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Perioperative complications of conduit urinary diversion with concomitant cystectomy for benign indications: A population-based analysis

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Abstract

AIMS—Beyond single-institution case series, limited data are available to describe risks of performing a concurrent cystectomy at the time of urinary diversion for benign end-stage lower urinary tract dysfunction. Using a population-representative sample, this study aimed to analyze factors associated with perioperative complications in patients undergoing urinary diversion with or without cystectomy.

METHODS—A representative sample of patients undergoing urinary diversion for benign indications was identified from the Healthcare Cost and Utilization Project Nationwide Inpatient Sample from 1998 to 2011. Perioperative complications of urinary diversion with and without concomitant cystectomy were identified and coded using the International Classification of Diseases, version 9. Multivariate logistic regression models identified hospital and patient-level characteristics associated with complications of concomitant cystectomy with urinary diversion.

RESULTS—There were 15,717 records for urinary diversion identified, of which 31.8% demonstrated perioperative complications: urinary diversion with concurrent cystectomy (35.0%) and urinary diversion without concomitant cystectomy (30.6%). Comparing the two groups, a concomitant cystectomy at the time of urinary diversion was significantly associated with a complication (OR = 1.23, 95%CI: 1.03–1.48). Comorbid conditions of obesity, pulmonary circulation disease, drug abuse, weight loss, and electrolyte disorders were positively associated with a complication, while private insurance and southern geographic region were negatively associated.

CONCLUSIONS—A concomitant cystectomy with urinary diversion for refractory lower urinary tract dysfunction elevates risk in this population-representative sample, particularly in those with certain comorbid conditions. This analysis provides critical information for preoperative patient counseling.

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POTENTIAL CONFLICTS OF INTEREST

Nothing to disclose.

Keywords

comorbidities; complications; cystectomy; neurogenic bladder; urinary diversion

1. INTRODUCTION

Urinary diversion for benign indications is relatively rare, and can be performed with or without a concomitant cystectomy. Diversion is typically offered as a last resort for refractory lower urinary tract dysfunction (LUTD) secondary to neurogenic bladder (eg, spinal cord injury, spina bifida, and multiple sclerosis are common indications), radiation cystitis, interstitial cystitis, or recurrent fistula formation.¹ There are varying opinions as to whether a cystectomy should be performed concurrently at the time of urinary diversion. Urinary diversion without a cystectomy may result in secondary carcinoma, pyocystitis, or pain.² As such, some physicians advocate for a concomitant cystectomy, which can essentially eliminate the sequelae of the retained bladder and has been shown to improve urinary quality of life.³ Nevertheless, cystectomy can increase the operative time and morbidity of the procedure.

Overall, there is a paucity of data describing the risks associated with benign cystectomy. Recent reports from single institution case series suggest the complication rates range from 39% to 73%.^{1–4} However, whether these rates differ between patients undergoing a concomitant cystectomy remains unclear. This study aimed to examine the complications of a concomitant cystectomy for patients undergoing urinary diversion for benign indications on a national level. We additionally aimed to identify patient and hospital-level factors associated with these outcomes.

2. MATERIALS AND METHODS

Our Institutional Review Board determined that this project met criteria for exemption.

2.1. Data source

Data from the Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) from 1998 to 2011 were examined. The NIS is a 20% stratified sample of all-payer hospital records in the United States, containing information from approximately seven million records each year in 44 states.⁵ Each record is a summary report of an individual's hospital stay (ie, discharge summary), indicating associated diagnoses and procedures performed during that hospitalization. The unit of analysis is the record (hospital discharge), which is unique for the patient; however, patients cannot be identified or matched across separate hospital discharges, thus individual patients cannot be followed over time or over multiple discharges.

2.2. Inclusion/exclusion criteria

Using International Classification of Diseases, version 9 (ICD-9) diagnosis codes, abstracted, de-identified data from hospital discharge summaries were collected. First, we limited the sample of records to those with a procedure code for urinary diversion,

specifically ileal conduit (ICD-9: 56.51-formation of a cutaneous ureteroileostomy). Based on iterative examinations of the records and previously published studies on diversion in the NIS data,⁶ we determined that this code was the most specific for urinary diversion that would exclude non-diversion procedures, such as bladder augmentation. This is also consistent with previous studies that report non-conduit diversions comprised only 12.9% of the urinary diversions performed.^{1–3} Next, we excluded records with a primary diagnosis of any malignancy (ICD-9: 140–239) and those for patients under the age of 18. Lastly, we divided the sample into two cohorts: those who underwent ileal conduit urinary diversion without concomitant cystectomy (ICD-9: 56.51) and those who underwent ileal conduit urinary diversion with concomitant cystectomy (ICD-9: 56.51 and either ICD-9: 57.71-radical cystectomy or ICD-9: 57.79-other total cystectomy).

2.3. Variables

From the available records, we abstracted patient-level data on age, gender, race/ethnicity, insurance payer status (private, Medicare, Medicaid, and other), and indicators for individual comorbidities (congestive heart failure, neurological disorders, valvular disease, pulmonary circulation disease, peripheral vascular disorders, chronic pulmonary disease, diabetes, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, deficiency anemia, alcohol abuse, drug abuse, psychoses, and depression). From this data, we tabulated Elixhauser⁷ comorbidities to establish a comorbidity count. We additionally captured NIS hospital-level characteristics: census geographic region (northeast, south, west, and midwest), urban-rural status, teaching status, and hospital size (small, medium, large).

Reported complications are group coded (code 238) in the NIS using the clinical classification software coding system.^{5,6} For patients with group code 238 listed among secondary diagnoses in the hospital discharge summary for the hospital admission during which the surgery took place, individual complication data relevant to urinary diversion and cystectomy were then identified (ICD-9 clinical modification codes: 997.1–997.5, 998.2, 998.3, 998.12, 998.13, 998.31, 998.32, 998.51, 998.59, 998.6, 998.83, 999.2).

2.4. Statistical analysis

We described patient and hospital characteristics in our population by concomitant cystectomy and compared characteristics by using Wilcoxon tests for continuous variables and Pearson's chi-squared tests for categorical variables. Multivariate logistic regression was performed to assess the association between concomitant cystectomy and perioperative complication while adjusting for other important covariates including sex, age, race, irradiation cystitis, Elixhauser comorbidities, hospital location, hospital size, hospital region, payer, and individual comorbidities.

All analyses incorporated NIS survey weights to generate nationally representative estimates, and *P*-values less than 0.05 were considered to be statistically significant. Analyses were conducted using R version 3.2.1 (www.r-project.org).

3. RESULTS

Between 1998 and 2011, 15,717 urinary diversions were performed for benign indications at the U.S. hospitals. Of these, 11,470 (73%) patients underwent urinary diversion without concomitant cystectomy and 4,247 (27%) patients underwent urinary diversion with concurrent cystectomy. Demographic, clinical, and hospital characteristics are presented in Table 1. The proportion of patients undergoing a concomitant cystectomy was significantly older (median age 64 vs. 59; $P < 0.001$). Male patients were more likely to undergo a concomitant cystectomy compared to females (55.8% vs. 37.4%, $P < 0.001$). Patients with Medicare insurance were also more likely to undergo a concurrent cystectomy compared to those with Medicaid, private, or other insurances ($P = 0.006$). The proportion of white/Caucasian patients undergoing a concomitant cystectomy was also higher when compared to other races/ethnicities ($P < 0.001$). However, demographic information identifying race/ethnicity was unavailable for 3,191 patients.

Urinary diversion was performed most commonly for neurogenic bladder (all cause), irradiation cystitis, interstitial cystitis, and fistula (Table 1). Surgical indications differed between groups ($P < 0.001$). The proportion of patients undergoing urinary diversion with concomitant cystectomy was higher for diagnoses of irradiation cystitis (14.5% vs. 7.7%) and interstitial cystitis (13.2% vs. 2.2%), and less for neurogenic bladder (22.1% vs. 27.8%) and fistula (9.3% vs. 17.8%).

3.1. Perioperative complications

The complications associated with both procedures are listed in Table 2. Overall, 31.8% of records documented at least one complication: urinary diversion with concurrent cystectomy (35.0%) and urinary diversion without concomitant cystectomy (30.6%). The most common complications in both groups were gastrointestinal (15.1%), urinary (6.6%), infectious (5.6%), and accidental punctures or lacerations (2.9%). After performing multivariate logistic regression, cystectomy at the time of urinary diversion was associated with an increased odds of a perioperative complication (OR = 1.23, 95%CI: 1.03–1.48) (Table 3). Southern geographic location (OR = 0.71, 95%CI: 0.56–0.90) and private insurance (OR = 0.79, 95%CI: 0.63–0.98) were negatively associated with complications.

Comorbid conditions as represented by Elixhauser comorbidities were not associated with perioperative complications (OR = 1.08, 95%CI: 0.78–1.48). However, specific individual comorbid conditions did show a positive association with developing a perioperative complication: obesity (OR = 1.48, 95%CI: 1.02–2.21), pulmonary circulation disease (OR = 2.03, 95%CI: 1.01–4.06), drug abuse (OR = 2.10, 95%CI: 1.10–3.99), weight loss (OR = 2.35, 95%CI: 1.74–3.17), and fluid and electrolyte disorders (OR = 1.61, 95%CI: 1.26–2.05). A diagnosis of irradiation cystitis did not show a significant association with perioperative complications (OR = 1.02, 95%CI: 0.76–1.36, $P = 0.47$).

4. DISCUSSION

Cystectomy at the time of urinary diversion was associated with a significantly increased risk of perioperative complications when compared to those undergoing urinary diversion

without a concomitant cystectomy (OR = 1.23, 95%CI: 1.03–1.48). Those patients who were privately insured or those located in the southern region appeared to have a lower risk. However, there was an increased overall risk of complications among those with diagnoses of obesity, pulmonary circulation disease, drug abuse, weight loss, and fluid and electrolyte disorders. While these individual comorbid conditions were shown to have an independent positive association, there was no association identified between Elixhauser comorbidities and developing a perioperative complication. Since the Elixhauser comorbidity count is tabulated by a predetermined algorithm using ICD-9 diagnosis codes, individual diagnoses may represent a more accurate association.⁷

There is limited available data on surgical outcomes for benign cystectomy for refractory LUTD. In 2000, Neulander et al⁸ reported no complications in a series of 19 patients undergoing simple cystectomy and urinary diversion secondary to radiation damage. Recently, however, several single-institution case series have shown that the complication rate for a cystectomy for benign indications is actually quite high, contrary to what was previously reported.^{1–3} In 2011, Rowley et al² published a series of 23 patients who underwent urinary diversion with concomitant supratrigonal cystectomy for benign indications. Their reported perioperative complication rate was 39.1%.² In 2014, Osborn et al¹ published a series of 139 patients with benign indications who underwent simple cystectomy with an overall complication rate of 67%.¹ Furthermore, in 2015, Al Hussein Al Awamlh et al⁹ reported a 65.5% 30-day postoperative complication rate for 29 patients undergoing simple cystectomy for radiation-induced refractory LUTD.⁹

The overall perioperative complication rate (35.0%) in this population-derived sample of patients undergoing urinary diversion with concomitant cystectomy for benign indications appears to be slightly lower than recent data reported from individual centers. This may be due to the limitations of our analyses. First, we were only able to analyze variables available in the dataset, and important patient and clinical characteristics influencing the likelihood of concomitant cystectomy were not available. Second, we specifically restricted the sample to those undergoing ileal conduit diversion because this was the most specific code for urinary diversion. Therefore the results under-report the overall prevalence of urinary diversions and the generalizability of the findings is limited. Nevertheless, previous reports have shown that non-conduit diversions are uncommon¹ in this patient population, and previous studies examining the use of urinary diversion for malignant cystectomy employed similar methods for coding.⁶

Furthermore, while the use of administrative data reveals associations between concomitant cystectomy and patient and hospital characteristics, causality cannot be ascertained. Analyzing records in the NIS is cross-sectional by design and only evaluates a patient's individual hospital record for a given admission. Thus, individual patients cannot be followed over time or over multiple discharges. As a result, there is no longitudinal data beyond the initial hospitalization, including outpatient follow-up and subsequent hospital readmissions. These limitations may explain why this study did not identify an association between irradiation cystitis and developing a perioperative complication.

Finally, any study using administrative data are subject to misclassification bias because of inconsistent or incorrect coding of procedures or diagnoses. We presumed that this bias would be equal for our comparison groups. While the frequency of coding errors can vary widely between states, regions, hospitals, and demographic groups, the ICD-9 codes used in this study are unlikely to be incorrectly classified due to the commonality of a cystectomy and ileal conduit. Furthermore, several studies have demonstrated reliability between professional ICD-9 coding and clinical records.^{10,11}

While a concomitant cystectomy can prevent sequelae of the retained bladder, there appears to be an added risk of a perioperative complication when performing a concomitant cystectomy during the urinary diversion for benign indications. Forthcoming study will seek to incorporate national readmission data and evaluate complications at long-term follow-up to better determine the best surgical approach for refractory LUTD. Nevertheless, the results of this population-representative analysis provide important information for preoperative patient counseling.

5. CONCLUSIONS

A concomitant cystectomy with urinary diversion for refractory LUTD elevates risk, particularly in those with certain comorbid conditions. Future study is needed on a national level to determine the complication rate at long-term follow-up, but this national analysis raises critical questions for patient counseling and determining the best surgical approach for refractory LUTD.

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TABLE 1

Descriptive characteristics of 15,717 records for urinary diversion with and without concomitant cystectomy, 1998–2011

	Diversion + cystectomy <i>n</i> = 4247	Diversion <i>n</i> = 11,470	<i>P</i>-value
Age (median, range)	61 (19–90)	58 (18–94)	<0.001
% Female (SE)	37.5	55.6	<0.001
% Race (SE)			<0.001
Caucasian	71.6	63.7	
African American	5.3	9.1	
Other	4.3	5.8	
Race not available	18.7	21.3	
Elixhauser comorbidities (median, SE)	2.1 (0.1)	2.0 (0.0)	0.266
% Diagnosis (SE)			<0.001
Neurogenic bladder	22.1 (1.9)	27.8 (1.1)	
Irradiation cystitis	14.6 (1.3)	7.7 (0.6)	
Interstitial cystitis	13.3 (1.6)	2.2 (0.4)	
Fistula	9.3 (1.0)	17.9 (0.9)	
Complication-GU graft	0.4 (0.2)	0.9 (0.2)	
Complication-urinary	1.7 (0.5)	3.4 (0.4)	
Bladder dysfunction	4.9 (0.7)	2.1 (0.3)	
Urinary incontinence	1.9 (0.5)	4.7 (0.5)	
Obstruction	2.6 (0.5)	3.4 (0.4)	
Cystitis NOS	4.9 (0.8)	2.6 (0.4)	
Other	24.1 (1.5)	27.4 (1.0)	
% Hospital location (SE)			0.993
Rural	5.7 (1.1)	5.8 (0.7)	
Urban	94.3 (1.1)	94.4 (0.7)	
% Hospital teaching status (SE)			0.575
Non-teaching	26.2 (2.6)	27.6 (1.8)	
Teaching	73.8 (2.6)	72.4 (1.8)	
% Hospital size (SE)			0.313
Small	6.7 (1.6)	7.3 (0.9)	
Medium	16.2 (2.3)	19.3 (1.9)	
Large	77.1 (2.8)	73.4 (2.1)	
% Hospital region (SE)			0.026
Northeast	12.2 (2.0)	18.2 (1.7)	
Midwest	28.6 (3.9)	27.2 (3.1)	
South	37.3 (3.7)	36.0 (2.5)	
West	21.9 (3.0)	18.6 (2.1)	
% Payer (SE)			0.006

	Diversion + cystectomy <i>n</i> = 4247	Diversion <i>n</i> = 11,470	<i>P</i>-value
Medicare	61.0 (1.8)	58.6 (1.7)	
Medicaid	9.0 (1.0)	13.3 (0.8)	
Private insurance	25.4 (1.7)	25.0 (1.1)	
Other	4.6 (0.7)	3.2 (0.6)	

GU, genitourinary; NOS, not otherwise specified; SE, standard error.

TABLE 2

Frequencies of perioperative complications for urinary diversion with and without concomitant cystectomys

Complication	Diversion + cystectomy (%)	Diversion (%)	Overall (%)
Any complication occurrence	35.0	30.6	31.8
Complications by system			
Gastrointestinal	16.2	14.7	15.1
Urinary	6.3	6.7	6.6
Cardiac	3.1	1.9	2.3
Respiratory	1.7	2.3	2.1
Peripheral vascular	0.4	0.1	0.2
Intraoperative complications			
Accidental puncture or laceration	3.5	2.7	2.9
Hematoma complicating a procedure	0.9	0.6	0.7
Seroma complicating a procedure	0.7	0.2	0.3
Postoperative complications			
Other infection	6.6	5.2	5.6
Persistent fistula	1.6	2.4	2.1
Superficial wound disruption	1.0	1.2	1.1
Internal wound disruption	2.0	0.3	0.8
Non-healing surgical wound	0.4	0.2	0.3
Infected seroma	0.2	0.1	0.2

TABLE 3

Variables associated with any perioperative complication in patients undergoing urinary diversion with concomitant cystectomy

Patient characteristic	OR (95%CI)	P-value
Diversion + cystectomy (vs. diversion)	1.23 (1.03, 1.48)	<0.05
Age	1.00 (1.01, 1.01)	
Female (vs. male)	0.91 (0.77, 1.08)	
Race/ethnicity (vs. White/Caucasian)		
Black/African American	1.00 (0.71, 1.39)	
Other	1.24 (0.97, 1.57)	
Race not available	0.84 (0.72, 0.97)	<0.05
Elixhauser comorbidities	1.08 (0.78, 1.48)	
Hospital location (vs. rural)		
Urban	0.66 (0.43, 1.00)	
Hospital teaching status (vs. non-teaching)		
Teaching	1.09 (0.89, 1.34)	
Hospital size (vs. small)		
Medium	1.04 (0.75, 1.44)	
Large	0.88 (0.65, 1.19)	
Hospital Region (vs. northeast)		
Midwest	0.79 (0.57, 1.08)	
South	0.71 (0.56, 0.90)	<0.01
West	0.99 (0.75, 1.30)	
Payer (vs. Medicare)		
Medicaid	0.94 (0.72, 1.24)	
Private insurance	0.79 (0.63, 0.98)	<0.05
Other	0.93 (0.64, 1.36)	
Presence of comorbid conditions		
Irradiation cystitis	1.02 (0.76, 1.36)	
Congestive heart failure	1.39 (0.92, 2.08)	
Valvular disease	1.05 (0.67, 1.63)	
Peripheral vascular disorders	1.58 (0.94, 2.67)	
Pulmonary circulation disease	2.03 (1.01, 4.06)	<0.05
Chronic pulmonary disease	1.31 (0.99, 1.73)	
Neurological disorders	1.27 (0.94, 1.73)	
Diabetes	1.07 (0.79, 1.44)	
Diabetes with chronic complications	1.40 (0.79, 2.48)	
Hypothyroidism	1.06 (0.71, 1.57)	
Renal failure	1.14 (0.82, 1.60)	
Liver disease	1.00 (0.43, 2.33)	

Patient characteristic	OR (95%CI)	P-value
Lymphoma	1.29 (0.36, 4.65)	
Metastatic cancer	0.92 (0.57, 1.47)	
Solid tumor without metastasis	1.02 (0.75, 1.39)	
Collagen vascular diseases/rheumatoid arthritis	1.01 (0.54, 1.88)	
Coagulopathy	1.50 (0.93, 2.39)	
Obesity	1.48 (1.02, 2.21)	<0.05
Weight loss	2.35 (1.74, 3.17)	<0.01
Fluid and electrolyte disorders	1.61 (1.26, 2.05)	<0.01
Chronic blood loss anemia	1.08 (0.62, 1.88)	
Deficiency anemia	1.01 (0.76, 1.34)	
Alcohol abuse	2.08 (0.97, 4.47)	
Drug abuse	2.10 (1.10, 3.99)	<0.05
Psychoses	1.03 (0.62, 1.70)	
Depression	1.14 (0.37, 1.36)	

OR, odds ratio; CI, confidence interval.