Postoperative Urinary Retention in Patients Undergoing Lung Resection: Incidence and Risk Factors

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Background. **The purpose of this study was to (1) determine the incidence of postoperative urinary retention (POUR) in patients undergoing lung resection at our institution, (2) identify differences in potential risk factors between patients with and without POUR, and (3) describe patient outcomes across POUR status.**

Methods. **The medical records of 225 patients between 2016 and 2017 were reviewed, and 191 met criteria for inclusion. The institution's catheterization removal protocol was followed in all patients. Recatheterization was defined as requiring in-and-out catheterization or Foley catheter placement. Fisher exact and Wilcoxon tests were used for analysis.**

Results. **POUR developed in 35 patients (18%). Patients with POUR were older ($P = .01$), had increased baseline creatinine ($P = .04$), and a higher prevalence of benign prostatic hyperplasia ($P = .007$). POUR patients were also less likely to get a Foley catheter intraoperatively ($P = .0002$). Other intraoperative factors, such as surgical approach and extent of resection, were not significantly different between patients with and without POUR. Postoperative factors (epidural use or days with chest tube) were similar. Although patients with POUR were more likely to be discharged with a Foley catheter (13% vs 0%, $P = .002$), no difference in length of stay, incidences of urinary tract infections, or 30-day readmission were observed.**

Conclusions. **POUR develops in approximately 1 in 5 patients undergoing lung resection. Patients with POUR were more likely to not have a Foley catheter placed intraoperatively. However, patients who had POUR did not have worsened patient outcomes (urinary tract infections, length of stay, or 30-day readmission).**

Postoperative urinary retention (POUR), which is the inability to void in the presence of a full bladder, is a well-described complication after procedures, with an overall incidence of 2% to 40%.[1] Although well-described after abdominal procedures, the incidence of POUR after thoracic surgery operations has only been described in a select group of patients (nearing 12% in patients undergoing minor thoracic procedures).[2] POUR may lead to urinary tract infections and prolonged hospital length of stay and is associated with patient-specific (age, sex, history of benign prostatic hyperplasia), anesthesia-specific (fluid administration, use of anticholinergic medications, and postoperative use of epidural and opioid analgesia), and operation-specific (duration of operation) risk factors or a combination of these.[1,3] Because POUR may be a multifactorial problem, we sought to (1) determine the incidence of POUR in patients undergoing lung resection at our institution, (2) identify differences in potential risk factors between patients with and without POUR, and (3) describe patient outcomes across POUR status.

Patients and Methods

Study Population and Data Collection

The medical records of 225 patients who underwent lung resections between June 1, 2016, and November 31, 2017, were reviewed for inclusion. Patients were excluded if they underwent concomitant procedures, died during the hospital stay, or were anuric or had a urostomy at baseline (n = 21). In addition, for 13 patients who underwent multiple operations during the study period, only the first procedure was included. The institution's catheterization removal protocol was followed in all patients (Figure 1). POUR was defined as requiring recatheterization (in-and-out catheterization or Foley catheter placement) within 5 days postoperatively and captured by reviewing the electronic medical record, where voids and bladder scan values are recorded by time.

We defined POUR as in-and-out catheterization or Foley catheter placement within 5 days postoperatively.

Accepted for publication Dec 23, 2019.

Presented at the Fortieth Annual Meeting of the Society of Cardiovascular Anesthesiologists, Phoenix, AZ, Apr 28-May 2, 2018.

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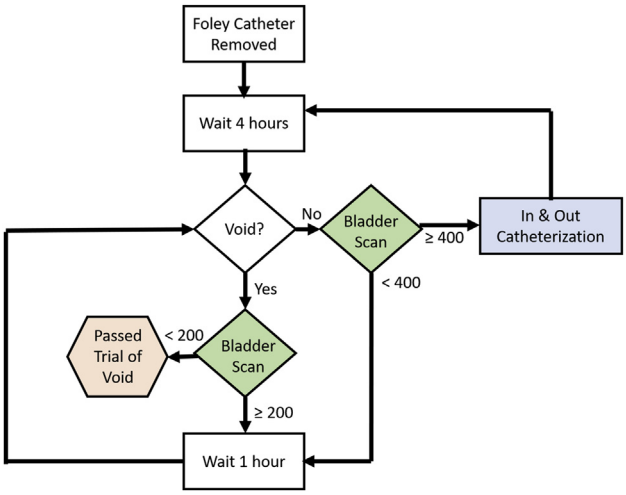

Figure 1. Bladder catheter removal protocol.

Patients who had an in-and-out catheterization had 3 attempts before placement of an indwelling catheter. Furthermore, if a patient required an indwelling catheter placement, the catheter was removed after 48 hours, and the bladder scan protocol was reinitiated. Not all patients with POUR were discharged with a Foley. There is no standardized protocol that dictates who undergoes Foley catheterization in the operating room. Not all patients underwent Foley catheters placement intraoperatively before their operation. It is standard at our institution for patients who are undergoing robotic thoracic surgery or an anticipated lobectomy to have a Foley catheter placed intraoperatively. In these cases, the catheter is always placed after induction with general anesthesia. However, for operations that are anticipated to be short (<2 hours), a Foley catheter is not always placed and is not placed during the hospitalization unless POUR develops.

Collected variables included known perioperative risk factors for POUR, such as male sex and history of benign prostatic hyperplasia, and baseline demographics. Intraoperative variables included approach, extent of resection, and intraoperative resuscitation. Postoperative variables included days with chest tube, intercostal nerve blockade, and opiate use. The complete list of variables is included in Table 1. Opioid use was collected for the first 5 days postoperatively and converted to morphine milligram equivalents (MME). Outcomes included length of stay, development of urinary tract infection, presence of Foley at discharge, and readmission rates.

All data extraction was conducted within the standard of the University of North Carolina's Institutional Review Board Committee (Study number 15-1841). The requirement for consent from individual study participants was waived given the retrospective nature of this medical record review.

Statistical Analyses

Patient demographics, surgical characteristics, and outcomes were compared between patients with and without POUR using Fisher exact and Wilcoxon tests, where appropriate. A P value of less than .05 was considered statistically significant. Analyses were performed using SAS 9.4 software (SAS Institute, Inc, Cary, NC).

Results

Of the 191 patients included in the analysis, and POUR developed in 35 patients (18%), and they required recatheterization during their hospitalization: 15 were in-and-out catheterizations (43%), and 20 were Foley catheter placements (57%). Median time to POUR, among these patients, was postoperative day 1 (interquartile range [IQR], 1-3 days; range, 0-8 days) (Figure 2).

Patients with POUR were older (median 67 vs 63 years, $P = .01$), had an increased frequency of benign prostatic hyperplasia (28% vs 3%, $P = .007$), had increased baseline creatinine (median 0.9 mg/dL vs 0.8 mg/dL, $P = .04$), and used tamsulosin more frequently (14% vs 3%, $P = .02$) compared with patients who did not have POUR. Of note, 9 of 10 patients who used tamsulosin preoperatively were restarted on tamsulosin by postoperative day 1. The incidence of developing POUR appeared to be higher in male patients, but the difference was not statistically significant (57% vs 38%, $P = .06$).

Intraoperative factors, such as surgical approach, extent of resection, use of anticholinergic medication, intercostal nerve blockade, and the amount of resuscitation, were not significantly different between patients with and without POUR (Table 1). The only difference between groups was that patients with POUR less commonly had an intraoperative Foley placed (66% vs 83%, $P = .03$).

There were no differences in postoperative factors, such as epidural use or days with chest tube, between POUR and non-POUR patients. Postoperative day (POD) 0 (ie, the day of the procedure) and overall 5-day postoperative opioid use was similar between patients with and without POUR (POD 0: 48 [IQR, 34-66] MME vs 50 [IQR, 35-69] MME, $P = .55$; and POD 5: 85 [IQR, 66-115] MME vs 93 [IQR, 62-153] MME, $P = .39$).

Although patients with POUR were more frequently discharged with a Foley catheter (14% vs 0%, $P = .0002$), no differences were seen in length of stay or incidences of urinary tract infection, 30-day emergency department visits, and 30-day readmission (Table 2). For the 5 patients discharged with a Foley catheter, duration of Foley use and number of nonthoracic surgery follow-up appointments are described in Table 3. In general, patients followed-up with a local urologist or primary care physician for trial of void or with a urologist in our system. With our limited data given the follow-up appointments scheduled outside our system, patients typically required between 0 and 2 follow-up visits in the first 30 days, and the Foley was removed within 2 weeks.

Comment

Overall, we found that the incidence of POUR in the lung resection population is relatively high, with POUR developing in almost 1 in every 5 patients. This is

Table 1. Preoperative, Intraoperative, and Postoperative Characteristics of Patients Undergoing Lung Resection at a Single Institution

Characteristics	POUR n = 35 (18%)	No POUR n = 156 (82%)	*P* Value
Male	20 (57)	60 (38)	.06
Age, y	67 (60-73)	63 (54-69)	.01
White	29 (83)	108 (70)	.15
Comorbidities			
Benign prostatic hyperplasia[a]	5 (28)	2 (3)	.007
Diabetes	10 (29)	26 (17)	.15
Malignancy	26 (76)	125 (81)	.63
Preoperative			
Creatinine, mg/dL	0.9 (0.8-1.1)	0.8 (0.7-1.0)	.04
FEV_1, %	72 (64-88)	82 (64-96)	.16
Tamsulosin	5 (14)	5 (3)	.02
Surgical approach			
VATS	23 (66)	98 (63)	.99
Robotic	3 (9)	15 (10)	…
Open	3 (9)	14 (9)	…
Convert to open	6 (17)	29 (19)	…
Laterality			
Right	22 (63)	90 (58)	.71
Left	13 (37)	61 (39)	…
Bilateral	0 (0)	5 (3)	…
Resection extent			
Single lobe	20 (57)	84 (56)	.96
Double lobe	1 (3)	3 (2)	…
Wedge	14 (40)	62 (41)	…
Other	0 (0)	2 (1)	…
Operative time, h	2.4 (1.4-3.9)	2.4 (1.6-3.4)	.92
Total colloid, mL	250 (175-500)	250 (250-500)	.56
Total crystalloid, mL	1000 (700-1450)	1000 (647-1400)	.71
Estimated blood loss, mL	50 (30-200)	100 (30-150)	.71
Glycopyrrolate dose, mg	0.6 (0.5-0.8)	0.6 (0.5-0.8)	.87
Epidural	4 (11)	36 (24)	.17
Epidural duration, d	4 (3-6)	3 (2-4)	.65
Chest tube duration, d[b]	3 (1-5)	3 (2-4)	.59
Intraoperative Foley	23 (66)	130 (83)	.03
Intercostal block	31 (89)	121 (78)	.17
Total inpatient opioids[c], MME	85 (66-115)	93 (62-153)	.39

[a]Among male patients only; [b]Chest tubes in 2 patients were removed after their discharge date; [c]Inpatient opioid use during postoperative days 0 to 5 (or discharge) during their hospitalization; patients with POUR before postoperative day 5 had opioid use after their diagnosis included from the total.

Continuous data are presented as median (interquartile range) and categorical data as n (%).

FEV_1, forced expiratory volume in 1 second; MME, morphine milligram equivalent; POUR, postoperative urinary retention; VATS, video-assisted thoracoscopic surgery.

consistent with other studies which have demonstrated that procedures typically requiring at least a 1- to 2-day inpatient hospitalization have higher rates of POUR.[4] This patient population had a slightly higher incidence of POUR compared with a study by Kim and colleagues[2] looking at thoracic surgery patients. The Kim study found an 11% incidence of POUR, but patients who received an intraoperative indwelling catheter were excluded, making direct comparison a challenge. Our study also confirmed known risk factors for POUR, namely age and benign prostatic hyperplasia.[1,4-8] It also suggests that male sex may increase the risk of POUR, although additional research is needed to confirm this result.

Interestingly, very few intraoperative and postoperative risk factors that were analyzed were associated with a higher incidence of POUR, making it difficult to develop targets for improvement. Of particular note, patients with POUR did not more commonly have an epidural placed

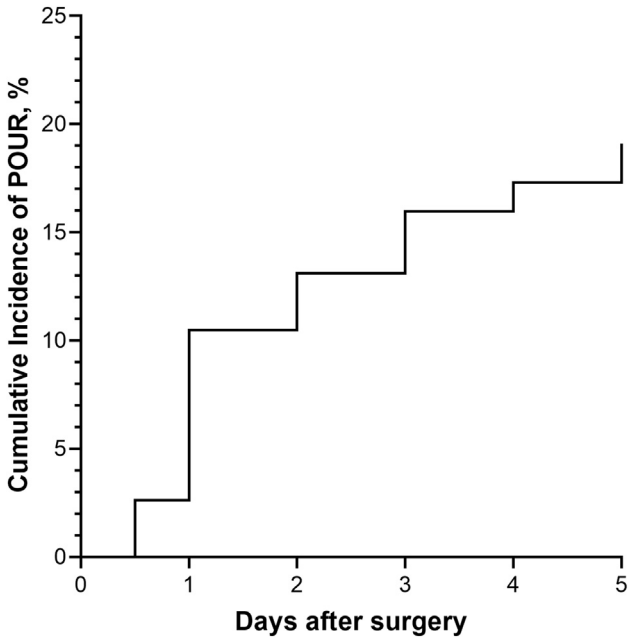

Figure 2. Cumulative incidence of postoperative urinary retention (POUR) by postoperative day.

for analgesic administration. Other studies have demonstrated an association between epidural use and POUR, but this was not observed in our small study.[4,9,10] Unlike historical lung resection cohorts,[11] we had a relatively lower epidural placement rate (~20%). Patients who are more likely to require a thoracotomy (due to size or location of the lung mass or who have chest wall involvement) based on preoperative imaging are considered for preoperative epidural catheter placement. All other patients undergo intercostal nerve blockade intraoperatively with liposomal bupivacaine.

Interestingly, patients with POUR less frequently had a Foley placed intraoperatively. Bladder distention during an operation (>790 mL) may lead to POUR.[12,13] Therefore, one target for improvement is to place indwelling catheters for longer cases. Nurse-driven bladder removal protocols with strict bladder scanning policies have also been shown to decrease the incidence of POUR.[14]

Table 2. Patient Outcomes

	POUR	No POUR	
Outcome	n = 35 (18%)	n = 156 (82%)	*P* Value
Urinary tract infection	0 (0)	4 (3)	0.99
Length of stay, d	6 (4-8)	5 (4-7)	0.19
Discharge with Foley	5 (14)	0 (0)	0.0002
30-day ED visit	5 (14)	23 (15)	0.99
30-day readmission	6 (17)	15 (10)	0.24

Categorical data are presented as n (%) and continuous data as median (interquartile range).

ED, emergency department; POUR, postoperative urinary retention.

Assessing the potential impact of opioid use on POUR was a challenge because there was no comparable opioid duration in patients without POUR. We therefore compared overall 5-day opioid use, which includes opioids received after POUR diagnosis, and POD 0 opioid use, neither of which was significantly different.

Almost every patient who was taking tamsulosin (9 of 10 patients), an α-blocker known to improve urinary retention symptoms in patients with benign prostatic hyperplasia,[15] was restarted on this medication by POD 1. Although the results regarding the use of prophylactic tamsulosin in patients at high risk of developing POUR are mixed,[15,16] the standard of care at our institution is to restart tamsulosin postoperatively for patients who take it on an outpatient basis. Despite largely adhering to this standard, patients with POUR had higher preoperative tamsulosin use.

Finally, an important take away from this study is that while POUR is a frequent occurrence in patients undergoing lung resection, occurring in almost 1 in 5 patients, POUR was not associated with many negative patient outcomes in our study. Patients with POUR were more commonly discharged home with a Foley catheter but did not have longer hospital stays or higher 30-day readmission rates. This is in contrast to previous studies.[17] Furthermore, the incidence of urinary tract infections, one of the common complications associated with urinary catheter use, in our patient population was very low (2%). This fact, combined with the observation that patients with POUR often had no intraoperative Foley catheter placed, suggests that intraoperative Foley catheter placement may be beneficial in appropriately selected patients.

Study Limitations

This study has several limitations. First, the limitations of our study include all the caveats of a small, nonrandomized study with limited follow-up. Owing to the limited study size, we could not perform a multivariate analysis to elucidate the association of other variables with the studied outcomes. Given the relatively rare occurrence of POUR, this study may be underpowered to detect significant differences between risk factors. Future studies that include a larger sample size and power analysis need to be conducted to determine risk factors for POUR.

In addition, we could not capture readmissions outside of our medical system because they are not linked to our electronic medical record, making the duration of outpatient Foley use and number of outpatient visits after discharge difficult to capture. We likely underestimated the total 30-day readmission rate, but there is likely no difference in this underestimation between POUR and non-POUR patients.

Our patient population also had a very low incidence of urinary tract infection and 30-day readmission, which limited our ability to detect differences in such outcomes.

Finally, important patient outcomes, such as patient satisfaction and quality of life, were not assessed. For example, although developing POUR may not increase a

Table 3. Use When Discharged With a Foley Catheter

Patient	Duration Foley Use Past Discharge, d	Follow-up Visits, No.	Notes
1	Unknown	0	Follow-up with local PCP for Foley removal
2	Unknown	0	Readmitted within 2 weeks
3	8	2	
4	<14	1	Follow-up with local urologist
5	6	2	

No., number; PCP, primary care physician.

patient's length of stay, it may cause an increase in dissatisfaction. Future studies should include patient satisfaction measures when assessing the effect of POUR on patient outcomes.

Nonetheless, this study presents a descriptive study of the incidence of POUR in a broad population of lung resection patients. Its findings that intraoperative Foley use may be protective and epidural use may not be a risk factor will be useful for future studies.

Conclusion

POUR develops in approximately 1 in 5 patients undergoing lung resection. These patients with POUR were more likely to not have a Foley catheter placed intraoperatively. However, patients who had POUR did not have worsened patient outcomes (urinary tract infection, length of stay, 30-day readmission).

References

1. Baldini G, Bagry H, Aprikian A, Carli F. Postoperative urinary retention: anesthetic and perioperative considerations. *Anesthesiology*. 2009;110:1139-1157.
2. Kim KW, Lee J-I, Kim JS, et al. Risk factors for urinary retention following minor thoracic surgery. *Interact Cardiovasc Thorac Surg*. 2015;20:486-492.
3. Verhamme KMC, Sturkenboom MCJM, Stricker BHC, Bosch R. Drug-induced urinary retention: incidence, management and prevention. *Drug Saf*. 2008;31:373-388.
4. Grass F, Slieker J, Frauche P, et al. Postoperative urinary retention in colorectal surgery within an enhanced recovery pathway. *J Surg Res*. 2017;207:70-76.
5. Blair AB, Dwarakanath A, Mehta A, et al. Postoperative urinary retention after inguinal hernia repair: a single institution experience. *Hernia*. 2017;21:895-900.
6. Mason SE, Scott AJ, Mayer E, Purkayastha S. Patient-related risk factors for urinary retention following ambulatory general surgery: a systematic review and meta-analysis. *Am J Surg*. 2016;211:1126-1134.
7. Tsambarlis PN, Sherer BA, Godlewski KF, Deal RM, Myers JA, Deane LA. Quantification of risk factors in 500 patients with postoperative urinary retention. *Can J Urol*. 2017;24:8705-8707.
8. Scholten R, Kremers K, van de Groes SAW, Somford DM, Koëter S. Incidence and risk factors of postoperative urinary retention and bladder catheterization in patients undergoing fast-track total joint arthroplasty: a prospective observational study on 371 patients. *J Arthroplasty*. 2018;33:1546-1551.
9. Forget P, Veevaete L, Lois F, et al. Is urinary drainage necessary in patients with thoracic epidural analgesia? A prospective analysis. *J Cardiothorac Vasc Anesth*. 2015;29:e30-e31.
10. Zaouter C, Ouattara A. Is urinary drainage necessary in patients with thoracic epidural analgesia? A prospective analysis: reply. *J Cardiothorac Vasc Anesth*. 2015;29:e31-e32.
11. El-Tahan MR. Role of thoracic epidural analgesia for thoracic surgery and its perioperative effects. *J Cardiothorac Vasc Anesth*. 2017;31:1417-1426.
12. Yoon PD, Chalasani V, Woo HH. Systematic review and meta-analysis on management of acute urinary retention. *Prostate Cancer Prostatic Dis*. 2015;18:297-302.
13. Kim HJ, Lee HY, Song SH, Paick J-S. Relationship of postoperative recatheterization and intraoperative bladder distention volume in holmium laser enucleation of the prostate for benign prostatic hyperplasia. *Korean J Urol*. 2013;54:89-94.
14. Kort NP, Bemelmans Y, Vos R, Schotanus MGM. Low incidence of postoperative urinary retention with the use of a nurse-led bladder scan protocol after hip and knee arthroplasty: a retrospective cohort study. *Eur J Orthop Surg Traumatol*. 2018;28:283-289.
15. Ghuman A, de Jonge SW, Dryden SD, Feeney T, Buitrago DH, Phang PT. Prophylactic use of alpha-1 adrenergic blocking agents for prevention of postoperative urinary retention: a review & meta-analysis of randomized clinical trials. *Am J Surg*. 2018;215:973-979.
16. Basheer A, Alsaidi M, Schultz L, Chedid M, Abdulhak M, Seyfried D. Preventive effect of tamsulosin on postoperative urinary retention in neurosurgical patients. *Surg Neurol Int*. 2017;8:75.
17. Kaplan JA, Carter JT. Near-perfect compliance with SCIP Inf-9 had no effect on catheter utilization or urinary tract infections at an academic medical center. *Am J Surg*. 2018;215:23-27.