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ORIGINAL ARTICLE

Postoperative urinary retention after inguinal hernia repair: a single institution experience

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Abstract
Purpose Inguinal hernia repair is a common general surgery procedure with low morbidity. However, postoperative urinary retention (PUR) occurs in up to 22% of patients, resulting in further extraneous treatments.This single institution series investigates whether patient comorbidities, surgical approaches, and anesthesia methods are associated with developing PUR after inguinal hernia repairs.
Methods This is a single institution retrospective review of inguinal hernia from 2012 to 2015. PUR was defined as patients without a postoperative urinary catheter who subsequently required bladder decompression due to an inability to void. Univariate and multivariate logistic regressions were performed to quantify the associations between patient, surgical, and anesthetic factors with PUR. Stratification analysis was conducted at age of 50 years.
Results 445 patients were included (42.9% laparoscopic and 57.1% open). Overall rate of PUR was 11.2% (12% laparoscopic, 10.6% open, and $p = 0.64$). In univariate analysis, PUR was significantly associated with patient age >50 and history of benign prostatic hyperplasia (BPH). Risk stratification for age >50 revealed in this cohort a 2.49 times increased PUR risk with lack of intraoperative bladder decompression ($p = 0.013$).
Conclusions At our institution, we found that patient age, history of BPH, and bilateral repair were associated with PUR after inguinal hernia repair. No association was found with PUR and laparoscopic vs open approach. Older males may be at higher risk without intraoperative bladder decompression, and therefore, catheter placement should be considered in this population, regardless of surgical approach.

Keywords Inguinal hernia repair · Laparoscopic hernia repair · Postoperative urinary retention

Introduction

Inguinal hernia repair is one of the most common procedures performed by general surgeons in the United States today [1]. The vast majority is performed in the outpatient setting with low morbidity. Postoperative urinary retention (PUR), the failure to void spontaneously after surgery thus requiring bladder catheterization, is a well-recognized complication of herniorrhaphy with reported rates of incidence varying widely, ranging from 0.37 to 22% [2, 3]. Although often viewed as a minor complication, PUR can cause anxiety, discomfort, and subject patients to additional procedures (i.e., catheterization) for relief. These procedures can prompt subsequent risks of urethral trauma, detrusor muscle damage, catheter-related infections, delay in discharge or possible admission, and increased costs [4]. When PUR is diagnosed in a timely fashion, patients typically undergo catheter decompression in the recovery room. However, patients who are unable to void after discharge may need to be evaluated

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in the Emergency Department (ED) with subsequent readmission and urology consultation.

The primary aim of our study is to report the occurrence of PUR after inguinal hernia repair in a single institution and identify variables associated with PUR. Previous attempts to identify factors associated with PUR following inguinal hernia repair have shown varying results. Risk factors identified incorporate both patient and operative variables including patient age, body mass index (BMI), medical history, intraoperative fluid volume, narcotic utilization, and bilateral repair [2, 5–7]. While a laparoscopic approach, compared to an open technique, has been suggested to increase the rate of PUR [8], limited comparative trials have investigated PUR as a primary outcome. We hypothesize that surgical technique, laparoscopic vs open, does not influence the outcome of PUR following inguinal hernia repair.

Methods

Data and samples

We conducted a retrospective review of patients undergoing either laparoscopic or open inguinal hernia repair between January 2012 and December 2015 at the Johns Hopkins Medical Institution. Institutional review board (IRB) approval was obtained. Inclusion criteria included age ≥18 years with primary diagnosis of inguinal hernia. We excluded patients that required emergent surgery, any concomitant operation with inguinal hernia as a secondary diagnosis or left the operating room with a catheter that remained in place overnight. Patients were included in our study if a catheter was placed solely for intraoperative bladder drainage following anesthetic induction and was subsequently removed prior to leaving the operating suite. Patients were identified using institutional operative billing coding, and verified with departmental databases. PUR was defined as the postoperative need for straight catheterization, placement of an indwelling catheter, or return visit to the ED for failure to void.

Demographic data were extracted from the medical records and medication lists in accordance with the IRB-approved protocol. Perioperative and anesthesia data collection were similarly obtained from the medical records and anesthesia data sheets. An intermediate acting local anesthetic: bupivacaine or ropivacaine was utilized in all spinal anesthesia cases.

Analysis

Statistical analyses were performed using Stata/SE 14.0 (StataCorp, College Station, Texas). Dependent variable (PUR yes/no) and independent variables were coded as categorical variables. Group differences for categorical variables and outcomes were assessed by Chi-square tests. A two-tailed test at alpha <0.05 was considered statistically significant. A multivariate logistic regression was performed with PUR as the dependent endpoint. Multivariate logistic regression was performed including the univariate variables identified within a confidence interval of 90% to assess the association between the occurrence of PUR and independent variables. The variable of surgical procedure was forced into the regression model for clinical significance. In addition, a subgroup analysis was performed for patients of age >50. The multivariate logistic model was built similarly, including unadjusted variables identified within a confidence interval of 90%.

Results

Within the 445 patients who met our inclusion and exclusion criteria, all 50 cases (11.2%) of PUR developed in males (Table 1). The PUR group was made up of older patients (>50 13.4%, 18–50 3.1%), and was more likely to have benign prostatic hyperplasia (BPH) (30.2%). The groups remained uniform by patient race (white 10.6%, black 9.4%, and others 16.7%), BMI (≤20 14.3%, 21–25 13.6%, 26–30 9.9%, and 31–35 14.3%), hospitalization status (outpatient 10.0% and inpatient 17.9%), hernia recurrence (recurrent 12.4% and primary 10.9%), and laterality (unilateral 10.0% and bilateral 16.7%). Similarly, no large differences were appreciated in the proportion of hypertension (HTN), chronic obstructive pulmonary disease (COPD), surgical approach, presence of intraoperative catheter, or total amount of intraoperative fluids received in the PUR group and those who did not develop PUR (Table 1).

In the univariate model (Table 2), BPH was associated with increased PUR (odds ratio 4.50, $p < 0.01$) and a trend was appreciated with inpatient hospitalization (1.95, $p = 0.08$), bilateral hernia (1.82, $p = 0.10$), and spinal anesthesia (3.53, $p = 0.10$), although statistical significance was not reached. Younger age (18–50: 0.42, $p = 0.02$ ref > 50) was a protective factor for PUR. An intraoperative catheter and the amount of intraoperative fluids were not associated with PUR, along with surgery duration, procedure type, use of inhalation anesthesia, and inhalation agent type. Patient factors including patient race, BMI, hospitalization, and recurrent hernia were also not associated with PUR (Table 2).

In the multivariate model (Table 3), BPH (3.23 [1.64–6.36], $p = 0.01$) was an independent prognostic factor associated with PUR. A bilateral inguinal hernia repair (2.13 [1.04–4.37], $p = 0.08$) did not reach significance, but a trend of increased PUR was noticed. A subsequent subgroup analysis was performed for patients age >50 (Table 4). On

Table 1 Patient, surgical, and anesthetic characteristics of inguinal hernia repairs

Total	Without PUR		With PUR		All
	395 (*n*)	88.8 (%)	50 (*n*)	11.2 (%)	445 (*n*)
Sex					
Male	367	88.0	50	12.0	417
Female	28	100.0	0	0.0	28
Age					
18–50	124	93.9	8	6.1	132
>50	271	86.6	42	13.4	313
Race					
White	277	89.4	33	10.6	310
Black	77	90.6	8	9.4	85
Others	40	83.3	8	16.7	48
BMI					
<=20	14	87.5	2	12.5	16
21–25	127	86.4	20	13.6	147
26–30	173	90.1	19	9.9	192
31–35	48	85.7	8	14.3	56
Hospitalization					
Outpatient (LOS ≤ 1)	340	90.0	38	10.0	378
Inpatient (LOS > 1)	55	82.1	12	17.9	67
Recurrent hernia					
Yes	85	87.6	12	12.4	97
No	310	89.1	38	10.9	348
Hernia side					
Unilateral	331	90.0	37	10.0	368
Bilateral	64	83.1	13	16.7	77
Comorbidities					
Diabetes	37	86.1	6	13.9	43
BPH	37	69.8	16	30.2	53
COPD	23	85.2	4	14.8	27
HTN	166	90.7	17	9.3	183
Procedure					
Laparoscopic	168	88.0	23	12.0	191
Open	227	89.4	27	10.6	254
Intraoperative catheter					
Yes	267	88.4	35	11.6	302
No	128	89.5	15	10.5	143
Intraoperative fluids					
<1 L	73	90.1	8	9.9	81
1 L– <2 L	279	88.3	37	11.7	316
2 L– <3 L	39	90.7	4	9.3	43
3 L+	4	80.0	1	20.0	5
Spinal anesthesia					
Yes	7	70.0	3	30.0	10
No	388	89.2	47	10.8	435
Inhalation agent					
Isoflurane	155	89.6	18	10.4	173
Sevoflurane	97	92.4	8	7.6	105
Desflurane	79	84.0	15	16.0	94
Forane	39	84.8	7	15.2	46
Surgery duration					
<100 min	116	90.0	13	10.0	129
100–130 min	173	88.3	23	11.7	196
131–160 min	66	89.2	8	10.8	74
161 + min	40	87.0	6	13.0	46

this analysis, BPH was again associated with PUR (3.97 [1.78–8.95], $p = 0.005$) and the presence of an intraoperative catheter was found to be protective, with decreased PUR risk (0.032 [0.003–0.31], $p = 0.013$).

Discussion

PUR can complicate recovery from any surgical procedure and occur in patients who do not have preexisting urinary symptoms. Although often regarded by clinicians as a trivial or minor complication, urinary retention following herniorrhaphy can be a significant source of patient morbidity and lead to emergency room visits, readmissions, and increased cost. At our institution, the average charge for an ED visit with an ICD10 diagnosis of urinary retention was $1577, not including cost of outpatient urologic follow-up. Predicting which patients are more susceptible may mitigate risk and aide with prompt postoperative care. In our single institution series, we report an overall PUR occurrence of 11.2% ($n = 50$) in 445 patients who underwent laparoscopic or open inguinal hernia repair. This falls within the range of previously reported incidences (0.37–22%) of PUR following herniorrhaphy [2, 3, 7]. This wide range may reflect a multifactorial nature of the development of PUR, given that a historically wide variety of associated risk factors has been reported. Furthermore, we found that patients older than 50 years and those with a history of BPH were associated with increased risk of PUR. Notably, in our series, no association was found within the total cohort of PUR and the absence of indwelling intraoperative catheter, intraoperative fluid volume, anesthetic type, or surgical method: laparoscopic vs open.

A risk factor that has frequently been identified as correlative with PUR is increased patient age. Many studies have concluded that patients of advanced age are at increased risk of PUR following herniorrhaphy [5, 6, 9]. Our series similarly supports this association with patients age >50 revealing significant association with PUR development following either laparoscopic or open inguinal hernia repair in univariate analysis. This association may

Table 2 Univariate analysis of patient, surgical, and anesthetic predictors of postoperative urinary retention

	Odds ratio (90% CI)	*p* value
Age		**0.02**
18–50	**0.42 (0.28–0.79)**	
>50	Ref	
Race		0.44
White	Ref	
Black	0.87 (0.44–1.72)	
Others	1.68 (0.83–3.40)	
BMI		0.69
≤20	1.30 (0.35–4.80)	
21–25	1.43 (0.82–2.51)	
26–30	Ref	
31–35	1.52 (0.72–3.19)	
Hospitalization		**0.08**
Outpatient (LOS <=1)	Ref	
Inpatient (LOS >1)	1.95 (1.08–3.54)	
Recurrent Hernia		0.69
Yes	1.15 (0.64–2.06)	
No	Ref	
Hernia side		**0.10**
Unilateral	Ref	
Bilateral	1.82 (1.02–3.23)	
Comorbidities		
Diabetes	1.32 (0.61–2.85)	0.56
BPH	**4.50 (2.33–8.37)**	**<0.01**
COPD	1.40 (0.55–3.53)	0.57
HTN	0.70 (0.42–1.18)	0.26
Procedure		0.64
Laparoscopic	1.15 (0.70–1.89)	
Open	Ref	
Intraoperative catheter		0.73
Yes	0.89 (0.52–1.53)	
No	Ref	
Intraoperative fluids		0.87
<1 L	0.83 (0.42–1.63)	
1 L– <2 L	Ref	
2 L– <3 L	0.77 (0.31–1.92)	
3 L+	1.89 (0.29–12.13)	
Spinal anesthesia		**0.10**
Yes	3.53 (1.11–11.32)	
No	Ref	
Specific inhalation agent		0.24
Isoflurane	Ref	
Sevoflurane	0.71 (0.34–1.47)	
Desflurane	1.64 (0.88–3.03)	
Forane	1.55 (0.70–3.40)	
Surgery duration		0.94
<100 min	0.84 (0.46–1.52)	
100–130 min	Ref	
131–160 min	0.91 (0.43–1.79)	
161 + min	1.13 (0.50–2.50)	

Bold data indicates significant findings with *p* values <0.10 or confidence intervals which do not include 1

Table 3 Multivariate regression of patient, surgical, and anesthetic predictors of PUR

	Odds Ratio (90% CI)	*p* value
Procedure		0.97
Laparoscopic	1.02 (0.54–1.90)	
Open	Ref	
Age		0.11
18–50	0.51 (0.26–1.02)	
>50	Ref	
Benign prostatic hyperplasia		**<0.01**
Yes	**3.23 (1.64–6.36)**	
No	Ref	
Hernia side		**0.08**
Bilateral	2.13 (1.04–4.37)	
Unilateral	Ref	
Spinal epidural		0.34
Yes	2.10 (0.58–7.55)	
No	Ref	
Hospitalization		0.21
Inpatient (LOS >1)	1.63 (0.86–3.07)	
Outpatient (LOS ≤ 1)	Ref	

Bold data indicates significant findings with *p* values <0.10 or confidence intervals which do not include 1

Table 4 Multivariate regression subgroup analysis of patient, surgical, and anesthetic predictors of PUR among patients aged 50 and above

	Odds Ratio (90% CI)	*p* value
Procedure		0.94
Laparoscopic	0.96 (0.40–2.32)	
Open	Ref	
Benign prostatic hyperplasia		**<0.01**
Yes	**3.97 (1.78–8.95)**	
No	Ref	
Hernia Side		0.16
Bilateral	1.90 (0.90–4.01)	
Unilateral	Ref	
Intraoperative bladder decompression		**0.01**
Yes	**0.032 (<0.01–0.31)**	
No	Ref	
Hospitalization		0.12
Inpatient (LOS > 1)	2.06 (0.95–4.49)	
Outpatient (LOS ≤ 1)	Ref	

Bold data indicates significant findings with *p* values <0.10 or confidence intervals which do not include 1

be related to an age-related progressive neuronal degeneration along with increasing rates of prostatic hypertrophy that may not have been diagnosed preoperatively [10]. We similarly found association of BPH with risk of PUR, a finding that has been intuitively reported in prior studies [6]. These preoperative patient characteristic risk factors can assist in identifying individuals at increased risk of PUR. On multivariate regression, bilateral repair was associated with PUR, although did not meet significance as compared to unilateral repair likely due to our sample size. This increased association of bilateral hernia repair and PUR has been reported in the previous literature [7], although refuted in other reports [2, 5].

Bladder scans were performed if individuals had failed to void postoperatively within 1 h following the procedure, or if they were experiencing discomfort. In this cohort, 21.4% of patients with a bladder scan identifying <250 cc of fluid had PUR, while 67.7% of patients with a scan of greater than 500 cc experienced PUR. Previous data have supported the association of postoperative bladder volume and risk of PUR [9, 11] and may reflect over-stretching of the detrusor muscle. This may present an opportunity to consider providing more time for spontaneous voiding and prevent unnecessary catheterization in patients with bladder scan volumes <250 cc in postoperative recovery units.

Current literature and common opinion often suggests that a laparoscopic approach increases the risk of PUR. The support for this claim is limited and conflicting. In a retrospective review of 345 patients, Winslow et al. reported a significant association of increased PUR risk following laparoscopic compared to open repair (7.9 vs 1.1%) [8]. However, meta-analyses of prospective randomized control trials of laparoscopic vs open inguinal hernia repair have not supported this same association of risk [12, 13]. Our single institution series similarly finds no association with operative approach and the development of PUR. These data suggest that concern for PUR should not influence the decision for an open instead of a laparoscopic approach for inguinal hernia repair.

Similarly, in the total cohort, no association was found with intraoperative urinary catheter placement, operative time, or anesthetic type. Current guidelines based on expert opinion suggest that a full bladder may make laparoscopic surgery more technically challenging and emptying the bladder may diminish risk of intraoperative bladder injury. Nevertheless, perioperative catheterization is rarely necessary and it is appropriate for the patient to void spontaneously prior to the operation [14]. Notably, subgroup analysis for patients age >50 demonstrated a significant association between PUR and absence of an intraoperative catheter (OR 2.49 $p = 0.013$). This suggests while routine placement may be a source of unnecessary catheterization that can be avoided, it may be considered in older individuals with a higher preoperative risk of PUR. It is likely that our older population's micturition reflex may be more sensitive to disruption of the afferent limb of the micturition reflex and more likely to lead to over-distension and dysfunction. However, intraoperative sterile bladder decompression is not without risk. Increased dysuria, frequency, and UTI have been reported following routine preoperative catheterization in the gynecologic surgery population [15].

On univariate analysis, spinal anesthesia and inpatient admission status fell within a CI of 90%, but were not independently associated with PUR in our multivariate model. Spinal anesthesia has been reported to be correlated with increased PUR due to a theorized inhibition of nerves involved in signal transmission from the detrusor muscle blocking the micturition reflex [10]. At our institution, general anesthesia is preferred for hernia repair, although spinal anesthesia was chosen for patients with history of postoperative cognitive dysfunction, hoarseness from prior intubations, significant cardiopulmonary comorbidities, or patient preference. However, only 10 of 445 patients underwent spinal anesthesia and the ability to make significant conclusions is thus limited. Inpatient admission also was found to trend towards significance. At our institution, inpatient admission was classified as patients staying longer than 23 h, therefore, not attributing individuals that required overnight stay secondary to the development of PUR. We hypothesize that this trend may reflect individuals who were more ill and underwent higher risk or emergent procedures requiring inpatient care as compared to the routine outpatient counterparts. The association of emergent procedure and higher risk of PUR have been previously reported [11]. Perhaps, this increased severity of illness impacts the sympathetic response and ability to void.

There are several limitations of this study. History of BPH was recorded based upon preoperative history, patient self-identification, or utilization of BPH medications. No formal urologic testing was provided preoperatively, and thus, our series likely underestimates the number of individuals with this disorder. In addition, all cases of PUR may not have been captured if individuals went to an outside ED following their procedure. The low number of patients undergoing spinal anesthesia did not allow for a more thorough analysis of how anesthesia type correlates with PUR. Although we did not analyze for surgeon-specific outcomes, a number of surgeons were involved in this study, and perhaps, differences in surgical techniques may have affected the occurrence of PUR in their patients. Another limitation is the number of patients in the study may have not allowed enough statistical power to identify all significant risk factors. However, to our knowledge, this is one of the larger, current, single institution series of laparoscopic and open inguinal hernia repair studies evaluating PUR as a primary outcome.

Conclusion

As reflected by the variability in previously reported risk factors, PUR is likely a multifactorial phenomenon that remains common following inguinal hernia repair. Risk modification and early identification of individuals with predilection may optimize treatment of PUR. In this series at our institution, we identified patient age and history of BPH to be associated with PUR after inguinal hernia repairs. No association was found with an increased occurrence of PUR and laparoscopic technique. Common opinion of the protective effects of open hernia approach against PUR has limited support in current literature and is not supported by our series. Therefore, choice of surgical technique needs not be influenced by consideration for PUR risk. However, individuals older than 50 are at increased risk for PUR, and may be at an even greater risk if a temporary intraoperative catheter is not placed. Therefore, while this association was not consistent across the whole cohort, intraoperative bladder decompression may be of benefit for elderly male patients. Future prospective study is necessary to better weigh the benefit of such an intervention and its impact on mitigating PUR risk.

Compliance with ethical standards

Conflict of interest AB declares no conflict of interest. AD declares no conflict of interest. AM declares no conflict of interest. HL declares no conflict of interest. XH declares no conflict of interest. CW declares no conflict of interest. JO declares no conflict of interest. HN declares no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board (IRB)and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required as per IRB.

Human and animal rights This is an IRB-approved study, whereby permission was given to review patient information.

Informed consent Patients who undergo treatment at our institution initially signed a consent form allowing us to study their clinical outcomes.

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