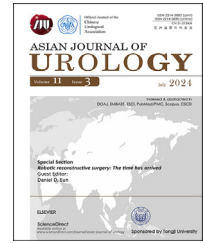


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Original Article

Defining the association between the prolonged operative time and 90-day complications in patients undergoing radical cystectomy

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KEYWORDS

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Abstract *Objective:* Radical cystectomy is a complex lengthy procedure associated with post-operative morbidity. We aimed to assess the operative time (OT) in patients undergoing radical cystectomy and its impact on 90-day postoperative complications and readmission rates.

Methods: The retrospective cohort study included 296 patients undergoing radical cystectomy and urinary diversion from May 2010 to December 2018 in our institution. The OT of 369 min was set as a cutoff value between short and long OT groups. The primary outcome was 90-day postoperative complication rates. Secondary outcomes were gastrointestinal recovery time, length of hospital stay, and 90-day readmission rates.

Results: The overall incidence of 90-day postoperative complications was 79.7% where 43.2% representing low-grade complications according to the Clavien–Dindo classification (Grade 1 and Grade 2), and 36.5% representing high-grade complications (Grade ≥ 3). Gastrointestinal tract and infectious complications are the most common complications in our data set (45.9% and 45.6%, respectively). On multivariable analysis, prolonged OT was significantly associated with odds of high-grade complications (odds ratio 2.340, 95% confidence interval 1.288–4.250, $p=0.005$). After propensity score-matched analysis, a higher incidence of major complications was identified in the long OT group 55 (51.4%) compared to 35 (32.7%) in the short OT group ($p=0.006$). A shorter gastrointestinal tract recovery time was noticed in the short OT group ($p=0.009$). Prolonged OT was associated with a higher 90-day readmission rate on univariate and multivariate analyses ($p<0.001$, $p=0.001$, respectively).

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Conclusion: Prolonged OT (>369 min) is associated with an increased risk of postoperative complications and readmission rates. The perception of potential postoperative complications requires careful monitoring of these patients which could translate into better operative outcomes.

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1. Introduction

Radical cystectomy (RC) with pelvic lymph node dissection and urinary diversion is the treatment of choice for localized muscle-invasive bladder cancer and high-risk patients with non-muscle-invasive bladder cancer [1].

Despite spectacular progress in surgical techniques for RC including the introduction of minimally invasive robotic-assisted cystectomy, this procedure continues to be associated with high complication rates [2]. Many studies have reported early postoperative complications in the range of 20%–57% [3–5].

Complication rates can be driven by many factors like the patient age, comorbidities, complexity of the surgical procedure (ileal conduit vs. continent diversion), operative approach (open vs. robotic), and surgical experience [6,7].

Recently, several pieces of literature have addressed that operative duration is a significant risk factor associated with postoperative complications [8]. Several studies have linked operative time (OT) with specific complications such as surgical site infection (SSI), venous thromboembolism, hematoma formation, necrosis, and anastomotic leak [9].

It has been an evidence-based association between OT and the development of hypothermia which in turn leads to other postoperative complications, such as cardiac events, impaired drug metabolism, prolonged anesthetic recovery time, and coagulopathy [10].

Despite the impact of OT on morbidity, it has been a topic of interest in many studies across different surgical specialties. There is no conspicuous specific time point beyond which the complications increase significantly. Some studies adopt the 6-h point after which cardiovascular, pulmonary, and renal complications increase incrementally with each hour beyond this point [1,11].

Another study identified the critical OT as 5 h beyond which a delayed hospital discharge was noticed in colorectal surgery [12].

Considering different OT thresholds across different surgical specialties and even in the same specialty among different literature reviews, further investigations could shed some light on this dilemma.

Therefore, this paradoxical situation calls for a reappraisal of the impact of OT on postoperative complications considering other potential risk factors. Therefore, we sought in this study to assess the OT in patients undergoing RC and its impact on 90-day postoperative complications and readmission rates.

2. Patients and methods

2.1. Study population

A retrospective study involved 296 patients undergoing RC and urinary diversion from May 2010 to December 2018. All surgical operations were performed by fellowship-trained urologic oncologic surgeons. Data were collected on the patient's age, sex, body mass index (BMI), smoking status, Charlson Comorbidity Index (CCI), length of hospital stay (LOS), type of surgery, type of lymphadenectomy, OT, type of diversion, estimated intraoperative blood loss, intraoperative administered fluid volume, tumor grade, and postoperative complications (Clavien–Dindo classification). Data were retrospectively collected through a chart review of the University of Minnesota Hospital database. The University of Minnesota Hospital database has granted permission to utilize their medical records for this research, analysis, and aggregate statistical reporting.

2.2. Outcome measures

The primary outcome was the frequency and severity of 90-day postoperative complications using the Clavien–Dindo classification [13] (using the highest Clavien–Dindo grade reported as a denominator). Secondary outcomes were the LOS, gastrointestinal tract (GIT) recovery time (time to first bowel movements), and 30- and 90-day readmission rates.

Criteria of hospital discharge included the resumption of bowel function, adequate oral intake, stable vital signs and laboratory values, adequate pain control, and independent ambulation. Outcomes are summarized as mean (standard deviation or 95% confidence interval [CI]) if parametric and medians and interquartile ranges (IQRs) if non-parametric.

2.3. Statistical analysis

In statistical analysis, the relationship between variables was assessed using the Chi-square test and Fisher exact test for categorical variables and the student *t*-test if parametric, and the Mann–Whitney test if non-parametric for continuous variables. Multiple logistic regression for postoperative Clavien–Dindo complications (low grade vs. high grade) and readmission status (yes or no), and multivariable linear regression for LOS and GIT recovery time as the

outcomes and the OT as the primary predictor with adjustment on age, gender, smoking, BMI, CCI, operative approach, estimated blood loss, surgical experience, enhanced recovery after surgery protocol, and diversion type.

The receiver operating characteristic (ROC) curve was calculated for OT and postoperative complications by plotting the sensitivity versus (1–specificity) that best predicts the incidence of high-grade postoperative complications. The areas under the ROC curve (AUCs) were used to determine the OT cutoff that yielded the highest AUC value associated with severe postoperative complications.

Propensity scores were calculated through logistic regression modeling based on the following covariates: age, BMI, CCI, and operative approach. Each patient of the short OT group was matched 1:1 with the nearest neighbor's propensity score of the long OT group, using the nearest neighbor matching algorithm without replacement.

SPSS v.25 (IBM Corp, Armonk, NY, USA) was used to perform all statistical analyses. *p*-Values of <0.05 were taken to indicate statistical significance.

Table 1 Demographic criteria for patients (*n*=296).

Variable	Value
Age, year	69 (62–76)
Sex	
Male	236 (79.7)
Female	60 (20.3)
Smoking	63 (21.3)
Weight, kg	80.55 (70.20–93.15)
Height, cm	1.75 (1.70–1.80)
BMI, kg/m ²	26.76 (24.00–30.66)
Charlson Comorbidity Index	
Mild (Grades 1, 2)	78 (26.4)
Moderate (Grades 3, 4)	128 (43.2)
Severe (≥Grade 5)	90 (30.4)
ASA score	
1	0 (0.0)
2	50 (16.9)
3	241 (81.4)
4	5 (1.7)
Operative approach	
Open	207 (69.9)
Robotic ^a	89 (30.1)
Previous abdominal surgery ^b	15 (5.1)
History of radiotherapy ^b	17 (5.8)
Neoadjuvant chemotherapy	122 (41.2)
Disposition	
Home	203 (68.6)
Home with nursing	8 (2.7)
Others ^c	85 (28.7)

BMI, body mass index; ASA, American Society of Anesthesiologists.

Note: values are presented as median (interquartile range) or *n* (%).

^a All robotic approaches were performed with extracorporeal urinary diversion.

^b The data of two patients were missing.

^c Others: these refer to short-term care facilities, long-term care facilities, and rehabilitation centers.

2.4. Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by University of Minnesota Institutional Review Board (No. 1053M65001). Informed consents were obtained from all individual participants included in the study.

3. Results

3.1. Demographic data

All demographic data are listed in [Table 1](#). The median (IQR) age was 69 (62–76) years. Of total 296 patients, 207 (69.9%) patients underwent open cystectomy while 89 (30.1%) were managed by the robotic approach.

ROC curve analysis revealed that the OT cutoff value as 369 min (AUC 0.688, 95% CI 0.580–0.712, *p*=0.003; [Fig. 1](#)). On subgroup analysis based on OT where the OT cutoff value was set to 369 min using the ROC curve (sensitivity 63.3%, specificity 50.5%, *p*=0.003), a higher median age was noticed in the short OT group (*n*=131) compared with that in long OT group (*n*=162) (71 [IQR 66–77] years vs. 66 [IQR 59–73] years, *p*<0.0001). Additionally, we found a higher comorbidity burden in the short OT group (*p*=0.043) ([Table S1](#)). Therefore, a propensity score matching analysis was performed adjusting for age, BMI, CCI, and operative approach resulting in 107 matched patients in each group ([Table S2](#)).

3.2. Intraoperative characteristics

The median OT was 374 (IQR 318–454) min. The median intraoperative estimated blood loss was 600 (IQR 400–1000) mL. All intraoperative details are listed in [Table S3](#).

3.3. Surgical outcomes

3.3.1. 90-day complications

The overall incidence of 90-day complications was 79.7% where 43.2% representing low-grade complications according to the Clavien–Dindo classification (Grades 1, 2), and 36.5% representing high-grade complications (≥Grade 3). The most common complications were GIT and infectious complications (45.9% and 45.6%, respectively) ([Table 2](#)).

On univariate analysis of potential risk factors for high-grade postoperative complications, the age, BMI, CCI, baseline renal function, and OT were identified as significant predictors to develop high-grade complications ([Table S4](#)).

On multivariable analysis, prolonged OT was significantly associated with odds of postoperative complications (OR 2.340, 95% CI 1.288–4.250, *p*=0.005) even with adjusted other variables ([Table 3](#), [Fig. 2](#)).

On subgroup analysis based on OT after propensity score matching analysis, a higher incidence of major complications was identified in the long OT group 55 (51.4%) compared to 35 (32.7%) in the short OT group (*p*=0.006)

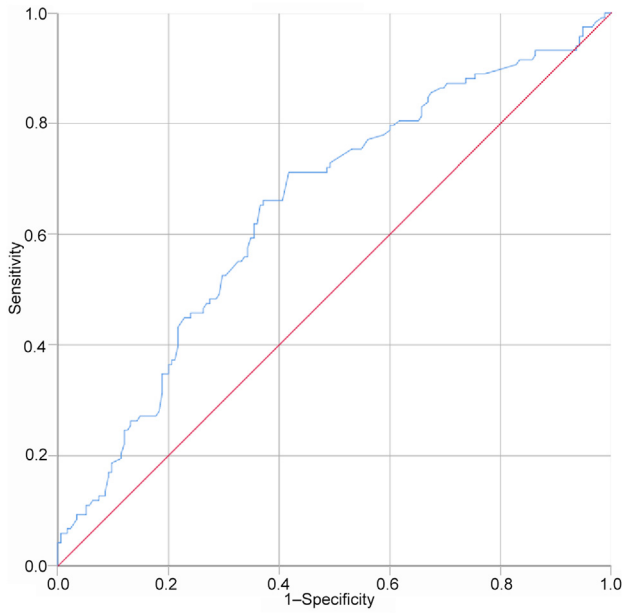


Figure 1 The receiver operating characteristic curve of operative time and postoperative complications to predict the cutoff value of the operative time yielding the highest area under the curve value associated with severe postoperative complications (369 min). Diagonal segments were produced by ties.

(Table 4). In the long OT group, a higher incidence of postoperative infectious, surgical, and genitourinary complications was noticed ($p=0.005$, $p=0.020$, and $p=0.004$, respectively).

Specifically, BMI and OT were significant predictors that were associated with increased risk to develop postoperative genitourinary complications on multivariable analysis ($p=0.002$ and $p=0.020$, respectively).

However, older age and prolonged OT were significantly associated with an increased risk of postoperative cardiac complications ($p=0.041$ and $p=0.001$, respectively).

The prolonged OT was the only significant factor associated with an increased risk of postoperative respiratory complications (OR=1.497, 95% CI 1.114–2.010, $p=0.007$).

On the other hand, intraoperative estimated blood loss was significantly associated with an increased risk to develop postoperative thromboembolic complications ($p=0.016$).

3.3.2. Secondary outcomes

The median time to bowel movements was significantly decreased in the short OT group 4 (IQR 3–6) days compared to long OT group 5 (IQR 4–6) days ($p=0.009$, Table 4). On multivariable analysis, OT was significantly associated with the time to resume first bowel movements ($p=0.040$, Table S5).

Median LOS was similar in short and long OT groups ($p=0.600$). OT was not significantly associated with LOS on multivariate analysis ($p=0.177$).

Overall, 30-day readmission was 40.2%. The long OT group showed a higher readmission rate of 54.2% compared to 30.8% in the short OT group ($p=0.001$). Similarly, a higher rate of 90-day readmission rate was identified in the long OT group ($p<0.001$). On multivariate analysis, longer OT was

Table 2 Postoperative outcomes ($n=296$).

Variable	Value
Postoperative complication (Clavien–Dindo classification)	
0	60 (20.3)
Grade 1	7 (2.4)
Grade 2	121 (40.9)
Grade 3	45 (15.2)
Grade 4	61 (20.6)
Grade 5	2 (0.7)
Different complication ^a	
GIT	
Ileus	86
<i>Clostridium difficile</i> colitis	21
GIT bleeding	4
Gastroenteritis	8
Esophagitis	14
Enteric fistulas	3
Infectious	
FUO	16
Abscess	26
UTI	55
Sepsis	32
Pyelonephritis	6
Surgical	
Wound seroma	15
Wound infection	16
Wound dehiscence	13
Abdominal fluid collection	27
Re-exploratory laparotomy	8
Genitourinary	
AKI	52
Urinary leak	7
Ureteral obstruction or stricture	6
Cardiac	
Arrhythmia	33
Myocardial infarction	2
Hypotension	13
Hypertension	10
Pulmonary	
Atelectasis	4
Pneumonia	11
Respiratory distress	4
Pleural effusion	2
Pneumothorax	1
Bleeding	
Anemia requiring blood transfusion	71
Postoperative hematoma	4
Thromboembolic	
Deep venous thrombosis	17
Pulmonary embolism	3
Neurological	
Delirium	32
Transient ischemic attack	1
Time to bowel movements, day	3 (3–5)
Length of hospital stay, day	8 (6–11)
30-day readmission	119 (40.2)
90-day readmission	126 (42.6)

GIT, gastrointestinal tract; FUO, fever of unknown origin; UTI, urinary tract infection; AKI, acute renal failure.

Note: values are presented as median (interquartile range), n (%), or n .
^a Patients have more than one complication.

Table 3 Multivariable logistic regression for postoperative complications (low grade or high grade) and the incidence of 90-day readmission rates.

Variable	Postoperative complication (Clavien–Dindo classification)					90-day readmission rate				
	β	Odds ratio	95% CI		p -Value ^a	β	Odds ratio	95% CI		p -Value ^a
			Lower	Upper				Lower	Upper	
Age	0.031	1.031	1.003	1.060	0.019	0.023	1.024	0.997	1.050	0.075
Sex	0.060	1.081	0.554	2.034	0.858	0.543	1.722	0.911	3.254	0.094
Smoking	−0.074	0.929	0.693	1.245	0.622	−0.102	1.026	0.772	1.361	0.862
BMI	0.059	1.061	1.011	1.113	0.016	0.020	1.020	0.975	1.068	0.386
CCI	0.190	1.209	1.026	1.425	0.023	0.091	1.095	0.935	1.282	0.260
Operative approach	0.480	1.616	0.884	3.211	0.119	0.500	1.649	0.929	2.926	0.068
OT ^b	−0.85	2.340	1.288	4.250	0.005	0.962	2.617	1.503	4.559	0.001
EBL	0.001	1.000	0.999	1.000	0.657	0.001	1.000	1.000	1.001	0.670
Surgical experience	0.080	1.143	0.667	1.734	0.739	−0.017	0.962	0.614	1.509	0.940
Diversion type	0.120	1.209	0.570	2.253	0.721	−0.775	0.440	0.231	0.835	0.020
ERAS	0.306	1.358	0.804	2.292	0.252	0.148	1.160	0.703	1.914	0.561

CI, confidence interval; BMI, body mass index; CCI, Charlson Comorbidity Index; OT, operative time; EBL, estimated blood loss; ERAS, enhanced recovery after surgery.

^a The p -value in bold indicating the significant value of <0.05 .

^b The OT is included in the model as a categorical variable using 369 min as a cutoff value.

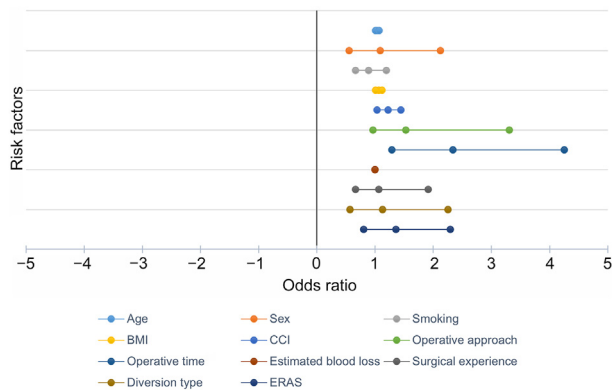


Figure 2 Forest plot showing multivariate analysis of potential risk factors of major postoperative complications. Odds ratios are shown with 95% confidence intervals for the age, sex, smoking, BMI, CCI, operative approach, operative time (369 min as the cutoff value), EBL, surgical experience, type of diversion, and ERAS as possible predictors for development of postoperative complications. BMI, body mass index; CCI, Charlson Comorbidity Index; EBL, estimated blood loss; ERAS, enhanced recovery after surgery protocol.

significantly associated with higher odds of the 90-day readmission rate (OR 2.617, 95% CI 1.503–4.559, $p=0.001$).

4. Discussion

Identifying risk factors that contribute to increased morbidity among patients undergoing surgery is of growing importance. Many studies have reported a robust association between prolonged OT and postoperative complications including infectious complications, sepsis, and pulmonary complications with an increased risk of complications with every extra hour of OT [14,15]. Similarly, in our study, we

found that patients undergoing RC with prolonged OT had twice the odds to develop high-grade postoperative complications on the Clavien–Dindo scale after adjustment of other confounders (OR 2.340, 95% CI 1.288–4.250, $p=0.005$). Additionally, the overall relative risk of complications increased linearly with increasing OT.

Prolonged OT is thought to be a precipitating factor for the development of postoperative complications, especially in high-risk patients with underlying high comorbidity burdens [16].

The most challenging hurdle in the pathway of OT analysis and its impact on postoperative complications is the presence of other confounders that affect surgery outcomes. Postoperative outcomes are conditional on many factors including preoperative CCI, occurrences of intraoperative complications, prior surgeries within the same operative field, complexity of the surgical procedure, operative approach (*i.e.*, open vs. laparoscopic), intraoperative EBL, surgeon's experience, and the operating team [11]. We conducted this study to define the association between prolonged OT and the development of postoperative complications considering the potential risk factors. To our knowledge, our study is the first to assess the OT as an independent risk factor for postoperative complications and 90-day readmission rates in RC patients.

In our study, the overall incidence of 90-day complications was 79.7%, of which 43.2% represented low-grade (minor) complications and 36.5% represented high-grade (major) complications. Besides OT, we found that the age, BMI, CCI, and baseline renal function were significant predictors for major 90-day complications on univariate analysis.

These results were different from those reported by Bochner et al. [17], who conducted a randomized clinical trial comparing outcomes between robot-assisted RC (RARC) and open RC (ORC). They observed complication

Table 4 Postoperative outcomes between matched groups based on operative time after propensity score-matched analysis.

Outcome	Operative time		p-Value ^a
	≤369 min (n=107)	>369 min (n=107)	
Postoperative complication (Clavien–Dindo classification)			0.006
Low grade (≤2)	72 (67.3)	52 (48.6)	
High grade (≥3)	35 (32.7)	55 (51.4)	
Complication category ^b			
Infectious	25 (23.4)	44 (41.1)	0.005
GIT	43 (40.2)	46 (43.0)	0.700
Surgical	18 (16.8)	32 (29.9)	0.020
Genitourinary	16 (15.0)	34 (31.8)	0.004
Cardiac	18 (16.8)	26 (24.3)	0.200
Respiratory	6 (5.6)	7 (6.5)	0.800
Bleeding	27 (25.2)	29 (27.1)	0.800
Thromboembolic	8 (7.5)	6 (5.6)	0.600
Neurological	18 (16.8)	10 (9.3)	0.100
ERAS	57 (53.3)	48 (44.9)	0.200
Length of hospital stay, day	9 (6–12)	8 (7–11)	0.600
Time to bowel movements, day	4 (3–6)	5 (4–6)	0.009
30-day readmission	33 (30.8)	58 (54.2)	0.001
90-day readmission	34 (31.8)	60 (56.1)	< 0.001

GIT, gastrointestinal tract; ERAS, enhanced recovery after surgery.

Note: values are presented as median (interquartile range) or n (%).

^a The p-value in bold indicating the significant value of <0.05.

^b Patients have more than one complication.

rates of 62% and 66% of RARC and ORC patients, respectively. Being inconsistent with our results (80.4%) may be attributed that the authors only reported Grade 2 to Grade 5 postoperative complications, as they did not report Grade 1 complications which were different from our results that reported all grades from Grade 1 to Grade 5.

In the same context, Mastroianni et al. [18,19] reported complication rates of 48% and 53% of RARC and ORC, respectively, in a randomized control trial for patients undergoing RC with intracorporeal diversion. This study was conducted in a single high-volume referral center which may explain the lower rates of complications in comparison to our results; moreover, the rates of neobladder are higher than those reported in general practice, which make their results difficult to be comparable in other pieces of literature.

There is no identifiable time point beyond which the complication rate significantly increases; however, some studies have demonstrated that surgical duration greater than 130 min is independently associated with postoperative morbidity [20,21]. Another study used 6-h duration in different surgical disciplines as the threshold beyond which the rate of complications was significantly increased [1]. A systematic review reported that the incidence of postoperative complications increased significantly with prolonged OT, as the odds of complications were doubled with OT thresholds exceeding 2 h or more. Meta-analysis also found that every 30 min of additional operating time was associated with a 14% increase in the likelihood of postoperative complications [22]. In this study, the OT threshold was determined using the ROC curve to be 369 min (6.15 h), which represents the 50th percentile of

our dataset. By analysis of the operative outcomes considering 369 min as an OT cutoff value after propensity score matching analysis, a higher rate of major complications of 51.4% was identified in the long OT group compared to 32.7% in the short OT group ($p=0.006$). With further analysis of different postoperative complications, the long OT group demonstrated a higher incidence of postoperative infectious, surgical, and genitourinary complications compared to the short OT group ($p=0.005$, $p=0.020$, and $p=0.004$, respectively).

Similarly, some studies demonstrated a significant association between prolonged OT and SSI with a two-fold increasing likelihood of SSI observed across various time thresholds [22,23].

On the other hand, some studies found no relationship between OT and surgical outcomes. Liverani et al. [24] conducted a study involving 250 patients undergoing different abdominal surgeries (clean and clean-contaminated) and did not find any significant association between operative duration and the number of septic complications, anastomotic dehiscence, or LOS. Another study reviewed complication rates in laparoscopic cystectomy considering an OT of 180 min as the cutoff value. Although complication rate was 9% in the longer OT group compared to 3% in the other group, yet this difference failed to achieve statistical significance [25].

On multivariate analysis, we found a significant association between prolonged OT and higher odds of major complications as well as the 90-day readmission rate even with adjusted other risk factors ($p=0.005$ and $p=0.001$, respectively). Our results are replicated by a study conducted on 4624 patients undergoing RC to assess potential risk factors

that influence 30-day readmission rates. They found that prolonged procedure length was significantly associated with higher odds of readmission rate ($p < 0.001$) [26].

Unlike previous studies, we could not find an association between smoking or operative approach with postoperative complications. That may be attributed to the high comorbidity burden found in non-smoker patients or those with the robotic approach which may mitigate the effect of smoking and the beneficial effect of the robotic approach to be significantly associated with postoperative complications. Moreover, a relatively younger age group was found in smoker patients (median 60 years) compared to non-smoker patients (median 68 years).

We demonstrated a shorter GIT recovery time in the short OT group ($p = 0.009$). On multivariable analysis, we found that the age, OT, and enhanced recovery after surgery protocol are significant risk factors associated with GIT recovery time.

We did not find a significant reduction of LOS in the lower OT group ($p = 0.600$). These results were comparable to the randomized control trial conducted by Mastroianni et al. [27] who could not achieve a significant reduction of LOS even with a shorter OT group (ORC patients) compared to the other group (RARC patients).

On the other hand, Lorentz et al. [26] found a significant reduction in the LOS with shorter surgery time. The variances between these results and our findings could be due to the initially longer median LOS (IQR 10–14 days) in certain hospitals. Moreover, a higher burden of preoperative comorbidity in the short OT group may attenuate the beneficial effect of shorter operative duration with a consequential inability to achieve shorter LOS.

Briefly, many driving forces, modifiable and non-modifiable factors, contribute to prolonged OT and subsequently increase the likelihood of postoperative complications. In this study, we sought to shed light on these modifiable risk factors, of which proper optimization could achieve better outcomes. Patients with higher comorbidity burden should be counseled about the increased chance to have postoperative complications compared to their cohorts of low morbidity level and probable need for postoperative critical care admission. Patients with chronic kidney diseases may be more liable to postoperative complications in case of prolonged OT with potential volume overload. Thus, it requires more careful monitoring of fluid administered using goal-directed fluid therapy [28]. The identified risk factors could be used in the development of a risk tool or decision scheme that might add a greater degree of precision of expected postoperative course for these risky patients and its proper management.

Basically, shorter OT with the perfect surgical outcome is of utmost importance for all surgeons regardless of their subspecialties. Surgical experience and learning curve are cornerstones to achieving that goal. The cumulative sum technique, one of the methods developed to monitor the performance and quality of the industrial sector, was adopted by the medical field 50 years ago. Lombardo et al. [29] evaluated the learning curve of the RARC with intracorporeal neobladder using the following criteria: OT of < 5 h, 24-h hemoglobin drop of < 2 g/dL, severe

complications (according to the Clavien–Dindo classification system) of $< 30\%$, positive surgical margins of $< 5\%$, and complete lymph-node dissection defined as more than 16 nodes. In the same context, a retrospective study was conducted on 167 patients undergoing RARC with intracorporeal neobladder [30]. Tuderti et al. [30] evaluated the impact of the learning curve and long-term assessment of functional outcomes. They found that the patients treated at the beginning of the learning curve had worse perioperative and functional results in comparison to those treated in the third tertile of the study timeline (with an improved learning curve) who experienced better surgical and functional outcomes.

Our study has some limitations. One of the limitations is the retrospective nature of the study with a relatively modest sample size, the inevitable effect of reporting bias, complications underreporting, and some missing data in the follow-up of the patients. Another limitation is the absence of a validated tool to measure surgeons' experience accurately. Moreover, it was difficult to find an association between known risk factors like smoking with postoperative complications.

5. Conclusion

Prolonged OT is associated with an increased risk of postoperative complications and readmission rates in patients undergoing RC. In our study, there is a time threshold (369 min) beyond which the likelihood of postoperative complications increases significantly. Therefore, the perception of potential postoperative complications requires careful monitoring of these patients which in turn translates into better operative outcomes.

Author contributions

Study concept and design: Peter Hanna, Christopher Warl,

Data acquisition: Peter Hanna.

Data analysis: Peter Hanna.

Drafting of manuscript: Peter Hanna.

Critical revision of the manuscript: Joseph Zabell, Badri-nath Konety, Christopher Warlick.

Conflicts of interest

The authors declare no conflict of interest.

Acknowledgment

Earlier version of this article was presented as a poster in the bladder section: invasive (MP 13-12) AUA-2021.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ajur.2023.04.004>.

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