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**ORIGINAL RESEARCH** **INTENSIVE CARE**

# Determination of predictive factors for intensive care unit admission following robot-assisted radical cystectomy

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## Abstract

**Background:** To identify determinants of postoperative intensive care unit (ICU) requirement of patients after robot-assisted radical cystectomy (RARC), as RARC is increasingly used for the treatment of recurrent high-grade or locally advanced bladder cancer.

**Methodology:** In this retrospective real-world study, data of 74 patients who had RARC between 2015 and 2017 for the definitive treatment of bladder cancer were examined to identify perioperative factors predicting ICU admission. Patients were grouped as those postoperatively admitted to intensive care unit (ICU group) and those taken to regular urology ward (non-ICU group). Their demographic and perioperative data, Charlson Comorbidity Index, treatments, and laboratory results were recorded. Independent samples t test, Mann-Whitney U test, multivariate logistic regression analysis were used for data analysis.

**Results:** Twenty-nine patients (39.2%) were postoperatively admitted to ICU while the remaining patients were followed in regular ward. Preoperative American Society of Anesthesiologists (ASA) class and estimated blood loss were significantly higher in the ICU group ($p < 0.05$).

**Conclusion:** Higher ASA classification was found to be predictive for ICU admission following RARC. Prospective randomized trials are required for validation of possible risk factors.

**Key words:** Robot-assisted radical cystectomy; Postoperative; Intensive care unit; Patient admission; Predictive Factors

**Abbreviations:** RARC – Robot-assisted radical cystectomy; LOS – Length of hospital stay; ORC – open radical cystectomy; APACHE II – Acute Physiology and Chronic Health Evaluation; CCI – Charlson comorbidity index; EBL – estimated blood loss; IQR – Interquartile range

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## 1. Introduction

Robot-assisted radical cystectomy (RARC) is increasingly adopted for the treatment of locally advanced bladder cancer[1-3] as potential advantages of shortened learning curve[4], enhanced visualization and

dexterity[5], shorter length of hospital stay (LOS)[2,3,6-8],infrequent or lower overall and high-grade complications[6,9-11], lower intraoperative blood loss or transfusion requirement[6,8,12,13], and higher rates of preservation of neurovascular structures[13]were reported over open radical cystectomy (ORC) in observational studies. Meta-analyses of randomized clinical trials comparing RARC with ORC, however, reported similar rates of perioperative morbidity, major complications, and quality of life with similar or slightly shortened LOS while only the intraoperative estimated blood loss (EBL) and requirement of blood transfusions were found be consistently lower in RARC groups[14-16]. Within this context of findings of perioperative outcomes, optimal postoperative management of patients who had RARC remains to be elucidated.

Need of management in intensive care unit (ICU) and LOS following radical cystectomy were evaluated before the introduction of RARC, indicating that American Society of Anesthesiologists (ASA) physical status classification, Acute Physiology and Chronic Health Evaluation (APACHE II) score, presence of surgical complications, and number of intraoperative transfusions are significant predictive factors for ICU requirement[17,18]. These findings, along with others[19], provided evidence for selective rather than routine postoperative ICU admission of patients, including the elderly, following radical cystectomy[20]. Our real-world study was designed to identify perioperative factors predicting postoperative ICU admission of patients who had RARC for the treatment of bladder cancer and thus help the rational use of critical medical resources and budgets within current medical practice.

## 2. Methodology

In this retrospective observational study, anonymized data were collected for 74 consecutive patients who underwent RARC operation for the treatment of locally advanced or recurrent high-grade bladder cancer between March 2015 and December 2017 in a single center. All patients had urethelial carcinoma (one with plasmacytoid variant) except for four patients with squamous cell carcinoma. RARC was performed with a four-arm da Vinci-S surgical system (Intuitive Surgical Inc., Mountain View, CA, USA). Briefly, surgical technique involved radical cystoprostatectomy in men and radical cystectomy with anterior pelvic exentration in women, bilateral extended pelvic lymph node dissection, and intracorporeal Studer pouch formation or intracorporeal ileal loop reconstruction. Neurovascular bundles were preserved where possible. Details of the RARC surgical techniques were reported previously[13,21].Patients were classified into two groups as postoperatively admitted to intensive care unit (ICU group) or taken to regular urology ward (non-ICU group), a decision which was made pre- or intraoperatively at the discretion of the responsible medical team based upon their clinical (e.g. cardiac comorbidities) and laboratory (e.g. metabolic acidosis) judgment within routine practice.

Patient characteristics of age, gender, body mass index, smoking history, preoperative ASA classes[22] and Charlson comorbidity index (CCI),[23] duration of surgery, EBL, perioperative erythrocyte infusion rate, type of diversion, postoperative venous blood gas values (pH, lactate, and base excess), pre- and postoperative hemoglobin and hematocrit levels, and LOS with APACHE II scores and duration of ICU stay for ICU patients were recorded as independent variables. Continued postoperative intubation was not regarded as an independent variable as it was deemed to be dependent upon the consideration for postoperative ICU need. This study protocol was conducted in accordance with the principles of Declaration of Helsinki and good clinical practice.

Descriptive statistics were presented as mean ± standard deviation or median and interquartile range (IQR) based on the distribution of the data. Categorical variables were expressed as numbers and percentages. Normality test of numerical variables was performed by Kolmogorov-Smirnov test. In the comparison of two independent groups, independent samples t test or Mann-Whitney U test were used where appropriate. For statistical analysis, Jamovi (Version 1.0.7, retrieved from https://www.jamovi.org) and JASP Team (Version 0.11.0.0) were used. Statistical significance level (p value) was considered as 0.05.

## 3. Results

A total of 74 patients were included in the study. There were29 patients (39.2%) in the ICU group and 45 patients (60.8%) in the non-ICU group. The mean age of patients was 62.9 ± 10.4 years in the ICU group

**Table 1: Baseline demographics and perioperative properties of the patients**

| Parameter | All patients (n = 74) | Groups | | p value |
|---|---|---|---|---|
| | | ICU patients (n = 29) | Non–ICU patients (n = 45) | |
| Age (mean ± SD) | 63.0 ± 9.9 | 62.9 ± 10.4 | 63.0 ± 9.6 | 0.951 |
| Gender (males) | 69 (93.2) | 28 (96.6) | 41 (91.1) | 0.642 |
| Smoking history | 52 (70.3) | 21 (72.4) | 31 (68.9) | 0.949 |
| BMI (kg/m$^2$), (mean ± SD) | 26.1 ± 2.7 | 25.7 ± 2.7 | 26.3 ± 2.7 | 0.332 |
| ASA score | | | | |
| ASA I | 37 (50.0) | 9 (31.0) | 28 (62.2) | **0.026** |
| ASA II | 32 (43.2) | 17 (58.6) | 15 (33.3) | |
| ASA III | 5 (6.8) | 3 (10.3) | 2 (4.4) | |
| CCI score | | | | |
| Low [0–1] | 52 (70.3) | 17 (58.6) | 35 (77.8) | 0.134 |
| High [≥2] | 22 (29.7) | 12 (41.4) | 10 (22.2) | |
| Duration of surgery (hours), median (IQR) | 7.0 (6.0–8.0) | 7.0 (6.0–8.0) | 6.5 (6.0–8.0) | 0.880 |
| Estimated blood loss (dL), [median (IQR)] | 200 (100–300) | 200 (150–300) | 150 (100–200) | **0.032** |
| Erytrocyte infusion | 7 (9.5) | 3 (10.3) | 4 (8.9) | 0.999 |
| Diversion type | | | | |
| Intracorporeal Studer | 43 (58.1) | 17 (58.6) | 26 (57.8) | 0.999 |
| Intracorporeal ileal conduit | 31 (41.9) | 12 (41.4) | 19 (42.2) | |
| pH, (mean ± SD) | 7.3 ± 0.0 | 7.3 ± 0.1 | 7.3 ± 0.0 | 0.461 |
| Lactate (mmol/L), *median (IQR)* | 1.6 [0.9– 3.0] | 1.6 [1.1– 2.5] | 1.2 [0.9– 3.2] | 0.765 |
| Base excess, (mean ± SD) | –5.2 ± 2.4 | –4.8 ± 2.7 | –5.5 ± 2.2 | 0.259 |
| Length of hospital stay (days) [median (IQR)] | 12 (10–14) | 12 (10–13) | 12 (10–15) | 0.229 |

*Data given as [n (%)], unless described otherwise.*
*BMI: Body mass index, CCI: Charlson comorbidity index, ICU: Intensive care unit, IQR: Interquartile range*

of patients was 62.9 ± 10.4 years in the ICU group and 63.0 ± 9.6 years in the non-ICU group. There was no significant differences between the groups in terms of age (p = 0.951) and sex (p = 0.642) (Table 1). Fourteen patients (48.3%) in the ICU group were admitted to the ICU with continued postoperative intubation. All non-ICU patients were extubated following RARC. Five patients (17.2%) in the ICU group required postoperative Esmolol administration for rhythm abnormalities while none required inotropes. No non-ICU patient later needed admittance to the ICU. Median APACHE II score of ICU patients was 24 (IQR 24-24) and median duration of stay in ICU was one day (IQR 1-1). All patients were successfully discharged and median LOS was similar as 12 days in ICU and non-ICU patient groups. In a 90-day follow-up, all patients were alive.

Baseline demographics, clinical characteristics and perioperative properties of the patients are summarized in Table 1. The preoperative ASA classes and median EBL were significantly higher in the ICU group (p = 0.026 < 0.05 for both). A trend was observed for higher number of patients with high CCI grades (> 2) in the ICU group when compared with no

**Table 2. Perioperative hemoglobin and hematocrit levels and % change in intensive care unit and non–intensive care unit groups**

| Parameter | All patients (n = 74) | Groups | | p value |
|---|---|---|---|---|
| | | ICU patients (n = 29) | Non–ICU patients (n = 45) | |
| Preoperative hemoglobin level (g/dL) | 13.4 (2.0) | 13.1 (2.3) | 13.6 (1.7) | 0.297 |
| Postoperative hemoglobin (g/dL) | 11.9 (1.7) | 11.7 (1.9) | 12.0 (1.5) | 0.533 |
| Change of hemoglobin levels after surgery (%), median (IQR) | –11.7 (–16.2– –6.4) | –11.4 (–16.1– –3.3) | –12.5 (–16.2– –6.6) | 0.385 |
| Preoperative hematocrit (%) | 39.7 (6.8) | 38.1 (9.0) | 40.8 (4.8) | 0.150 |
| Postoperative hematocrit (%) | 35.9 (4.8) | 35.6 (5.4) | 36.1 (4.5) | 0.662 |
| Change of hematocrit levels after surgery (%), median (IQR) | –9.9 (–17.0– –4.8) | –8.1 (–14.7– 0.0) | –11.4 (–17.1– –5.6) | 0.150 |

*Data given as mean ± SD, unless described otherwise; , IQR = Interquartile range*

**Table 3. Univariate and multivariate logistic regression models of preoperative American Society of Anesthesiologists physical status classification and intraoperative estimated blood loss to predict intensive care unit admittance**

| Variable | Univariate | | Multivariate | |
|---|---|---|---|---|
| | Odds ratio [95%CI] | p value | Odds ratio [95%CI] | p value |
| ASA class (ref = ASA I) | | | | |
| ASA II | 3.53 [1.27– 9.81] | 0.016 | 3.60 [1.28– 10.09] | 0.015 |
| ASA III | 4.67 [0.67– 32.49] | 0.120 | 4.82 [0.69– 33.84] | 0.114 |
| Estimated blood loss | 1.00 [1.00– 1.00] | 0.612 | 1.00 [1.00– 1.00] | 0.506 |

*Dependent variable: Patient groups.*
*ASA: American Society of Anesthesiologists physical status classification, CI: Confidence interval, ref: Reference.*

non-ICU patients (41.4% vs. 22.2%, p = 0.134).There was no significant difference between the groups in terms of preoperative and postoperative levels of hemoglobin and hematocrit (p > 0.05 for all). The percent change in hemoglobin and hematocrit between the groups was also not significant. A trend, however, was observed for higher median hematocrit decrease in the non-ICU group postoperatively when compared with ICU patients (11.4% vs. 8.1%, p = 0.150). The mean preoperative and postoperative hemoglobin and hematocrit levels and percent change in these parameters are presented in Table 2.

## 4. Discussion

Radical cystectomy continues to be the recommended treatment of choice for recurrent high-grade or locally advanced bladder cancer[24]. Surgical methods and perioperative management strategies, however, have evolved over the years[25]. This study aimed to evaluate perioperative factors associated with ICU requirement following RARC. The findings showed that patients admitted to ICU had higher ( > Class I) preoperative ASA classes and intraoperative EBL yet only ASA class II designation was found to be a predictive factor for ICU admittance in risk modelling. ASA class III was not found as a risk because of small sample size. While advanced age ( > 65 years) was associated earlier with higher ICU requirement rate after RARC[26], we did not analyze subgroups for ages as our patients were considerably younger. Erythrocyte transfusion rates for RARC patients were low and similar among ICU and non-ICU groups. As intraoperative surgical complication rate for RARC of

our group was about one percent[27], we did not include intraoperative complications as a variable. Overall, our study confirmed that ASA classification continues to be a predictive factor for ICU requirement following radical cystectomy regardless of the surgical method.

Postoperative management strategies of patients who had RARC remain to be investigated. Randomized clinical trials comparing RARC and ORC lack reporting of postoperative management algorithms and outcomes[28-32].Udovicich et al. reported that higher volume of radical cystectomy operations performed per year was found to be related with fewer prolonged ( > 24 hours) ICU admissions yet surgical details were not presented in the study[33]. Our ICU admittance rate and length of ICU stay following RARC were found to be similar or lower when earlier reports were considered.[3,26,34] The effect of surgery volume on use of ICU following RARC needs to be investigated within current practice. American Urological Association 2018 guidelines recommend enhanced recovery after surgery (ERAS) protocols to be followed for all complex urological surgeries, including RARC, to optimize perioperative care and reduce LOS and complications[25]. Indeed, Cheng et al. reviewed patients who had radical cystectomy with ERAS protocols. Their findings indicate a low ICU admission rate (6.4%) with identified risk factors of advanced age and high CCI score ( > 2) potentially predicting unplanned ICU requirement. The authors concluded that patients with these high-risk factors could benefit from direct postoperative ICU admission after radical cystectomy[35].Our finding of a trend for higher CCI scores being a predictive factor for ICU requirement after radical cystectomy is in line with these results. Our patient population, however, was considerably younger and this could account for the finding in our study that age was not a risk factor for ICU requirement.

## 5. Limitations

Our study is limited by its relatively low number of participants, retrospective nature, and unstructured clinical judgment for determining ICU need. Additionally, we did not record volumes of erythrocyte transfusions and electrolyte infusions. More aggressive erythrocyte transfusion and fluid replacement in the ICU group could account for the trend observed for higher hematocrit decrease in non-ICU patients postoperatively. The observed trends for ASA class III designation and high CCI grading being potential predictive factors for ICU admittance following RARC require further examination in larger patient groups.

## 6. Conclusion

As a conclusion, ASA class II patients who had RARC had a higher chance for ICU admittance when compared to ASA class I patients. Prospective and randomized studies incorporating ERAS protocols to evaluate optimal and rational postoperative management of RARC patients are warranted to validate the findings of this study. There is a decision which was made pre- or intraoperatively at the discretion of the responsible medical team based upon their clinical (e.g. cardiac comorbidities) and laboratory (e.g. metabolic acidosis) judgment within routine practice. Additional analyses of completed or ongoing randomized trials of RARC would also be of benefit for providing data and insights for future postoperative management studies to optimize resource allocation for ICU requirements.

## 7. Acknowledgments

This study was presented at the 19th Congress of Turkish Society of Intensive Care Medicine, Antalya, Turkey at 19-22 April, 2018.

## 8. Declaration of interest

Authors declare no conflict of interest related to the current study.

## 9. Authors' contribution

FTB: Study design, Literature review, Manuscript review and proof reading

EA: Data collection

**SI:**Manuscript review, editing and proof reading

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