

Variations in Reconstruction After Radical Cystectomy

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BACKGROUND. Most urologists specializing in the management of patients with bladder cancer consider continent urinary diversion the reconstructive technique that affords the best quality of life after radical cystectomy. The authors sought to evaluate factors that predict reconstructive technique after radical cystectomy.

METHODS. Using linked data from Medicare and the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program, 3611 subjects were identified who underwent radical cystectomy for bladder cancer between 1992 and 2000. Multivariate logistic regression was used to identify factors independently associated with utilization of continent reconstruction after radical cystectomy, incorporating patient and provider variables.

RESULTS. In multivariate analysis, the likelihood of continent diversion was inversely associated with older age (odds ratio [OR] ≤ 0.68 , $P < .002$), African American race (OR 0.43, $P = .003$), and higher comorbidity index (OR 0.71, $P = .03$), and directly associated with male sex (OR 1.45, $P = .002$), higher education level (OR 1.54, $P = .03$), and year of surgery (OR ≥ 1.56 , $P < .001$ for all year categories vs. 1992–1994). Treatment at academic (OR 1.43, $P = .003$) and NCI-designated cancer centers (OR 5.50, $P < .001$) and by high-volume providers (OR 1.49, $P < .001$) was independently associated with continent reconstruction.

CONCLUSIONS. Disparities in the utilization of continent urinary diversion after radical cystectomy suggest that demographic, socioeconomic, provider-based, and clinical variables predict the likelihood that those undergoing radical cystectomy will receive continent reconstruction. Regionalization of bladder cancer care may ameliorate many of the disparities noted but must be balanced against the risk imposed by a delay in care. *Cancer* 2006;107:729–37. © 2006 American Cancer Society.

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Few cancer-directed surgeries confer the substantial morbidity of a radical cystectomy for bladder cancer. Removing the bladder necessitates creation of an alternate reservoir for urine, a necessity that led to the development of myriad reconstructive techniques categorized as incontinent (using an ileal conduit) or continent (using a urethral or cutaneous neobladder) urinary diversions. Advantages of continent urinary diversions have led experts in the surgical management of bladder cancer to label neobladders the optimal reconstructive technique for patients undergoing radical cystectomy.¹ Appropriate use of these techniques can be considered a marker of quality of care in this setting.

An ileal conduit is a tube constructed from an ileal segment through which urine drains continuously into an external urostomy bag. Advantages of the ileal conduit include shorter operative time and relative ease of the surgical technique. The primary disadvantage is the presence of a stoma and external appliance, which may be cosmetically unappealing and functionally constraining. Continent diversions include orthotopic neobladders, in which a bladder

constructed of intestine connects to the urethra, allowing more natural volitional voiding, and continent cutaneous reservoirs in which a storage reservoir fashioned from bowel is emptied through periodic catheterization of a small skin opening.² Advantages include daytime urinary continence and, with a urethral neobladder, lack of an abdominal stoma. However, these advantages are measured against increased technical difficulty, longer operative time, and the possibility that patients may have difficulty with catheterization. Furthermore, certain clinical contraindications preclude creation of a neobladder, among them compromised renal function and tumor at the urethral margin of resection.

Morbidity and mortality outcomes between patients undergoing ileal conduit and orthotopic neobladder are comparable.³ Although no disease-specific quality-of-life instrument has been created that universally captures patients after radical cystectomy,⁴ many studies demonstrate better outcomes among patients who undergo continent urinary diversions.⁵⁻¹⁰ Patients receiving an orthotopic neobladder have decreased distress related to urinary leakage and better body image.^{5,6} Furthermore, the availability of neobladder reconstruction may reduce patient and physician resistance to radical cystectomy in those with earlier stage disease, possibly leading to improved disease-specific survival.¹¹

Despite evidence of advantageous outcomes among recipients of continent urinary diversions, there has been no appreciable increase in the use of these procedures in Medicare beneficiaries over the past decade.¹² This analysis set out to identify variations in continent reconstruction based on patient and provider characteristics. We hypothesized that given the limited number of cystectomies performed by the average urologist,¹³ provider-driven factors may supersede clinical factors in the selection of reconstructive technique. We posited that care delivered at comprehensive cancer centers and by more experienced providers is more likely to include the more technically complex continent urinary diversion, and that these provider-driven factors may be more important than sociodemographic, geographic, or clinical variables.

MATERIALS AND METHODS

Patient Population

We identified individuals undergoing radical cystectomy for bladder cancer from a linked database combining the Surveillance, Epidemiology, and End Results (SEER) national cancer registry and Medicare claims for 1992 through 2000.¹⁴ The SEER registry identifies patients with a cancer diagnosis; the data cur-

rently available are from 11 geographic regions representative of the general U.S. population. The SEER registry comprises both urban and rural regions; it includes the metropolitan areas Atlanta, Detroit, Los Angeles, San Francisco/Oakland, San Jose/Monterey, and Seattle/Puget Sound, and the states Connecticut, Hawaii, Iowa, New Mexico, and Utah.

Medicare claims data analyzed included the Medicare Provider Analysis and Review (MEDPAR) file, the National Claims History (NCH) records, and hospital variables derived from Medicare's Healthcare Cost Report (HCRIS) and Provider of Service (POS) survey. The MEDPAR file includes all Medicare Part A short and long stay claims with International Classification of Diseases (9th revision [ICD-9]) diagnosis and procedure codes for each admission. The NCH records detail physician and provider claims with Current Procedural Terminology Coding System (4th edition [CPT-4]) codes and corresponding ICD-9 codes. Linkage of the SEER registry with Medicare data allows integration of detailed cancer information, such as stage and grade, with claims information pertaining to procedural codes, comorbidities, and dates of treatment.

Study subjects were identified on the basis of primary malignancy codes indicating a bladder cancer diagnosis in conjunction with either ICD-9 code 57.71 or CPT-4 codes 51570 or 51575 indicating that the individual underwent a radical cystectomy. The method of urinary diversion was delineated from Medicare claims: subjects who underwent a neobladder were identified on the basis of ICD-9 code 57.87 or CPT-4 code 51596, concomitant with a code for radical cystectomy. Subjects who underwent an ileal conduit were identified with ICD-9 code 56.51 or CPT-4 codes 50815 and 50820, concomitant with a code for radical cystectomy.

Demographic data abstracted included age, sex, race/ethnicity, and marital status. We consolidated race/ethnicity into four categories: white, African American, Hispanic, and other. Information on individual subject socioeconomic variables is not available through the linked SEER-Medicare files; therefore, values were ascribed to individuals based on ZIP code data from the U.S. Census Bureau. We present annual income as the median income in a subject's ZIP code of residence. We present education level as the percentage of residents in a subject's ZIP code with a college-level education. Patient comorbidity was assessed with the Charlson index, in which a higher score indicates greater comorbidity, abstracted from Medicare claims according to established techniques.^{15,16}

Grade of bladder cancer was classified 1-4, with a higher grade indicating poorer histologic differen-

tiation. We categorized stage at radical cystectomy according to the American Joint Committee on Cancer/International Union Against Cancer (AJCC/UICC) TNM Classification and Stage groupings.¹⁷ We determined the extent of lymph node metastases from SEER disease extension codes. A previous diagnosis of cancer did not preclude inclusion in our analysis.

Hospitals were classified by type and volume. We considered a major academic affiliation to denote a teaching hospital and categorized all other affiliations as nonteaching hospitals. We categorized hospitals designated by the National Cancer Institute (NCI) as clinical or comprehensive cancer centers as NCI centers. We determined hospital volume from hospital files included with SEER-Medicare. We averaged total volume counts from 1996, 1998, and 2000 to determine yearly hospital volume. We defined high-volume centers as those in the 90th percentile of annual hospital cystectomy volume (5 or more radical cystectomies per year) as in previous analyses.¹³ We abstracted surgeon volume from the NCH files, with total volume counts for the years 1991–2000 averaged to obtain yearly volume. We defined high-volume surgeons as those in the 90th percentile of annual cystectomy volume (4 or more radical cystectomies per year).

Statistical Analysis

Descriptive statistics are presented for demographic and clinical data. We compared these data among subjects stratified by bladder reconstruction with chi-square analysis. In order to determine the independent association of subject demographic and clinical variables with the type of reconstruction after radical cystectomy, we created multivariate models utilizing logistic regression. We incorporated variables thought to influence reconstructive modality, including demographic, socioeconomic, provider-based, and clinical variables. The variables for surgeon volume and hospital volume were substantially confounded and it was not possible to reliably estimate separate coefficients. We therefore dropped the variable with the weaker association, surgeon volume, from the regression models. All statistical analyses were performed with SAS 8.02 software (SAS Institute Inc., Cary, NC).

RESULTS

We identified 3611 subjects from the SEER-Medicare files diagnosed with bladder cancer between 1992 and 1999 who underwent a radical cystectomy in the years 1992–2000 and for whom complete information regarding reconstruction technique after cystectomy

was available. Of those, 718 subjects (19.9%) underwent continent urinary diversion and 2893 (80.1%) were diverted with an ileal conduit.

Table 1 displays characteristics of the study sample stratified by reconstructive technique. Subjects who underwent a continent diversion were younger and were more commonly male and married. Racial variation was significant, with whites more likely to undergo continent diversion. Socioeconomic variation was also significant, with continent diversion more common among subjects in wealthier and more educated ZIP codes. Variation by SEER site was significant. The Los Angeles and Seattle metropolitan areas accounted for nearly 50% of the continent diversions performed in the SEER registry. Furthermore, continent reconstructions were more common among subjects treated at academic and NCI-designated cancer centers and among subjects treated by high-volume providers. Increasing comorbidity positively correlated with probability of ileal conduit diversion. No variation in reconstruction was noted based on stage or grade of bladder cancer. However, negative lymph node status was associated with continent diversion.

Table 2 presents the multivariate model of factors associated with continent diversion, exclusive of provider variables. Demographic characteristics independently associated with continent reconstruction included age, sex, and race/ethnicity. Men were more likely to undergo continent diversion; age was inversely associated with continent reconstruction. Compared with whites, African Americans were less likely to undergo continent diversion. Subjects from more highly educated ZIP codes were more likely to receive a continent diversion. Regional variation was significant: compared with residents of Los Angeles, residents of all other SEER registries were less likely to undergo continent reconstruction after radical cystectomy. Clinical variables similarly affected reconstructive technique. A greater burden of comorbid illnesses was inversely associated with continent reconstruction. Likewise, later stage disease was negatively associated with continent urinary diversion. Finally, those who underwent radical cystectomy toward the end of the decade were more likely to receive a continent reconstruction.

Inclusion of provider variables in the multivariate model affected many of these associations (Table 3). The association between continent reconstruction and the demographic variables age, gender, and race/ethnicity remained. Provider variables explained differences in the utilization of continent diversion between the Los Angeles registry and urban SEER registries Seattle, Atlanta, and San Jose, as differences in reconstruction were no longer significant. Conversely, controlling for

TABLE 1
Characteristics of the Study Sample

	All patients	Continent diversion	P		All patients	Continent diversion	P
Overall, no. (%)	3611	718 (19.9)		SEER Registry, no. (%)			
Demographic data				Hawaii	89	4 (4.5)	
Age, no. (%)				Iowa	411	32 (7.8)	
65-69 y	872	238 (27.3)	<.001	New Mexico	162	21 (13.0)	
70-74 y	1097	251 (22.9)		Seattle	384	116 (30.2)	
75-79 y	994	171 (17.2)		Utah	131	20 (15.3)	
At least 80 y	648	58 (9.0)		Atlanta	138	38 (27.5)	
Sex, no. (%)				San Jose	187	50 (26.7)	
Male	2631	566 (21.5)	<.001	Los Angeles	628	245 (39.0)	
Female	980	152 (15.5)		Hospital type, no. (%)			
Race/ethnicity, no. (%)				Academic	1444	321 (22.2)	.004
White	3184	636 (20.0)	.048	Nonacademic	2167	397 (18.3)	
African American	156	19 (12.2)		NCI cancer center	589	274 (46.5)	<.001
Hispanic	119	29 (24.4)		Noncancer center	3022	444 (14.7)	
Other	152	34 (22.4)		Hospital volume, no. (%)			
Marital status, no. (%)				High volume (≥ 5 per y)	1240	362 (29.2)	<.001
Married	2445	526 (21.5)	.002	Low volume (< 5 per y)	2371	356 (15.0)	
Not married	1100	180 (16.4)		Surgeon volume, [‡] no. (%)			
Unknown	66	12 (18.2)		High volume (≥ 4 per y)	859	281 (32.7)	<.001
Socioeconomic status				Low volume (< 4 per y)	2033	401 (19.7)	
Annual income,* no. (%)				Clinical characteristics			
Less than \$20,000	23	3 (13.0)	<.001	Charlson score, no. (%)			
\$20,000-\$49,999	1877	310 (16.5)		0	1458	320 (22.0)	.001
\$50,000-\$74,999	1140	276 (24.2)		1-2	1674	330 (19.7)	
At least \$75,000	418	94 (22.5)		At least 3	479	68 (14.2)	
Unknown	153	35 (22.9)		Grade, no. (%)			
College educated, [†] no. (%)				1	75	16 (21.3)	.22
Less than 25%	1764	270 (15.3)	<.001	2	596	108 (18.1)	
25-40%	851	177 (20.8)		3	2020	391 (19.4)	
Greater than 40%	843	236 (28.0)		4	721	165 (22.9)	
Unknown	153	35 (22.9)		Unknown	199	38 (19.1)	
Provider characteristics				Stage, no. (%)			
Year of surgery, no. (%)				I	1316	286 (21.7)	.05
1992-1994	1199	191 (15.9)	<.001	II	780	163 (20.9)	
1995-1997	1381	289 (20.9)		III	803	144 (17.9)	
1998-2000	1031	238 (23.1)		IV	712	125 (17.6)	
SEER Registry, no. (%)				Lymph node status, no. (%)			
San Francisco	349	54 (15.5)	<.001	Positive	371	71 (19.1)	.02
Connecticut	565	65 (11.5)		Negative	2436	514 (21.1)	
Detroit	567	73 (12.9)		Unknown	804	133 (16.5)	

SEER indicates Surveillance, Epidemiology, and End Results.

* Based on subject ZIP code median income.

† Based on the proportion of persons in the subject's ZIP code who are at least college educated.

‡ Data available for 3208 subjects.

provider characteristics enhanced the disparity between Los Angeles and Connecticut, Detroit, Iowa, and Utah. Finally, incorporating provider variables into the model eliminated the association between advanced stage and reconstruction with an ileal conduit.

Among the provider variables analyzed, care at an NCI-designated cancer center increased the probability of continent reconstruction 5-fold (odds ratio [OR] 5.50, $P < .001$). Likewise, care at an academic institution or high-volume hospital was independently associated with continent reconstruction.

DISCUSSION

Our study has several important findings. First, although most bladder cancer experts agree that continent reconstruction is the optimal reconstruction after radical cystectomy, the majority of patients who had surgery in the 1990s received an ileal conduit incontinent diversion. Increased utilization of continent diversion over the course of the decade may demonstrate dissemination of reconstructive techniques or simple urbanization of bladder cancer care throughout the 1990s. Our results contrast a preliminary analysis of

TABLE 2
Multivariate Analysis of Factors Associated with Continent Reconstruction, Omitting Provider Variables

	OR (95% CI)
Age (vs. 65–69 y)	
70–74 y	0.67 (0.54–0.84)
75–79 y	0.44 (0.34–0.56)
At least 80 y	0.20 (0.14–0.27)
Male sex (vs. female)	1.37 (1.09–1.71)
Race/ethnicity (vs. white)	
African American	0.58 (0.34–0.98)
Hispanic	1.02 (0.63–1.64)
Other	1.11 (0.70–1.78)
Married partner status (vs. not married)	1.17 (0.95–1.44)
Median income* (vs. ≥\$75,000)	
Less than \$20,000	0.85 (0.22–3.30)
\$20,000–\$49,999	1.10 (0.75–1.61)
\$50,000–\$74,000	1.28 (0.93–1.78)
College educated [†] (vs. less than 25%)	
25–40%	1.22 (0.88–1.67)
At least 40%	1.82 (1.28–2.59)
Charlson score (vs. 0)	
1–2	1.06 (0.87–1.28)
At least 3	0.70 (0.51–0.95)
SEER registry (vs. Los Angeles)	
San Francisco	0.24 (0.17–0.34)
Connecticut	0.18 (0.13–0.24)
Detroit	0.22 (0.16–0.30)
Hawaii	0.07 (0.02–0.19)
Iowa	0.13 (0.09–0.20)
New Mexico	0.22 (0.13–0.37)
Seattle	0.65 (0.48–0.87)
Utah	0.26 (0.15–0.44)
Atlanta	0.55 (0.35–0.85)
San Jose	0.43 (0.29–0.64)
Year of surgery (vs. 1992–1994)	
1995–1997	1.58 (1.27–1.97)
1998–2000	2.21 (1.74–2.80)
Stage at least III (vs. I)	0.80 (0.67–0.96)
Lymph nodes negative	0.98 (0.81–1.20)

OR, odds ratio; 95% CI, 95% confidence interval; SEER, Surveillance, Epidemiology, and End Results.
* Based on subject ZIP code median income.
[†] Based on the proportion of persons in the subject's ZIP code who are at least college educated.

Medicare claims that evinced no increase in the use of continent diversion over a similar time period. This may be due to the use of interval sample data in that study as opposed to the complete longitudinal sample available in our analysis.

Second, demographic factors were associated with the technique of urinary diversion after a radical cystectomy. As expected, older individuals were less likely to undergo continent diversion. Management of bladder cancer in the elderly is often complicated by comorbid disease, itself an independent predictor of ileal conduit diversion.¹⁸ Although single-institution series have demonstrated decreased survival for elderly subjects after radical cystectomy, SEER regis-

TABLE 3
Multivariate Analysis of Factors Associated with Continent Reconstruction, Including Provider Variables

	OR (95% CI)
Age (vs. 65–69 y)	
70–74 y	0.68 (0.54–0.87)
75–79 y	0.43 (0.33–0.55)
At least 80 y	0.19 (0.13–0.27)
Male sex (vs. female)	1.45 (1.15–1.84)
Race/ethnicity (vs. white)	
African American	0.43 (0.25–0.76)
Hispanic	0.92 (0.55–1.53)
Other	1.09 (0.66–1.80)
Married partner status (vs. not married)	1.13 (0.90–1.41)
Median income* (vs. ≥\$75,000)	
Less than \$20,000	0.70 (0.16–3.07)
\$20,000–\$49,999	1.22 (0.81–1.84)
\$50,000–\$74,000	1.43 (1.01–2.01)
College educated [†] (vs. less than 25%)	
25–40%	1.14 (0.81–1.61)
At least 40%	1.54 (1.06–2.23)
Charlson score (vs. 0)	
1–2	0.97 (0.79–1.19)
At least 3	0.71 (0.51–0.97)
SEER registry (vs. Los Angeles)	
San Francisco	0.38 (0.26–0.56)
Connecticut	0.15 (0.11–0.22)
Detroit	0.16 (0.11–0.24)
Hawaii	0.10 (0.03–0.29)
Iowa	0.11 (0.07–0.17)
New Mexico	0.39 (0.23–0.66)
Seattle	1.22 (0.88–1.68)
Utah	0.22 (0.12–0.40)
Atlanta	1.17 (0.74–1.86)
San Jose	0.74 (0.48–1.13)
Year of surgery (vs. 1992–1994)	
1995–1997	1.56 (1.23–1.97)
1998–2000	1.98 (1.53–2.54)
Stage at least III (vs. I)	0.85 (0.70–1.03)
Lymph nodes negative	1.04 (0.84–1.28)
Hospital type	
Academic (vs. non)	1.43 (1.14–1.81)
NCI cancer center (vs. non)	5.50 (4.20–7.22)
High volume hospital (vs. low)	1.49 (1.19–1.86)

OR, odds ratio; 95% CI, 95% confidence interval; NCI, National Cancer Institute.
* Based on subject ZIP code median income.
[†] Based on the proportion of persons in the subject's ZIP code who are at least college educated.

try analyses have indicated that prognosis correlates with stage and lymph node status, but not age.^{18,19} Furthermore, compared with elderly patients managed conservatively, stage- and age-matched patients treated with radical cystectomy have better survival.²⁰ Selection of continent diversion in these subjects may improve quality-of-life outcomes.

Sex-based differences may relate to a perceived increase in voiding dysfunction and urethral recurrence among women treated with radical cystectomy

and orthotopic diversion.²¹ Historically, radical cystectomy in the female has been combined with urethrectomy and incontinent ileal diversion. However, recent analyses have demonstrated the feasibility and safety of performing orthotopic reconstruction in women.^{22,23} A subsequent analysis of the following decade may show loss of the association between gender and reconstructive modality. Although African Americans represented a small subset of our study sample, they were less likely to undergo continent diversion. Bladder cancer predominantly affects white men; however, African Americans present with later stage tumors and have worse disease-specific survival.^{19,24} Despite more advanced disease, African Americans are less likely to receive aggressive therapy for bladder cancer.^{19,25} Insurance status and access to care may mediate these disparities.²⁴

Third, socioeconomic status had a significant impact on diversion technique after radical cystectomy. Being from a more highly educated ZIP code was independently associated with continent reconstruction. Education level affects patient adherence and decision-making in a variety of conditions. In breast cancer, women of higher education level are more likely to undergo breast-conserving surgery and adjuvant chemotherapy than less educated subjects.^{26,27} In colorectal cancer, education level is positively associated with screening and the receipt of adjuvant chemotherapy after surgery.^{28,29}

Fourth, clinical factors affected reconstructive modality after radical cystectomy. Patients with 3 or more chronic comorbid conditions were less likely to undergo continent diversion. In these patients, the risk of prolonged anesthesia time in the setting of complicating comorbidities likely outweighs the benefit of improved quality of life with a neobladder. Patients with more comorbid conditions may have higher rates of postoperative complications after more complex reconstructions. Furthermore, comorbidity correlates with later pathologic stage at the time of cystectomy, possibly due to a delay in therapy secondary to patient and physician reluctance to pursue aggressive interventions in sicker patients.³⁰ These factors combine to limit utilization of a more technically complex reconstruction in this population.

Finally, provider variables exhibited a pronounced association with reconstruction technique. From 1992 to 2000, the proportion of subjects undergoing radical cystectomy who received a continent diversion steadily increased. Unlike less technically advanced procedures, such as laparoscopic cholecystectomy, dissemination of procedures such as the orthotopic neobladder may lag significantly, with restriction to higher volume, tertiary referral centers.³¹ Progression

of continent diversion may parallel the dissemination of laparoscopic techniques in urology, which require more substantial training than that required to perform laparoscopic cholecystectomy. Although laparoscopic nephrectomy was introduced over a decade ago, recent analyses have revealed limited utilization of urologic laparoscopy.^{32,33} Regional variation may reflect differences in referral patterns, provider training, and the fact that clinical guidelines for reconstruction after radical cystectomy have not been defined. In general, continent diversions are more common in the western U.S. and in urban SEER regions, with Los Angeles representing an outlier region. Patterns of utilization of continent diversion may mimic trends in aggressive therapy for bladder cancer: over the past decade, radical cystectomy has seen marked urbanization.³⁴ As fewer community hospitals support large extirpative surgeries, surgical facility with complex reconstructions diminishes. Academic centers, specifically those recognized for excellence by the NCI, are more likely to house multidisciplinary clinics, specialists who focus on the management of bladder cancer, and nursing staff familiar with continent reconstruction. Not surprisingly, we found a marked association between hospital type and continent diversion.

Volume-outcome relations are well established for several surgical procedures including radical prostatectomy and radical cystectomy.^{13,35,36} These studies demonstrate decreased rates of postoperative morbidity and mortality under the care of high-volume providers. Prompted by these established volume-outcome relations and rising health care costs, the Leapfrog group mandated regionalization of selected procedures to high-volume centers that meet certain process of care measures.^{37,38} Regionalization of care has been projected to reduce operative mortality significantly for common intermediate-risk procedures, such as coronary artery bypass grafting (CABG), with less pronounced benefits for procedures, albeit high risk, that are less commonly performed.³⁹ Among oncologic surgeries in urology, radical cystectomy carries the highest risk, but is 1 of the least common, and thus investigations examining the regionalization of radical cystectomy have demonstrated little projected benefit when postoperative morbidity and mortality were the primary outcome.⁴⁰ Despite adjusting for hospital characteristics that are likely highly correlated with volume, we found an association between volume and a process of care measure: utilization of an optimal reconstruction. Incorporating utilization of a continent reconstructive modality as a process of care measure may exacerbate disparities between outcomes at high- and low-volume centers, rendering the impact of regionali-

zation of radical cystectomy more significant. Not only will morbidity and mortality outcomes improve, but the probability that patients will receive the more optimal reconstruction will increase despite technical complexity.

Regionalization has certain pitfalls, especially when employed for large oncologic surgeries such as esophagectomy and pancreatic cancer surgery. Detriments to the patient may include the increased expense of travel, although travel time did not change dramatically in examining regionalization for esophagectomy and pancreatectomy,⁴¹ and a delay in care due to the saturation of high-volume centers. Overextending centers of expertise may be more relevant for high-volume procedures such as CABG, but if regionalization places cystectomy centers above capacity, the delay in care could be detrimental to oncologic management. Sanchez-Ortiz et al.⁴² demonstrated that a delay of at least 12 weeks between biopsy and cystectomy was associated with significantly worse disease-specific and overall survival compared with no delay. Delay in cystectomy has also been associated with upstaging at the time of surgery.⁴³ Other investigations corroborated a 12-week delay as a threshold for adverse clinical outcome.^{44,45} Institution of regionalization for radical cystectomy must balance these competing dynamics to ensure the best possible outcome.

Our study has several limitations. First, because our analysis focused on Medicare patients, our results may not be generalizable. However, the overwhelming majority of newly diagnosed bladder cancer patients are between the ages of 60 and 79 years; thus, most bladder cancer patients are of Medicare age, the population sampled in our study.⁴⁶ Second, we were unable to control for clinical and pathologic factors that contraindicate the use of orthotopic diversion, such as renal insufficiency or cancerous involvement of the bladder neck in women or the urethral margin in both genders. Third, a decision to perform an ileal conduit may be justified on the basis of these or other unmeasured factors, including prohibitive length of the intestinal mesentery, patient body habitus, or social barriers to neobladder management such as poor functional status. Fourth, individual socioeconomic data were not available for our subjects, a limitation of most U.S. public health surveillance databases.⁴⁷ Analysis of socioeconomic variables necessitates the attribution of group characteristics to each subject. Although this represents a limitation, the use of census tract and ZIP code-level data in these analyses has proven valid.^{48,49} Lastly, we cannot incorporate patient preference as a variable. Although experts in the man-

agement of bladder cancer agree that continent reconstruction is the optimal form of urinary diversion, after a full discussion of the risks and benefits of the various reconstructive options, some patients elect diversion with an ileal conduit.

Despite these limitations, we demonstrate disparities in the utilization of continent urinary diversion after radical cystectomy based on demographic, socioeconomic, clinical, and, most notably, provider variables. Older patients, women, African Americans, those who are less educated, and those with extensive comorbidity were less likely to undergo a continent reconstruction. Utilization of continent diversion was more common in the western U.S. and urban SEER regions. Care at academic or NCI-designated cancer centers or by high-volume providers also increased the probability of continent reconstruction.

Regionalization of bladder cancer care may promote increased utilization of continent urinary diversion. Regionalization protocols that include process of care measures focus on nonsurgical components of the delivery of care. However, surgical variables that may not affect oncologic outcomes can significantly impact patient quality of life postoperatively. Incorporation of process-of-care measures for infrequently performed oncologic surgeries may uncover disparities between high- and low-volume providers. However, the benefits of regionalization must be balanced against the risks of a delay in care.

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