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Authors

Banks, Kian
Sun, Angela
Le, Sidney
et al.

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Effect of reduced urinary catheter duration on time to ambulation after VATS lobectomy

Kian C. Banks [a,b,*], Angela Sun [c], Sidney T. Le [a,b], Julia Wei [c], Diana S. Hsu [a,b], Sora Ely [d], Katherine E. Barnes [e], Rachel K. Wile [e], Clara Maxim [c], Simon K. Ashiku [a], Ashish R. Patel [a], Jeffrey B. Velotta [a]

[a] Department of Thoracic Surgery, Kaiser Permanente Northern California, 3600 Broadway, Oakland, CA 94611 USA
[b] Department of Surgery, UCSF East Bay, 1411 E 31st St, Oakland, CA 94602 USA
[c] Division of Research, Biostatistical Consulting Unit, Kaiser Permanente Northern California, 2000 Broadway, Oakland, CA 94612 USA
[d] Department of Cardiothoracic Surgery, Yale School of Medicine, 789 Howard Avenue, New Haven, CT 06510 USA
[e] School of Medicine, University of California, San Francisco, 533 Parnassus Ave, San Francisco, CA 94143 USA

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ABSTRACT

Introduction: Faster time to ambulation (TTA) after video assisted thoracoscopic surgery (VATS) is associated with improved outcomes. We hypothesized that reduced urinary catheter duration leads to shorter TTA after VATS lobectomy.

Methods: We studied VATS lobectomy patients from 2014 through 2018. TTA of patients that did not have urinary catheters or whose catheters were removed at the end of the operation (reduced cath) was compared to TTA of those whose catheters were removed the day after surgery (long cath).

Results: Overall, 67 and 234 patients were included in the reduced cath and long cath groups, respectively. Median TTA was shorter in the reduced cath group compared to the long cath group (6.5 h Q1-Q3: 4.8-10.7 vs 11.0 h Q1-Q3: 6.8-18.3, $p<0.01$). Length of stay, urinary complications, and 30-day readmissions were not significantly different between groups.

Discussion: While it is possible to ambulate with a urinary catheter in place, the presence of such a catheter nevertheless presents an additional barrier to early mobilization among VATS lobectomy patients. Despite other efforts to promote early ambulation within our integrated health system, we have found that avoiding urinary catheter use or removing them immediately post-operatively is associated with shorter times to initial ambulation. Given the known benefits of early ambulation among VATS lobectomy patients, reduction or omission of urinary catheters may provide an additional tool for surgeons to promote early mobilization.

Conclusions: Reduction of urinary catheter duration is associated with reduced TTA after VATS lobectomy.

1. Introduction

Faster time to ambulation after thoracic surgery is associated with improved patient outcomes, and enhanced recovery after thoracic surgery (ERATS) protocols emphasize early mobilization as a key tenet [1–5]. Several barriers exist, however, to early ambulation. Post-operative pain, recovery from anesthesia, and attachment to intravenous, intrathoracic, and urinary catheters can all limit patients' abilities to mobilize early in the post-operative period. While it is not possible to eliminate these barriers entirely, it may be possible to reduce them.

Although prior studies have demonstrated mixed outcomes among patients with early urinary catheter removal, these studies were primarily performed among patients undergoing thoracic epidural anesthesia [6–8]. As other methods of regional anesthesia have led to reduced thoracic epidural usage, outcomes after early catheter removal can be revisited. In fact, there is recent evidence to suggest lower rates of urinary tract infection (UTI) among thoracic surgery patients whose urinary catheters were removed immediately post-operatively [9]. Evidence does not exist, however, assessing the relationship between catheter removal and time to ambulation after video-assisted thoracoscopic surgery (VATS).

* Corresponding author at: Department of Surgery, UCSF East Bay, 1411 E 31st St, Oakland, CA 94602 USA.
E-mail address: kian.banks@ucsf.edu (K.C. Banks).

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In this study we aimed to evaluate if a reduction in urinary catheter duration leads to improved outcomes among VATS lobectomy patients. Specifically, we hypothesized that patients with reduced urinary catheter duration have shorter time to ambulation after VATS lobectomy.

2. Material and methods

2.1. Study design and population

We identified patients who underwent VATS lobectomy from January 1, 2014 through July 31, 2018. All lobectomies included in this study were performed at Kaiser Permanente Oakland Medical Center by one of three board certified thoracic surgeons with a standardized regimen. All patients received intraoperative intercostal nerve blockade in a standard fashion. Eligible patients included those at least 18 years of age. We included only patients who underwent VATS lobectomy in order to compare outcomes among a homogenous group of patients. For this reason, we excluded patients who required intensive care unit (ICU) admission after surgery, those that required epidural or regional anesthesia, and those whose urinary catheters were removed on or after postoperative day two as these patients did not follow our typical postoperative course. Patients requiring urinary catheters prior to surgery were also excluded. This time period was specifically chosen because perioperative management and protocols were consistent throughout this time period. While urinary catheter placement is the default for VATS lobectomy patients at our institution, surgeons frequently choose to forego such catheterization. Thus, there is not a set protocol for when to place a catheter or not, and the decision regarding which patients receive urinary catheters is completely arbitrary at our institution.

Patients were divided into two groups. The "reduced catheter" group consisted of those who did not have urinary catheters at all or those whose catheters were removed at the end of the operation, prior to extubation. This group was compared to the "long catheter" group whose catheters were removed the day after surgery. We performed this study with approval by our Institutional Review Board with a waiver of the requirement for informed consent.

2.2. Data collection

Urinary catheter use and time to first ambulation are consistently documented in the electronic medical record and were collected. Baseline characteristics of age, sex, race/ethnicity, year of surgery, and operative time were collected. Additionally, presence of comorbidities of diabetes, hypertension, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), and coronary artery disease (CAD) were collected. The primary outcome of interest was time to ambulation which was defined as the time from leaving the operating room until time of first ambulation. Secondary outcomes included urinary retention, urinary tract infection (UTI), hospital length of stay (LOS), presence of urinary catheter upon discharge, and 30-day readmission. LOS was calculated by subtracting the date and time of hospital admission from the date and time of hospital discharge.

2.3. Statistical analysis

Frequencies and proportions were used to describe categorical variables. Mean and standard deviation were used to describe normally distributed variables while median and quartile 1 to quartile 3 (Q1-Q3) were used to describe non-normally distributed variables. Categorical variables were compared using Fisher's Exact and Chi-squared tests. Student's t-test was used to compare normally distributed continuous variables, and Wilcoxon rank sum tests were used to compare non-normally distributed continuous variables. Data were analyzed using Statistical Analysis Systems (SAS) 9.4 (Cary, NC) with $P<0.05$ as the threshold for statistical significance.

3. Results

3.1. Cohort characteristics

Of the 301 patients who met study criteria, 67 were included in the reduced catheter group and 234 were included in the long catheter group. Age, sex, and race/ethnicity were not different between the two groups (Table 1). Cases in each group were distributed across the five years included in the study, however, the distributions were slightly different overall (Table 1). Median procedure time was 11 min longer in the long catheter group than the reduced catheter group ($p=0.03$). While comorbidities were generally similar between the two groups, the long catheter group had higher rates of CKD (16.2% vs 1.5%, $p<0.01$).

3.2. Outcomes

Median time to ambulation was shorter in the reduced catheter group compared to the long catheter group (6.5 h (Q1-Q3: 4.8-10.7) vs 11.0 h (Q1-Q3: 6.8-18.3), $p<0.01$). Median LOS was 33.7 h (IQR 30.9-57.9) in the reduced catheter group compared to 37.4 h (IQR 31.2-58.1) in the long catheter group ($p=0.20$). Within 30 days of surgery, 16.4% of patients in the reduced catheter group returned to the emergency department compared to 23.9% of patients in the long catheter group ($p=0.19$). Rates of UTI were not significantly different between the reduced and long catheter groups (3.0% vs 1.7%, respectively; $p=0.61$). Similarly, there was no significant difference in urinary retention (4.5% vs 5.1%, respectively; $p>0.99$) or the proportion of patients that went home with a urinary catheter (1.5% vs 1.3%, respectively; $p>0.99$). A summary of outcome comparisons can be found in Table 2.

Table 1
Demographic, Clinical, and Surgical Characteristics by Catheter Status among VATS Lobectomy Patients.

Characteristic, n (%)	Patient total $N=301$	Reduced Catheter $N=67$ (22.3)	Long Catheter $N=234$ (77.7)	p-value*
Mean age, years (SD)	66.4 (11.0)	64.6 (11.3)	66.9 (10.9)	0.13†
Sex, n (%)				
Male	109 (36.2)	24 (35.8)	85 (36.3)	0.94
Female	192 (63.8)	43 (64.2)	149 (63.5)	
Race/ethnicity, n (%)				
Asian	55 (18.3)	13 (19.4)	42 (18.0)	0.30
Black	24 (8.0)	2 (3.0)	22 (9.4)	
Hispanic	22 (7.3)	4 (6.0)	18 (7.7)	
Other/Multiple/ Unknown	17 (5.7)	2 (3.0)	15 (6.4)	
White	183 (60.8)	46 (68.7)	137 (58.6)	
Year of surgery, n (%)				
2014	34 (11.3)	4 (6.0)	30 (12.8)	**<0.01**
2015	67 (22.3)	17 (25.4)	50 (21.4)	
2016	84 (27.9)	9 (13.4)	75 (32.1)	
2017	69 (22.9)	25 (37.3)	44 (18.8)	
2018	47 (15.6)	12 (17.9)	35 (15.0)	
Median procedure time, minutes (Q1-Q3)	196 (163-240)	190 (153-216)	201 (166-246)	**0.03**‡
Diabetes, n (%)	50 (16.6)	12 (17.9)	38 (16.2)	0.75
Hypertension, n (%)	167 (55.5)	36 (53.7)	131 (56.0)	0.74
COPD, n (%)	60 (19.9)	10 (14.9)	50 (21.4)	0.24
Chronic kidney disease, n (%)	39 (13.0)	1 (1.5)	38 (16.2)	**<0.01**
Coronary artery disease, n (%)	62 (20.6)	15 (22.4)	47 (20.1)	0.68
Pain disorder, n (%)	46 (15.3)	11 (16.4)	35 (15.0)	0.77

* p-value calculated by one-way Chi-Square test unless otherwise indicated
† p-value for comparison calculated by Student's t-test
‡ p-value for comparison calculated by Wilcoxon rank sum test. COPD, chronic obstructive pulmonary disease.

Table 2
Clinical Outcomes by Urinary Catheter Status among VATS Lobectomy Patients.

Clinical Outcome	Patient total (N = 301)	Reduced Catheter N = 67 (22.3)	Long Catheter N = 234 (77.7)	p-value [*]
Median TTA, hours (Q1-Q3)	9.9 (6.3-17.8)	6.5 (4.8-10.7)	11.0 (6.8-18.3)	**<0.01**[†]
Ambulation within 24 hrs, n (%)	279 (92.7)	63 (94.0)	216 (92.3)	0.79[‡]
Median LOS, hours (Q1-Q3)	36.1 (31.2-57.9)	33.7 (30.9-57.9)	37.4 (31.2-58.1)	0.20[†]
30-day return to ED, n (%)	67 (22.3)	11 (16.4)	56 (23.9)	0.19
UTI within seven days, n (%)	6 (2.0)	2 (3.0)	4 (1.7)	0.61[‡]
Urinary retention, n (%)	15 (5.0)	3 (4.5)	12 (5.1)	1.00[‡]
Discharge with catheter, n (%)	4 (1.3)	1 (1.5)	3 (1.3)	1.00[‡]

[*] p-value calculated by one-way Chi-Square test unless otherwise indicated
[†] p-value for comparison calculated by Wilcoxon rank sum test
[‡] p-value for comparison calculated by Fisher exact test. TTA, time to ambulation; Q1-Q3, quartile 1 to quartile 3; hrs, hours; LOS, length of stay; ED, emergency department; UTI, urinary tract infection.

4. Discussion

This study found an association between reduction in urinary catheter use and time to ambulation among VATS lobectomy patients. This is the first study to assess a relationship between catheter removal and time to ambulation in thoracic surgery patients. These results emphasize the burdensome nature of unnecessary catheter usage and the potential benefit of reducing their use in thoracic surgery patients for whom early ambulation is of utmost importance.

Early ambulation has been determined to be safe and feasible as early as within one hour post-operatively [2,10,11]. Such studies have demonstrated that, with particular emphasis, early ambulation can be achieved seemingly regardless of catheter status. However, in settings in which such strict protocols are not in place or readily enforced, other steps can be taken to promote early mobilization. Additionally, if eliminating the burden of a urinary catheter promotes shorter time to first ambulation, it very well may be that these patients are also more likely to ambulate more frequently than those with urinary catheters.

The time to ambulation among the reduced catheter group of 6.5 h is worth noting given that this is around the time our institutional post-operative protocols require that patients will be encouraged to mobilize to void if they have not yet been able to do so after surgery. While there may be other confounding factors associated with earlier mobilization besides lack of a urinary catheter, our integrated health system's nursing administration has allowed us to survey all of the nurses on the thoracic surgery floor and the majority have responded that the two main detriments to early ambulation after thoracic surgery are the chest tube and urinary catheter. Based on these discussions with the nursing staff, our attempt to eliminate urinary catheters for all VATS lobectomies in the near future is the ultimate goal, as our current practice continues to necessitate mandatory chest tube placement in all cases. The drive to ensure patients are not experiencing post-operative urinary retention likely offers a secondary benefit of promoting early ambulation.

While the distributions of subjects over the five-year period differed slightly between the comparison groups, the post-operative protocols in place did not change during this period. The included time period specifically stops prior to subsequent changes in our protocols, so all subjects in the cohort should be comparable regardless of the year of their VATS lobectomy.

Our reported procedure times include the time in the operating room rather than the time from incision to skin closure. With this in mind, it is interesting that median procedure time was 11 min shorter in the reduced catheter group. This time difference likely does not represent a large clinical difference; however, it may at least partially be related to additional time taken to place the urinary catheter. Urinary catheter placement is an additional step after intubation and prior to positioning the patient in the lateral decubitus position used during VATS lobectomies, so it is possible this represents a source of delay in the operating room. There were some patients in the reduced catheter group that still underwent catheterization prior to surgery, so this may only be one contributing factor to the difference in procedure times. Surgeons may predict some cases will be longer than others, however, the fact that the difference in operative time between the two groups is only 11 min suggests that estimated operative duration probably was not the single driving factor for whether to place a catheter or not.

The difference in rate of CKD between the two groups can likely be explained by an inclination to maintain a urinary catheter among patients in which obstructive uropathy due to urinary retention may have especially detrimental consequences. However, the proportions of patients developing urinary retention were not different and were quite low in both groups. It is possible that with proper monitoring for urinary retention, this concern among patients with CKD may be unfounded. Given that there were not differences in other baseline comorbidities between the two groups, it is unlikely that these played a role in the decision of whether to place a urinary catheter.

Our findings of low UTI rates are similar to prior findings by Allen et al who achieved a 0% UTI rate among patients who had prolonged urinary catheter use [7]. That study, however, was performed among patients with thoracic epidurals, so leaving urinary catheters in place was found to benefit patients in terms of decreased rates of urinary retention [7]. With the increasing support for intercostal and paravertebral nerve blockade, the need for prolonged urinary catheter use is further challenged [12–15]. Considering our findings of low rates of urinary retention, urinary catheter removal or omittance may become the norm, and prolonged catheter-use may be saved only for nonstandard cases such as when strict intake and output must be monitored post-operatively.

Although our study did not find differences in other outcomes aside from our primary outcome of time to ambulation, early mobilization has previously been associated with improved outcomes [1–4]. Thus, barriers to mobilization should be limited whenever possible. The clinical significance of our results is the demonstration that urinary catheters likely serve as an additional barrier to ambulation post-operatively. We believe the reduction of TTA by over 40% itself likely represents a clinically meaningful improvement, and any change that does not lead to negative consequences while still promoting earlier ambulation is worthwhile. Although our protocols emphasized early ambulation throughout the study period, it appears that earlier catheter removal or catheter omittance may have served as an adjunct to achieve this goal.

Our study has several limitations. Only an association can be inferred between urinary catheter management and time to ambulation. While our practice pattern remained stable during the time period studied, it is not possible to definitively rule out confounding factors. For example, we cannot determine the exact reasons why patients were in the reduced vs long catheter groups, however, we can see that baseline characteristics were largely similar between the groups. Also, we only collect data on initial time of ambulation. Frequency and duration of ambulation would be interesting factors to study; however, this level of granularity is not tracked within our system. Additionally, our reduced catheter group was comprised of both patients who had urinary catheters removed immediately after surgery as well as those who did not have urinary catheters placed at all. Due to sample size, we were unable to analyze these groups separately, though this would make for a potentially interesting comparison.

5. Conclusions

Overall, this study supports the concept that reduced urinary catheter usage may lead to earlier mobilization after VATS lobectomy. With otherwise similar rates of emergency department readmissions, urinary tract infections, and urinary retention; reduced urinary catheter use may help limit barriers to ambulation. Additional studies may help further evaluate potential benefits of limiting urinary catheter use among thoracic surgery patients.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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