	8 (8%)	15 (7%)	
Mean Hounsfield units ± SD	771 ± 185	787 ± 179	755 ± 190	.288
Preoperative stent, n (%)	36 (18%)	19 (20%)	17 (16%)	.262
Balloon dilation performed, n (%)	27 (13%)	12 (12%)	15 (14%)	.745
Retrograde pyelogram performed, n (%)	102 (51%)	43 (44%)	59 (56%)	.134
Holmium laser use				.289
None, n (%)	14 (7%)	4 (4%)	10 (10%)	
Mean time ± SD, s	39 ± 36	42 ± 37	37 ± 35	
Type of ureteroscope, n (%)				.276
Semirigid	68 (34%)	28 (29%)	40 (38%)	
Flexible	134 (66%)	69 (71%)	65 (62%)	
Access sheath used, n (%)	124 (61%)	61 (63%)	63 (60%)	.744
Postoperative stent placed, n (%)				.194
Direct cystoscopic vision	158 (78%)	70 (72%)	88 (84%)	
Fluoroscopic guidance	44 (22%)	27 (28%)	17 (16%)	
Mean operative time ± SD, min	80.0 ± 34.3	82.4 ±31.3	76.7 ± 36.1	.127
Mean fluoroscopy time ± SD, s	85.6 ± 36.9	77.1 ± 37.8	93.5 ± 34.4	.035
Metabolic stone analysis, n (%)				.437
Calcium oxalate	130 (64%)	60 (62%)	70 (67%)	
Calcium phosphate	35 (17%)	18 (19%)	17 (16%)	
Uric acid	8 (4%)	6 (6%)	2 (2%)	
Struvite	4 (2%)	2 (2%)	2 (2%)	
None performed	25 (12%)	11 (11%)	14 (13%)	
Residual stone >3 mm, n (%)	15 (7%)	10 (10%)	5 (5%)	.174

BMI, body mass index; SD, standard deviation.
* 51 cases during safety, minimization, and awareness radiation training.

on fluoroscopy time during unilateral uncomplicated ureteroscopy for urolithiasis performed by urology residents.

MATERIALS AND METHODS

Institutional review board approval was obtained for this retrospective review. All patients diagnosed with urolithiasis were counseled regarding their options, including attempt at spontaneous passage or treatment. Choice of treatment option was mutually agreed on at the discretion of the surgeon and the patient. The patient charts, CT scans, operative reports, and operative nursing records of the consecutive, unilateral, uncomplicated ureteroscopy cases for urolithiasis performed by first-year urology residents in 2 sequential academic years were reviewed. A total of 4 residents participated in the study with 2 per year. During the 2011-2012 academic year, the residents only received radiation safety training and served as baseline data to evaluate the effect of SMART. Six months into the second academic year of the study, 2012-2013, the residents initiated SMART consisting of didactic radiation "safety" training, didactic and clinical instruction on "minimizing" fluoroscopy use during ureteroscopy, and participation in a monitoring program, which raised "awareness" of resident fluoroscopy use relative to their peers (Table 1). The data from the first 6 months of the 2012-2013 year before initiating SMART also served as baseline data.

All cases were directly supervised by the same experienced staff urologists throughout the study period. Of the 240 patients, 38 patients were excluded, leaving a total of 202 patients in this report. Of the excluded patients, the supervising staff urologist performed the majority of the cases (20 patients), preoperative imaging was not available for review in 10 patients, the procedure was complicated by fluid extravasation in 4 patients, and 4 patients were less than 18 years old. Patient