ORIGINAL PAPER

UROLOGICAL ONCOLOGY

Evaluation of comorbidity indices in determining the most suitable candidates for uro-oncological surgeries in elderly men

Ismail Selvi[1], Ali Ihsan Arik[2], Numan Baydilli[3], Mehmet Sinan Basay[2], Halil Basar[2]

[1]*Başakşehir Çam ve Sakura City Hospital, Department of Urology, Istanbul, Turkey*
[2]*Health Science University, Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital, Department of Urology, Ankara, Turkey*
[3]*Erciyes University Medical School, Department of Urology, Kayseri, Turkey*

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Corresponding author
Ismail Selvi
Başakşehir Çam ve Sakura City Hospital
Department of Urology
Olimpiyat Bulvari Yolu
34480 Istanbul, Turkey
phone: +90 212 909 60 00
ismselvi33@hotmail.com

Introduction We aimed to evaluate the superiority of different comorbidity indices in determining the most suitable elderly male candidates for uro-oncological operations. While making this assessment, we also aimed to determine the risk factors that may affect surgery-related major complications and overall survival.

Material and methods Data of 543 male patients, 60 years or older, who underwent uro-oncological surgery (radical cystectomy, radical prostatectomy, radical or partial nephrectomy, transurethral resection of bladder tumor) between September 2009 and January 2019 were retrospectively evaluated. Demographic, clinical and pathological characteristics of the patients, preoperative comorbidity indices, postoperative complications, length of hospitalization, re-admission rates within 90 days and postoperative follow-up outcomes were recorded. Patients in similar tumor stages were divided into different subgroups. All subgroups were divided into two main categories: middle age (60–69 years-old) and elderly age (≥70-years-old).

Results No significant difference was found for all types of surgery in terms of postoperative outcomes in both age groups (p >0.05). Age-adjusted Charlson Comorbidity Index (ACCI), Preoperative Score to Predict Postoperative Mortality (POSPOM), Rockwood Frailty Index (RFI) and tumor characteristics were found to be more significant predictors for postoperative major complications and overall mortality than Eastern Cooperative Oncology Group (ECOG), American Society of Anesthesiologists (ASA) and New York Heart Association (NYHA) functional classification.

Conclusions Our findings show that patient age alone is not a risk factor for increased postoperative complications and overall mortality. Although many different comorbidity indices have been used in urological practice, ACCI, POSPOM and RFI are more valuable predictors. Uro-oncological surgeries may be performed safely in elderly males after a good clinical decision based on these indices.

Key Words: aging male ‹› uro-oncological surgeries ‹› comorbidity indices ‹› overall survival ‹› postoperative complications

INTRODUCTION

Perioperative and postoperative complications and undesirable adverse outcomes following oncological surgeries significantly affect the quality of life and survival of patients. This is even more substantial in elderly patients [1]. Life expectancy has increased in recent years due to advanced treatment modalities. Since the majority of uro-oncological cases are diagnosed in men over 60 years old, identifying patients suitable for surgery is very important. For this purpose, comorbidity assessment plays a decisive role in determining treatment selection and survival prediction [1–4].

There are several comorbidity indices and nomograms for predicting preoperative surgical risk, postoperative complications and overall survival. The main indices routinely used in urology practice are the American Society of Anesthesiologists (ASA) score, Charlson Comorbidity Index (CCI) and Eastern Cooperative Oncology Group performance status (ECOG-PS) [2]. Moreover, some studies have also reported that other indices such as the Modified Frailty Index, the New York Heart Association functional classification (NYHA) and the Canadian Cardiovascular Society (CCS)classification can be used for this purpose [3]. However, studies on the most suitable comorbidity indices for the determination of elderly candidates who should undergo uro-oncological surgery are still under investigation [1, 2, 3].

The management of localized renal and bladder cancers is somewhat clearer since there are no other equivalent treatment options other than surgery for these cancers [1]. Nevertheless, focal ablative therapies (e.g. radiofrequency ablation, cryoablation) or active surveillance for small renal cell carcinomas and bladder-sparing trimodal treatments for bladder tumors can be recommended as an alternative to radical surgeries in elderly patients, even if they do not have the same curative effects [5, 6]. On the other hand, the optimal management of prostate cancer is still controversial since there are other equivalent options besides surgery such as watchful waiting, active surveillance, radiotherapy or combined therapies depending on the patient and tumor characteristics [3]. Different studies show that a surgical decision cannot be easily made for elderly patients. Less-invasive focal therapies or watchful waiting tend to be offered as alternative options even if the level of evidence is lower [1, 3, 6, 7]. In this study, we aimed to evaluate the superiority of different comorbidity indices in determining the most suitable elderly male candidates for different uro-oncological operations. While making this assessment, we also aimed to determine the risk factors that may affect surgery-related major complications and overall survival.

MATERIAL AND METHODS

Patient selection

Data of 592 male patients, 60 years or older, who underwent uro-oncological surgery between September 2009 and January 2019 were retrospectively evaluated. Patients were selected from among those undergoing open radical cystectomy for bladder cancer, open retropubic radical prostatectomy (RRP) for prostate cancer, open radical or partial nephrectomy for renal cell carcinoma (RCC), and transurethral resection of bladder tumor (TUR-BT) for non-muscle-invasive bladder cancer (NMIBC).

Demographic characteristics, tumor histopathologies, clinical and pathological tumor stages, presence of additional diseases, preoperative ASA score, ECOG-PS, age-adjusted Charlson Comorbidity Index (ACCI), NYHA, Preoperative Score to Predict Postoperative Mortality (POSPOM), Rockwood Frailty Index (RFI), perioperative and postoperative complications within 90 days of surgery according to the modified Clavien Classification of Surgical Complications (CCSC), length of hospitalization, re-admission rates within 90 days after discharge and postoperative follow-up outcomes were recorded.

Patients with missing demographic and clinical data to calculate these indices were excluded from the study. Patients who received neoadjuvant therapy for the current disease were also excluded to more accurately observe the effect of surgery on postoperative outcomes. Tumor stage and grade classifications were performed according to current oncology guidelines of the European Association of Urology [5–8]. Finally, 543 patients with complete data were included in the study. All radical oncological operations were performed under general anaesthesia by the same experienced urology team. Among patients who underwent TUR-BT operation by the same urology team, only those under spinal anesthesia were included in the study to create homogeneous groups. Figure 1 shows the flow chart of the study design.

Instruments for comorbidity assessment

American Society of Anesthesiologists Score

This score was defined to assess patient preoperative physical health status in 1941 by the American Society of Anesthesiologists. The score ranges from 0 to 4 according to possible perioperative risks [9].

Eastern Cooperative Oncology Group Performance Status

This scale is used to assess general performance status of oncology patients. It is scored from 0 to 5. A total of '0' points indicate normal health status and '5' points indicate death [10].

Age-adjusted Charlson Comorbidity Index

This index is used for prediction of adverse events during surgery and occurring within the first postoperative 30 days [11]. Presence and severity of comorbidities related to 19 different diseases (e.g. cardiovascular, pulmonary, gastrointestinal, urological,

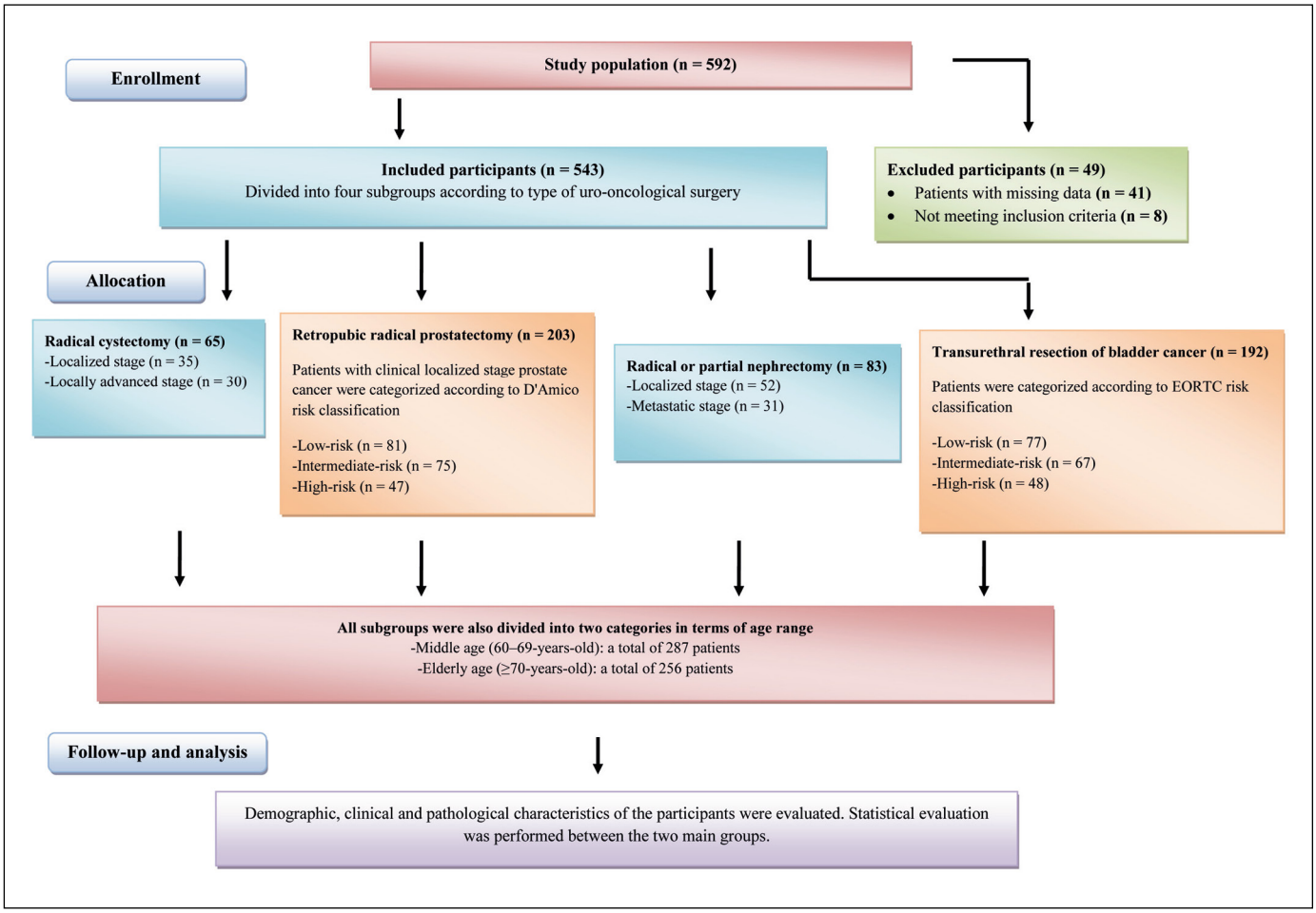

Figure 1. *Flowchart of the study population.*

neurological or hematological diseases) are evaluated. Each parameter is scored in a range of 1-6 and the total score is calculated. In patients over 50 years old, 1 point is added for each decade.

New York Heart Association functional classification

This classification divides patients into four categories based on limitation during physical activity, with degrees in shortness of breath and/or angina [12]. A score of '1' point indicates 'No limitation of physical activity' whereas '4' points indicate 'Unable to carry on any physical activity without discomfort'.

Preoperative Score to Predict Postoperative Mortality

This risk score is used to both evaluate general health status of the patient and to predict the probability of in-hospital mortality, so it helps physicians make preoperative clinical decisions about patients. This score evaluates seventeen risk factors (e.g. age, cardiovascular, cerebrovascular, pulmonary, nephrologic, urologic, endocrine and oncologic pathologies). A score over 28 indicates a worse prognosis [13].

Rockwood Frailty Index

This index is used to predict the length of hospitalization and the major complications for elderly patients in relation to frailty characteristics during the postoperative period [14]. A score of '1–4' points mean 'no frailty', 5–6 points mean 'mild to moderate frailty', and 7–9 points mean 'severe frailty'. The risks for fall, delirium, disability and associated complications are generally higher in the severe frailty group.

Modified Clavien Classification of Surgical Complications

This classification system was first developed in 1992 for determining the severity of complications

Table 1. *Demographic, clinical and pathological data and oncological outcomes of patients undergoing radical cystectomy*

Parameters	Localized stage			Locally advanced stage		
	Group I 60–69-years-old (n:20)	Group II ≥70-years-old (n:15)	p value	Group I 60-69-years-old (n:16)	Group II ≥70-years-old (n:14)	p value
Age (years)	65.55 ±2.25	74.33 ±2.69	† <0.001*	64.50 ±2.63	73.29 ±1.81	† <0.001*
Body mass index (kg/m^2)	24.88 ±4.41	24.42 ±2.74	† 0.708	25.79 ± 3.84	25.38 ±.49	† 0.761
Smoking (n, %)	9 (45.0)	7 (46.7)	‡ 0.922	12 (75.0)	10 (71.4)	¶ 0.574
Pathology of TUR-BT (n,%)						
Ta, low-grade	1 (5.0)	1 (6.7)				
Ta, high-grade	4 (20.0)	0 (0.0)	¶ 0.292			
T1, high-grade	2 (10.0)	3 (20.0)				
T2, high-grade	13 (65.0)	11 (73.3)		16 (100)	14 (100)	
Pathology of cystectomy (n,%)						
T0	3 (15.0)	4 (26.7)		–	–	
Ta	4 (20.0)	2 (13.3)		–	–	
T1	3 (15.0)	2 (13.3)	‡ 0.839	–	–	‡ 0.796
T2	10 (50.0)	7 (46.7)		–	–	
T3	–	–		11 (68.8)	9 (64.3)	
T4	–	–		5 (31.3	5 (35.7)	
Presence of atypical variant histology (n,%)	2 (10.0)	4 (26.7)	¶ 0.367	5 (31.3)	4 (28.6)	¶ 0.596
Presence of concomitant CIS (n,%)	4 (20.0)	3 (20.0)	¶ 0.668	8 (50.0)	5 (35.7)	‡ 0.431
Surgical margin positivity (n,%)	–	–		4 (25.0)	2 (14.3)	¶ 0.657
Pathological lymph node positivity (pLN+) (n,%)	–	–		4 (25.0)	5 (35.7)	¶ 0.694
Presence of preoperative hydronephrosis (n,%)	5 (25.0)	6 (40.0)	¶ 0.467	8 (50.0)	6 (42.9)	‡ 0.730
ACCI	3.25 ±1.41	3.47 ±1.40	† 0.656	4.00 ±2.55	5.43 ±2.27	† 0.117
ECOG-PS (n,%)						
0	3 (15.0)	2 (13.3)		3 (18.8)	2 (14.3)	
1	7 (35.0)	5 (33.3)	‡ 0.811	5 (31.3)	4 (28.6)	‡ 0.798
2	9 (45.0)	7 (46.7)		5 (31.3)	4 (28.6)	
3	1 (5.0)	1 (6.7)		3 (18.8)	4 (28.6)	
POSPOM score	22.55 ±6.84	23.80 ±6.20	† 0.577	23.00 ± 10.89	26.57 ±9.47	† 0.572
NYHA score (n,%)						
1	7 (35.0)	7 (46.7)		3 (18.8)	4 (28.6)	
2	10 (50.0)	5 (33.3)	‡ 0.808	9 (56.3)	7 (50.0)	‡ 0.817
3	2 (10.0)	2 (13.3)		4 (25.0)	3 (21.4)	
4	1 (5.0)	1 (6.7)		0 (0.0)	0 (0.0)	
ASA score (n,%)						
I	1 (5.0)	1 (6.7)	‡ 0.827	2 (12.5)	1 (7.1)	‡ 0.878
II	14 (70.0)	9 (60.0)		9 (56.3)	8 (57.1)	
III	5 (25.0)	5 (33.3)		5 (31.3)	5 (35.7)	
RFI	4.60 ±2.06	5.87 ±1.99	† 0.077	5.06 ±2.11	5.86 ±2.17	† 0.321
Modified Clavien Classification of Surgical Complications (n,%)						
No complications	7 (35.0)	5 (33.3)	‡ 0.625	2 (12.5)	2 (14.4)	‡ 0.831
Minor complications	10 (50.0)	6 (40.0)		6(37.5)	6 (42.8)	
Major complications	3 (15.0)	4 (26.7)		8 (50.0)	6 (42.8)	
Follow-up time (months)	57.45 ±22.49	42.20 ±22.10	† 0.054	38.06 ±21.20	33.50 ±22.43	† 0.573
Length of hospitalization (days) median (min-max)	8 (6–12)	8 (6–14)	§ 0.564	8 (6–15)	8 (6–12)	§ 0.984
Readmission rate (n,%)	6 (30.0)	5 (33.3)	¶ 0.560	5 (31.3)	6 (42.9)	‡ 0.510
First 90-day mortality rate (n,%)	1 (5.0)	1 (6.7)	¶ 0.681	1 (6.3)	1 (7.1)	¶ 0.724
Overall mortality rate (%)	5 (25.0)	6 (40.0)	¶ 0.467	7 (43.8)	7 (50.0)	‡ 0.732

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CIS – carcinoma in situ; ECOG-PS – Eastern Cooperative Oncology Group performance status; NYHA – New York Heart Association functional classification; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index; TUR-BT – transurethral resection of bladder tumor

* p <0.05 Asterisk (*) indicates statistically significant difference; † Independent sample T test – Data are expressed as 'mean ± standard deviation'; § Mann-Whitney U test – Data are expressed as 'median (25th percentile–75th percentile)'; ‡ Pearson Chi-square test; ¶ Fisher's exact test – Data are expressed as 'number (percent)'

in general surgery. Afterwards, it was validated and adjusted to other surgical procedures [15]. This classification ranks postoperative complications in an objective and reproducible manner and consists of five grades. In our study, Grade I–II complications were classified as 'minor', while Grade III–V complications were classified as 'major'.

Statistical analysis

Shapiro-Wilk test, histogram and Q-Q plots were performed to assess data normality. Variance homogeneity was assessed using Levene's test. Mann Whitney-U test was performed for non-normal distribution between two groups, whereas Independent sample t test was used for normal distribution. Chi-square analysis or Fisher's exact test were performed for categorical variables. Cox regression analysis was used to determine variables that affect postoperative major complications (CCSC >2) and overall survival. All analyses were made using IBM SPSS Statistics 22 (IBM, Armonk, NY USA) software package $p < 0.05$ was considered statistically significant.

RESULTS

We divided patients who were similar in terms of tumor type, tumor stage, clinical risk classification and treatment (surgery ± adjuvant treatment) into different subgroups. When patients in all subgroups were divided into two categories in terms of age range [middle age (60–69-years-old) and elderly age (≥70-years-old)], their demographic, clinical and pathological data and oncological outcomes were found to be similar. The clinicopathological features of the patients according to the types of urological cancer are shown in Tables 1–4.

ACCI, POSPOM and RFI were found to be the most important determinants for both postoperative major complications and overall survival in all radical surgery groups; while pathologic tumor stage and CCSC in addition to these three parameters were also found to be significant in overall survival prediction (Tables 5, 6, 7). In addition, the presence of preoperative hydronephrosis and pathological tumor stage in patients undergoing radical cystectomy, and pathological upstaging and pathological lymph node positivity in patients undergoing RRP were observed to be other important determinants for predicting postoperative major complications (Table 5, 6). According to our results, D'Amico risk classification and pathological upstaging were other important predictors for overall survival in patients undergoing RRP (Table 6).

We determined RFI as the most important predictive factor for both postoperative major complications and overall survival in patients undergoing TUR-BT. We also observed ACCI for postoperative major complications and CCSC for overall survival to be other predictors in these patients (Table 8).

In multivariable models, patient age was not found to be a risk factor for increased postoperative major complications or decreased overall survival in any uro-oncological surgery groups (Tables 5–8). However, high comorbidity is a more important factor increasing postoperative major complications and mortality rates for all surgeries. Our findings show that ACCI, POSPOM and RFI are more significant predictors of postoperative major complications and overall mortality among different comorbidity indices.

DISCUSSION

Investigations of new parameters are still ongoing to determine the age range and comorbidity burden that would indicate more ideal candidates for uro-oncological surgery. Studies to identify the most appropriate risk assessment tool and incorporating existing prognostic models in newly defined nomograms for the prediction of cancer-specific and overall survival are still the focus [16].

Soma et al. [1] found that higher Modified Frailty Index was significantly associated with poor ECOG-PS and poor overall survival in all types of urological cancers. In addition, urological cancer patients have been generally observed to have older age. This increases the likelihood of impaired physical function, low kidney function, hypoalbuminemia and anemia. All these conditions may also cause patients to experience a higher rate of depression [1]. It was observed that nonsurgical therapies (systemic chemotherapy and/or radiotherapy) were more preferred than radical surgeries in patients with higher frailty scores. As a result, they have considered that the Modified Frailty Index could be used to make decisions on undergoing uro-oncological surgery.

In a multicenter study, CCI ≥2 was found to be an independent predictor of 90-day post-operative complications [17]. Since ASA score has been stated to perform better than many other indices, it is recommended to use this in addition to other prediction models due to its simplicity and reproducibility [18]. However, disease specific factors (e.g. tumor stage, nodal status, hydronephrosis) are also determinants in addition to comorbidity related factors, and should be included in prognostic models [16]. In addition to these parameters, validated nutritional assessment tools and comprehensive geriatric assessment tools have also been recently investigated as predictors of postoperative outcomes in the elderly population since patients over 60 years old comprise the

Table 2. *Demographic, clinical and pathological data and oncological outcomes of patients undergoing radical prostatectomy for clinically localized stage prostate cancer*

Parameters	Low-risk patients according to D'Amico risk classification‡			Intermediate-risk patients according to D'Amico risk classification‡			High-risk patients according to D'Amico risk classification‡		
	Group I 60–69-years-old (n:38)	Group II ≥70-years-old (n:43)	p value	Group I 60-69-years-old (n:41)	Group II ≥70-years-old (n:34)	p value	Group I 60-69-years-old (n:28)	Group II ≥70-years-old (n:19)	p value
Age (years)	63 (62–66)	71 (7072)	§ <0.001*	65 (63–67)	72 (71–73)	§ <0.001*	64 (62–65)	73 (71–74)	§ <0.001*
Body mass index (kg/m^2)	24.15 (22.30–26.45)	25.60 (22.30–27.80)	§ 0.302	23.70 (22.30–29.20)	24.40 (22.30–27.65)	§ 0.658	24.40 (21.92)	22.5 (22.3–24.6)	§ 0.586
Smoking (n,%)	20 (52.6)	20 (46.5)	‡ 0.582	25 (61.0)	20 (58.8)	‡ 0.850	12 (42.9)	7 (36.8)	‡ 0.680
Upstaging after prostatectomy (n,%)	–	–		7 (17.1)	6 (17.6)	‡ 0.948	8 (28.6)	6 (31.6)	‡ 0.825
Upgrading after prostatectomy (n,%)	7 (18.4)	8 (18.6)	‡ 0.983	7 (17.1)	9 (26.5)	‡ 0.323	4 (14.3)	3 (15.8)	¶ 0.600
Downgrading after prostatectomy (n,%)	–	–		7 (17.1)	4 (11.8)	‡ 0.518	1 (3.6)	2 (10.5)	¶ 0.557
Surgical margin positivity (n,%)	1 (2.6)	1 (2.3)	¶ 0.721	3 (7.3)	3 (8.8)	¶ 0.569	4 (14.3)	4 (21.1)	¶ 0.411
Pathological lymph node positivity (pLN+) (n,%)	–	–		2 (4.9)	1 (2.9)	¶ 0.571	2 (7.1)	2 (10.5)	¶ 0.536
ACCI	3 (2–4)	2 (2–3)	§ 0.362	3 (2–4)	3 (2–5)	§ 0.076	3 (2–6)	4 (2–6)	§ 0.734
ECOG-PS (n,%)									
0	18 (47.4)	22 (51.2)		24 (58.5)	14 (41.2)		13 (46.4)	8 (42.1)	
1	14 (36.8)	18 (41.9)	‡ 0.450	15 (36.6)	15 (44.1)	‡ 0.193	11 (39.3)	8 (42.1)	‡ 0.958
2	6 (15.8)	3 (7.0)		2 (4.9)	5 (14.7)		4 (14.3)	3 (15.8)	
3	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
POSPOM score	21 (15–23)	21 (13–23)	§ 0.827	21 (15–23)	22 (18–24.25)	§ 0.128	22.5 (12–27.75)	22 (18–24)	§ 0.695
NYHA score (n,%)									
1	16 (42.1)	20 (46.5)		18 (43.9)	13 (38.3)		10 (35.7)	6 (31.6)	
2	19 (50.0)	22 (51.2)	‡ 0.506	19 (46.4)	18 (52.9)	‡ 0.944	12 (42.9)	11 (57.9)	‡ 0.644
3	3 (7.9)	1 (2.3)		3 (7.3)	2 (5.9)		5 (17.9)	2 (10.5)	
4	0 (0.0)	0 (0.0)		1 (2.4)	1 (2.9)		1 (3.6)	0 (0.0)	
ASA score (n,%)									
I	5 (13.1)	3 (7.0)	‡ 0.577	4 (9.7)	4 (9.7)	‡ 0.445	5 (17.9)	1 (5.3)	‡ 0.439
II	24 (63.2)	27 (62.8)		30 (73.2)	30 (73.2)		16 (57.1)	13 (68.4)	
III	9 (23.7)	13 (30.2)		7 (17.1)	7 (17.1)		7 (25.0)	5 (26.3)	
RFI	4 (3–6)	4 (3–5)	§ 0.795	4 (3–6)	5 (4–7)	§ 0.092	4 (3–6.75)	5 (3–7)	§ 0.792
Modified Clavien Classification of Surgical Complications (n,%)									
No complications	33 (86.8)	34 (79.1)	‡ 0.305	32 (78.1)	24 (70.6)	‡ 0.607	18 (64.3)	13 (68.4)	‡ 0.936
Minor complications	4 (10.5)	8 (18.6)		8 (19.5)	7 (20.5)		6 (21.4)	4 (21.1)	
Major complications	1 (2.7)	1 (2.3)		1 (2.1)	3 (8.9)		4 (14.3)	2 (10.5)	
Follow-up time (months) median (min-max)	45 (24–72)	48 (24–72)	§ 0.622	42 (12–72)	39 (12–72)	§ 0.561	39 (12–72)	45 (12–72)	§ 0.823
Length of hospitalization (days) median (min-max)	3 (3–6)	4 (3–7)	§ 0.098	4 (3–6)	4 (3–7)	§ 0.589	4 (3–7)	4 (3–7)	§ 0.697
Readmission rate (n,%)	3 (7.9)	1 (2.3)	¶ 0.337	2 (4.9)	6 (17.6)	¶ 0.130	9 (32.1)	3 (15.8)	¶ 0.310
First 90-day mortality rate (n,%)	–	–		–	–		–	–	
Overall mortality rate (%)	3 (7.9)	2 (4.7)	¶ 0.661	3 (7.3)	6 (17.6)	¶ 0.285	6 (21.4)	4 (21.1)	¶ 0.634

ACCI – age-adjusted Charlson Comorbidity index; ASA: American Society of Anesthesiologists; ECOG-PS – Eastern Cooperative Oncology Group performance status; NYHA – New York Heart Association functional classification; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index

* p <0.05 Asterisk (*) indicates statistically significant difference; ‡ D'Amico risk classification: This estimates risk of prostate cancer recurrence based on clinical factors (prostate-specific antigen level, Gleason Score, and tumor stage), and classifies patients into three risk groups such as low-risk, intermediate-risk and high-risk.

§ Mann-Whitney U test – Data are expressed as 'median (25th percentile – 75th percentile)'; ‡ Pearson Chi-square test; ¶ Fisher's exact test – Data are expressed as 'number (percent)'

Table 3. *Demographic, clinical and pathological data and oncological outcomes of patients undergoing nephrectomy*

Parameters	Localized stage			Metastatic stage		
	Group I 60–69-years-old (n:27)	Group II ≥70-years-old (n:25)	p value	Group I 60–69-years-old (n:19)	Group II ≥70-years-old (n:12)	p value
Age (years)	65 (62–66)	72 (71–73)	§ <0.001*	64 (62–67)	73 (71–75)	§ <0.001*
Body mass index (kg/m^2)	24.4 (21.3–26.6)	23.6 (22.3–25.6)	§ 0.847	24.4 (22.1–25.6)	22.3 (20.47–27.7)	§ 0.765
Smoking (n, %)	12 (44.4)	9 (36.0)	‡ 0.582	9 (47.4)	6 (50.0)	‡ 0.886
Surgery type (n, %)						
Radical	14 (51.9)	17 (68.0)	‡ 0.236	19 (100.0)	12 (100.0)	
Partial	13 (48.1)	8 (32.0)		–	–	
Pathological tumor stage (n,%)						
T1a	12 (44.4)	7 (28.0)		–	–	
T1b	5 (18.6)	12 (48.0)		–	–	
T2a	8 (29.6)	4 (16.0)	‡ 0.141	–	–	
T2b	2 (7.4)	2 (8.0)		–	–	
T3	–	–		–	–	
T4	–	–		19 (100.0)	12 (100.0)	
Tumor histopathology (n,%)						
Clear cell renal cell carcinoma	17 (63.0)	17 (68.0)		16 (84.1)	9 (75.1)	
Papillary type 1 renal cell carcinoma	4 (14.8)	5 (20.0)	‡ 0.607	1 (5.3)	1 (8.3)	‡ 0.614
Papillary type 1 renal cell carcinoma	4 (14.8)	1 (4.0)		1 (5.3)	2 (16.6)	
Chromophobe renal cell carcinoma	2 (7.4)	2 (8.0)		1 (5.3)	0 (0.0)	
ACCI	3 (2–4)	3 (2–4)	§ 0.592	3 (2–4)	3.5 (2.25–4.75)	§ 0.484
ECOG-PS (n,%)						
0	7 (25.9)	8 (32.0)		4 (21.1)	1 (8.3)	
1	17 (63.0)	15 (60.0)	‡ 0.854	10 (52.6)	9 (75.0)	‡ 0.440
2	3 (11.1)	2 (8.0)		5 (26.3)	2 (16.7)	
3	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
POSPOM score	22.30 ±7.74	22.60 ±7.60	† 0.887	24.42 ±6.43	26.17 ±7.20	† 0.501
NYHA score (n,%)						
1	6 (22.2)	9 (36.0)		3 (15.8)	1 (8.3)	
2	10 (37.0)	7 (28.0)	‡ 0.550	7 (36.8)	7 (58.3)	‡ 0.308
3	10 (37.0)	9 (36.0)		9 (47.4)	3 (25.0)	
4	1 (3.7)	0 (0.0)		0 (0.0)	1 (8.3)	
ASA score (n,%)						
I	4 (14.8)	4 (16.0)	‡ 0.497	3 (15.8)	1 (8.3)	‡ 0.564
II	15 (55.6)	10 (40.0)		10 (52.6)	5 (41.7)	
III	8 (29.6)	11 (44.0)		6 (31.6)	6 (50.0)	
RFI	4 (3–6)	4 (3–6)	§ 0.867	5 (3–6)	6.5 (3.5–7.0)	§ 0.435
Modified Clavien Classification of Surgical Complications (n,%)						
No complications	21 (77.8)	16 (64.0)	‡ 0.330	13 (68.5)	5 (41.7)	‡ 0.226
Minor complications	3 (11.1)	7 (28.0)		4 (21.0)	6 (50.0)	
Major complications	3 (11.1)	2 (8.0)		2 (10.5)	1 (8.3)	
Follow-up time (months)	56.70 ±26.17	47.70 ±15.58	† 0.129	35.00 ±29.41	35.92 ±23.48	† 0.924
Length of hospitalization (days) median (min-max)	3 (2–5)	3 (2–5)	§ 0.739	3 (2–5)	3 (2–7)	§ 0.889
Readmission rate (n,%)	3 (11.1)	3 (12.0)	¶ 0.628	4 (21.1)	2 (16.7)	¶ 0.574
First 90-day mortality rate (n,%)	–	–		–	–	
Overall mortality rate (%)	3 (11.1)	2 (8.0)	¶ 0.538	7 (36.8)	5 (41.7)	¶ 0.541

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; ECOG-PS – Eastern Cooperative Oncology Group performance status; NYHA – New York Heart Association functional classification; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index
* p <0.05 Asterisk (*) indicates statistically significant difference; † Independent sample T test – Data are expressed as 'mean ± standard deviation'; § Mann-Whitney U test Data are expressed as 'median (25th percentile – 75th percentile)'; ‡ Pearson Chi-square test; ¶ Fisher's exact test – Data are expressed as 'number (percent)'

Table 4. *Demographic, clinical and pathological data and oncological outcomes of patients undergoing transurethral resection of bladder tumor for non-muscle-invasive bladder cancer*

Parameters	Low-risk patients according to EORTC risk classification‡‡			Intermediate-risk patients according to EORTC risk classification‡‡			High-risk patients according to EORTC risk classification‡‡		
	Group I 60–69-years-old (n:45)	Group II ≥70-years-old (n:32)	p value	Group I 60–69-years-old (n:30)	Group II ≥70-years-old (n:37)	p value	Group I 60–69-years-old (n:23)	Group II ≥70-years-old (n:25)	p value
Age (years)	66 (62–67)	75 (71–80)	§ <0.001*	65 (63–67)	76 (72–81)	§ <0.001*	65 (63–67)	76 (73–80)	§ <0.001*
Body mass index (kg/m^2)	24.4 (23.6–26.8)	24.5 (23.6–27.5)	§ 0.497	24.1 (23.3–27.2)	24.4 (23.5–27.5)	§ 0.412	26.6 (23.6–28.4)	24.4 (22.5–27.5)	§ 0.569
Smoking (n,%)	21 (46.7)	15 (46.9)	‡ 0.986	16 (53.3)	21 (56.8)	‡ 0.779	10 (43.5)	13 (52.0)	‡ 0.555
Pathology of TUR-BT (n, %)									
Ta, low grade	45 (100.0)	32 (100.0)		30 (100.0)	37 (100.0)		3 (13.0)	4 (16.0)	
Ta, high grade	–	–		–	–		7 (30.4)	7 (28.0)	‡ 0.736
T1, low grade	–	–		–	–		3 (13.0)	2 (8.0)	
T1, high grade	–	–		–	–		10 (43.6)	12 (48.0)	
Presence of atypical variant histology (n, %)	–	–		–	–		1 (4.3)	3 (12.0)	¶ 0.337
Presence of concomitant CIS (n, %)	–	–		–	–		6 (26.1)	6 (24.0)	‡ 0.868
ACCI	3 (2–3)	3 (2–3)	§ 0.357	4 (3–4)	3 (3–4)	§ 0.403	3 (3–4)	4 (3–5)	§ 0.230
ECOG-PS (n,%)									
0	33 (73.3)	25 (78.1)		16 (53.3)	26 (70.3)		13 (56.5)	13 (52.0)	
1	7 (15.6)	5 (15.6)	‡ 0.817	12 (40.0)	10 (27.0)	‡ 0.335	9 (39.1)	9 (36.0)	‡ 0.632
2	4 (8.9)	2 (6.3)		2 (6.7)	1 (2.7)		1 (4.3)	3 (12.0)	
3	1 (2.2)	0 (0.0)		0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
POSPOM score	23 (20–24)	22 (19.25–24)	§ 0.343	22 (19–26)	22 (19–24.5)	§ 0.643	25 (21–28)	24 (20–28)	§ 0.634
NYHA score (n,%)									
1	15 (33.3)	7 (21.9)		3 (10.0)	8 (21.6)		8 (34.8)	7 (28.0)	
2	24 (53.3)	16 (50.0)	‡ 0.223	12 (40.0)	12 (32.4)	‡ 0.431	7 (30.4)	12 (48.0)	‡ 0.497
3	6 (13.3)	9 (28.1)		15 (50.0)	17 (45.9)		7 (30.4)	6 (24.0)	
4	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)		1 (4.3)	0 (0.0)	
ASA score (n,%)									
I	16 (35.6)	13 (40.6)	‡ 0.559	7 (23.3)	16 (43.2)	‡ 0.232	3 (13.0)	2 (8.0)	‡ 0.592
II	27 (60.0)	16 (50.0)		21 (70.0)	19 (51.4)		13 (56.5)	12 (48.0)	
III	2 (4.4)	3 (9.4)		2 (6.7)	2 (5.4)		7 (30.4)	11 (44.0)	
RFI	3 (2-4)	4 (3-4)	§ 0.665	4 (2.75-4)	4 (2.5-4)	§ 0.857	4 (3-6)	4 (2-5)	§ 0.347
Modified Clavien Classification of Surgical Complications (n,%)									
No complications	39 (86.7)	29 (90.6)	‡ 0.575	22 (73.3)	22 (59.5)	‡ 0.249	15 (65.2)	15 (60.0)	‡ 0.957
Minor complications	6 (13.3)	3 (9.4)		6 (20.0)	14 (37.8)		6 (26.1)	8 (32.0)	
Major complications	0 (0.0)	0 (0.0)		2 (6.7)	1 (2.7)		2 (8.6)	2 (8.0)	
Follow-up time (months) median (min-max)	42 (24–60)	36 (24–60)	§ 0.731	48 (24–72)	39 (24–72)	§ 0.187	48 (24–72)	48 (24–72)	§ 0.375
Length of hospitalization (days) median (min-max)	1 (1–1)	1 (1–1)	§ 0.468	2 (1–3)	1 (1–3)	§ 0.181	2 (2–3)	2 (2–3)	§ 0.312
Readmission rate (n,%)	0 (0.0)	1 (3.1)	¶ 0.416	2 (6.7)	2 (5.4)	¶ 0.610	2 (8.7)	1 (4.0)	¶ 0.468
First 90-day mortality rate (n,%)	–	–		–	–		–	–	
Overall mortality rate (%)	2 (4.4)	1 (3.1)	¶ 0.627	1 (3.3)	2 (5.4)	¶ 0.579	2 (8.7)	2 (8.0)	¶ 0.663

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CIS – Carcinoma in situ; ECOG-PS – Eastern Cooperative Oncology Group performance status; EORTC – European Organisation for Research and Treatment of Cancer; NYHA – New York Heart Association functional classification; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index; TUR-BT – transurethral resection of bladder tumor

* p <0.05 Asterisk (*) indicates statistically significant difference; ‡‡ EORTC risk classification: This estimates risk of recurrence and progression in non–muscle invasive bladder cancer based on clinical and histopathological parameters (tumor T stage, tumor grade, concomitance of CIS, the number of tumors, tumor size and prior recurrence rate), and classifies patients into three risk groups such as low-risk, intermediate-risk and high-risk; § Mann-Whitney U test – Data are expressed as 'median (25th percentile – 75th percentile)'; ‡ Pearson Chi-square test; ¶ Fisher's exact test – Data are expressed as 'number (percent)'

Table 5. *Predictive factors for postoperative major complications and overall survival after radical cystectomy*

Postoperative major complication (CCSC >2)	Univariate Model				Multivariate Model			
	OR	95% CI		p	OR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.010	0.909	1.121	0.859				
Body mass index	1.102	0.955	1.270	0.183				
Smoking	1.083	0.378	3.105	0.882				
Pathologic tumor stage	1.614	1.055	2.471	0.027	1.415	1.046	3.143	0.013
Presence of atypical variant histology	3.253	0.985	10.747	0.053				
Presence of concomitant CIS	1.641	0.545	4.943	0.379				
Surgical margin positivity (n, %)	2.278	0.419	12.388	0.341				
Presence of preoperative hydronephrosis	2.179	1.080	5.362	0.036	1.402	0.862	3.305	0.011
ACCI	2.324	1.072	5.039	0.033	1.846	0.956	3.425	0.024
ECOG-PS	1.159	0.928	4.131	0.020				
ASA	2.533	0.959	6.689	0.061				
NYHA	1.294	1.014	2.725	0.024				
POSPOM	1.831	1.027	2.477	0.025	1.490	1.078	1.313	0.001
RFI	1.446	1.090	1.917	0.010	1.397	0.842	1.695	0.034

Overall survival	Univariate Model				Multivariate Model			
	HR	95% CI		p	HR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.026	0.945	1.115	0.536				
Body mass index	1.013	0.913	1.123	0.814				
Smoking	1.119	0.502	2.494	0.784				
Pathologic tumor stage	1.397	0.887	1.615	0.042*	1.102	0.765	1.568	0.039*
Presence of atypical variant histology	1.640	0.680	3.958	0.271				
Presence of concomitant CIS	1.764	0.792	3.931	0.165				
Surgical margin positivity (n, %)	1.152	0.343	3.874	0.819				
Presence of preoperative hydronephrosis	1.844	0.835	4.069	0.130				
ACCI	2.268	1.402	2.657	<0.001*	1.868	1.491	2.342	<0.001*
ECOG-PS	1.954	1.239	3.081	0.004*				
ASA	2.783	1.353	5.728	0.005*				
NYHA	2.298	1.483	3.561	<0.001*				
POSPOM	1.408	1.065	1.853	<0.001*	1.304	1.002	1.657	0.003*
RFI	1.674	1.344	2.085	<0.001*	1.522	1.191	1.944	0.001*
CCSC	2.001	1.524	2.626	<0.001*	1.839	1.274	2.654	0.001*

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CCSC – the modified Clavien Classification of Surgical Complications; CI – Confidence interval; CIS – carcinoma in situ; ECOG-PS – Eastern Cooperative Oncology Group performance status; HR – hazard ratio, NYHA – New York Heart Association functional classification; OR – odds ratio; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index
*p <0.05 Asterisk (*) shows statistically significant difference

majority of candidates undergoing uro-oncological surgery [19]. Kenis et al. [20] considered that the G8 screening tool could be more helpful for providing a more accurate geriatric evaluation than ASA and CCI, and for selecting the best treatment strategy. Hennus et al. [21] observed that patients undergoing nephrectomy with high-stage tumors and major co-morbidities (CCI >2) had significantly more severe postoperative complications. On the other hand, age was not detected as a predictive factor increasing complication rates. In another similar study, Lv et al. [4] stated that short- and long-term outcomes were similar in the elderly (≥70-years-old) and middle aged (between 50–69-years-old) patients undergoing

Table 6. *Predictive factors for postoperative major complications and overall survival after radical prostatectomy*

Postoperative major complication (CCSC >2)	Univariate Model				Multivariate Model			
	OR	95% CI		p	OR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.002	0.897	1.119	0.965				
Body mass index	1.018	0.881	1.176	0.811				
Smoking	1.677	0.595	4.727	0.328				
D'Amico risk classification	2.629	1.233	5.605	0.012*				
Upstaging after prostatectomy	12.812	7.728	93.021	<0.001*	6.482	5.427	21.417	<0.001*
Upgrading after prostatectomy	8.936	2.994	26.665	<0.001*				
Surgical margin positivity (n, %)	3.452	0.982	12.141	0.053				
Pathological lymph node positivity	9.123	7.562	21.463	<0.001*	5.145	3.488	11.378	<0.001*
ACCI	2.011	1.464	2.764	<0.001*	2.045	0.898	4.658	0.030*
ECOG-PS	2.810	1.497	3.521	<0.001*				
ASA	2.061	0.840	5.059	0.114				
NYHA	2.723	1.124	4.502	<0.001*				
POSPOM	1.283	1.158	1.422	<0.001*	1.372	1.127	1.671	0.002*
RFI	1.695	1.287	2.233	<0.001*	1.245	0.897	1.982	0.023*

Overall survival	Univariate Model				Multivariate Model			
	HR	95% CI		p	HR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.018	0.936	1.108	0.665				
Body mass index	1.043	0.925	1.176	0.492				
Smoking	1.146	0.517	2.542	0.738				
D'Amico risk classification	2.074	1.269	3.389	0.004*	1.402	0.845	2.156	0.013*
Upstaging after prostatectomy	7.825	3.540	17.295	<0.001*	3.124	1.652	5.340	0.021*
Upgrading after prostatectomy	3.518	1.519	8.151	0.003*				
Surgical margin positivity (n, %)	3.740	1.353	10.339	0.011*				
Pathological lymph node positivity	4.363	2.690	10.051	<0.001*				
ACCI	1.765	1.440	2.162	<0.001*	1.617	1.170	1.967	0.002*
ECOG-PS	1.801	1.170	3.659	<0.001*				
ASA	2.114	1.056	4.234	0.035*				
NYHA	2.603	1.618	4.095	<0.001*				
POSPOM	1.142	1.094	1.192	<0.001*	1.026	1.003	1.326	0.002*
RFI	1.781	1.427	2.223	<0.001*	1.423	1.123	1.864	0.004*
CCSC	6.832	3.396	11.310	<0.001*	2.034	1.345	5.334	<0.001*

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CCSC – the modified Clavien Classification of Surgical Complications; CI – confidence interval; ECOG-PS – Eastern Cooperative Oncology Group performance status; HR – hazard ratio; NYHA – New York Heart Association functional classification; OR – odds ratio; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index
*p <0.05 Asterisk (*) shows statistically significant difference

laparoscopic radical nephrectomy due to localized RCC. Our findings support these results, except for the ASA score. ACCI, POSPOM and RFI provide highly valuable predictions in terms of postoperative major complications and overall survival. In addition, tumor related factors such as preoperative hydronephrosis, upstaging and pathological lymph node positivity also significantly affect prognosis for radical surgeries. We included patients in the same subgroups in terms of tumor characteristics and stages to better perform survival analysis in homogeneous groups by preventing confounding factors as much as possible. Although age is a parameter in all these indices, we observed that elderly age

Table 7. *Predictive factors for postoperative major complications and overall survival after radical nephrectomy*

Postoperative major complication (CCSC >2)	Univariate Model				Multivariate Model			
	OR	95% CI		p	OR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.004	0.857	1.176	0.957				
Body mass index	1.003	0.808	1.243	0.981				
Smoking	1.344	0.312	5.783	0.692				
Pathological tumor stage	1.055	0.761	1.464	0.744				
Tumor histopathology	1.019	0.580	1.792	0.947				
ACCI	3.588	1.315	9.789	0.013*	2.423	1.895	5.602	0.024*
ECOG-PS	2.864	0.817	10.040	0.100				
ASA	2.243	1.103	4.922	0.037*				
NYHA	2.936	0.980	8.797	0.064				
POSPOM	1.264	1.054	1.518	0.012*	1.035	0.985	1.365	0.032*
RFI	3.346	1.471	7.610	0.004*	2.235	1.754	4.028	0.017*

Overall survival	Univariate Model				Multivariate Model			
	HR	95% CI		p	HR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.090	0.973	1.221	0.138				
Body mass index	1.037	0.911	1.180	0.587				
Smoking	1.468	0.541	3.984	0.450				
Pathological tumor stage	2.108	1.387	3.204	<0.001*	1.806	1.189	2.741	0.006*
Tumor histopathology	1.064	0.660	1.715	0.798				
ACCI	3.728	1.999	6.954	<0.001*	2.684	1.425	4.302	0.007*
ECOG-PS	3.168	2.213	7.069	<0.001*				
ASA	3.615	1.442	9.066	0.006*				
NYHA	2.518	1.198	5.292	0.015*				
POSPOM	1.188	1.082	1.304	<0.001*	1.023	0.846	1.268	0.023*
RFI	2.838	1.808	4.456	<0.001*	2.437	1.501	3.958	<0.001*
CCSC	4.729	2.338	8.717	<0.001*	2.815	0.802	7.274	<0.001*

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CCSC – the modified Clavien Classification of Surgical Complications; CI – confidence interval; ECOG-PS – Eastern Cooperative Oncology Group performance status; HR – hazard ratio; NYHA – New York Heart Association functional classification; OR – odds ratio; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index
*p <0.05 Asterisk (*) shows statistically significant difference

alone does not affect postoperative morbidity and overall survival. Our study, which included more homogeneous subgroups, has reached a conclusion similar to Hennus [21] and Lv [4] that avoiding surgery is not a very correct approach in elderly patients only because of advanced age.

In the radical cystectomy series of Meng et al. [2], body mass index (BMI) and male gender were found to be the strongest predictors of serious complications, and elderly age significantly affected the development of minor adverse events and extended hospitalization. However, these demographic data and comorbidity indices (modified CCI, ASA score and the Modified Frailty Index) were concluded not to have enough accuracy as prediction tools for adverse events [2]. In our opinion, the heterogeneity of patients in terms of surgical technique, use of neoadjuvant chemotherapy, radiation exposure and surgical experience may have caused this interpretation.

Similar to the findings of Meng et al. [2], Lascano et al. [22] reported that the Modified Frailty Index had poor sensitivity and specificity for predicting 30-day mortality of patients undergoing cystectomy. But this index had better prediction for 30-day mortality of patients undergoing prostatectomy,

Table 8. *Predictive factors for postoperative major complications and overall survival after transurethral resection of bladder tumor*

Postoperative major complication (CCSC >2)	Univariate Model				Multivariate Model			
	OR	95% CI		p	OR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.019	0.921	1.127	0.712				
Body mass index	1.034	0.827	1.291	0.770				
Smoking	2.636	1.059	7.454	0.064				
Pathologic tumor stage	1.644	0.855	3.164	0.136				
Presence of atypical variant histology	3.500	0.700	8.342	0.096				
Presence of concomitant CIS	1.955	0.224	7.057	0.544				
EORTC risk classification	2.827	1.094	7.304	0.032*				
ACCI	2.599	1.647	4.102	<0.001*	2.091	1.252	3.724	0.003*
ECOG-PS	2.492	1.516	8.041	0.003*				
ASA	3.992	1.560	5.973	0.007*				
NYHA	1.316	0.538	3.219	0.048*				
POSPOM	2.154	1.039	2.781	0.007*				
RFI	3.535	2.034	6.143	<0.001*	3.535	2.034	6.143	<0.001*

Overall survival	Univariate Model				Multivariate Model			
	HR	95% CI		p	HR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	1.051	0.954	1.157	0.318				
Body mass index	1.015	0.815	1.264	0.895				
Smoking	2.496	0.639	9.741	0.188				
Pathologic tumor stage	1.055	0.520	2.145	0.880				
Presence of atypical variant histology	2.445	1.528	6.272	0.082				
Presence of concomitant CIS	3.593	1.761	6.967	0.106				
EORTC risk classification	1.201	0.541	2.667	0.652				
ACCI	3.094	2.011	4.761	<0.001*				
ECOG-PS	3.918	2.952	7.864	<0.001*				
ASA	3.425	1.549	8.641	0.005*				
NYHA	1.675	0.731	3.838	0.223				
POSPOM	1.179	1.100	1.263	<0.001*				
RFI	4.212	2.251	7.883	<0.001*	4.212	2.251	7.883	<0.001*
CCSC	5.234	4.580	9.846	<0.001*	4.026	3.782	6.025	0.002*

ACCI – age-adjusted Charlson Comorbidity index; ASA – American Society of Anesthesiologists; CCSC – the modified Clavien Classification of Surgical Complications; CI – confidence interval; CIS – carcinoma in situ; ECOG-PS – Eastern Cooperative Oncology Group performance status; EORTC – European Organisation for Research and Treatment of Cancer; HR – hazard ratio; NYHA – New York Heart Association functional classification; OR – odds ratio; POSPOM – Preoperative Score to Predict Postoperative Mortality; RFI – Rockwood Frailty Index
*p <0.05 Asterisk (*) shows statistically significant difference

nephroureterectomy and nephrectomy [22]. We think that the heterogeneous characteristics of their cystectomy patients may have caused this result. In addition, although there are many different modified fragility indices, the RFI, which we used in our study, has been reported to be more practical and more sensitive [14]. Therefore, the use of a different frailty index may also have affected the results of Meng [2] and Lascano [22]. On the other hand, Compoj et al. [23] reported similar findings to our study. They found no significant difference in postoperative complications, 30-day mortality and overall survival rates between two elderly patient groups (75–84 years vs. >85 years) undergoing radical cystectomy.

In a multicenter study, Hah et al. [24] stated that advanced age (≥70-years-old) and higher comorbidity resulted in significantly higher rates of cancer-specific mortality in patients with high-risk prostate cancer according to D'Amico risk classification. However, they were not found to be predictors for patients with low-risk or intermediate-risk prostate cancer [24]. Sivaraman et al. [25] observed similar findings in high-risk prostate cancer patients with a CCI ≥2, but it was an important point that other-cause mortality was higher than cancer specific mortality in this age group. Older (>70) age and higher CCI were also found to be associated with shorter survival by Froehner et al. [26], while Boehm et al. [27] did not report their effects on mortality. Conversely, some studies have stated that excellent performance status, biological age and prolonged life expectancy can be more decisive than chronological age when making the treatment decision. The absence of major comorbidity may support active treatment despite advanced age [3]. 10-year overall survival rates were reported to be 59-82% in patients over 70 years old undergoing RRP. This rate has also been reported to reach 79% in carefully selected men over the age of 80 [3]. The main limitation of many previous studies was that RRP was generally performed on patients with longer life expectancy [3]. The fact that radiotherapy has been more preferred in the high-risk prostate cancer group or in patients with higher comorbidity or older age may decrease the strength of these studies in observing the effects of RRP on postoperative morbidity and survival [3, 24]. In our study evaluating overall survival, we observed that comorbidity had a negative effect on all-cause death in all D'Amico risk groups, whereas age did not.

There is still not enough evidence-based practice and consensus for the management of bladder cancer in extremely old patients. Conservative strategies are generally more preferred in this group since clinical decisions are usually based on tumor stage, comorbidities and chronological age instead of biological age [28]. However, extremely advanced age (over 85 years old) was not a contraindication for standard management of high grade non-muscle invasive bladder cancer according to Carrion et al [28]. Moreover, overall survival rates decreased when palliative management was performed instead of standard treatment. A relatively low rate of complications related to TUR-BT and intravesical BCG application was observed in this group, whereas patients under palliative management were found to suffer more severely from tumor-related symptoms and their rate of hospital readmission was higher [28]. TUR-BT operations under spinal anesthesia are generally much better tolerated than radical surgeries, even in elderly patients [28]. It has also been stated that tumor stage and grade of NMIBC are the most important prognostic factors for progression, disease-specific survival and overall survival [8], the major cause of mortality is recurrence or progression-related deaths [29]. In our study, we divided patients into three risk groups according to the European Organisation for Research and Treatment of Cancer (EORTC) risk classification based on tumor prognostic characteristics. We found that age alone did not significantly increase the rate of postoperative major complications and overall mortality in all subgroups, but high comorbidity had a more important effect.

Since heterogeneous tumor characteristics and stages may cause a misleading interpretation of postoperative complications and survival outcomes, we compared patients in the same oncological stage or risk classification for each cancer to avoid unintended bias. We consider that this is the main strength of our study. Moreover, unlike other studies, we evaluated the effect of more parameters and different comorbidity indices on postoperative outcomes.

However, we had some limitations. The retrospective, non-randomised study design, relatively short-term follow-up and the small number of patients were our main limitations. Secondly, since there were not enough partial nephrectomy patients in localized RCC cases for statistical analysis, we included these patients in the same group with those undergoing radical nephrectomy for localized RCC. Although there are no significant differences between complication types and rates of open radical and partial nephrectomy techniques, it is another limitation that these patients were not included in separate groups. Thirdly, since laparoscopic surgeries began after 2016 in our center, we excluded these patients to avoid bias factors related to laparoscopic skills and learning cycle. As a result, we could not evaluate the postoperative outcomes of patients undergoing minimally invasive surgeries.

CONCLUSIONS

Our findings show that patient age alone is not a risk factor for increasing postoperative complications and overall mortality. The main factors are patient comorbidity and tumor characteristics. Although many different indices have been used in urological practice to determine comorbidity, according to our results, ACCI, POSPOM and RFI are more valuable predictors than ECOG-PS, ASA and NYHA. We consider that uro-oncological surgeries may be

performed safely in elderly males after good clinical decision making.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

FINANCIAL SUPPORT

The authors declare that they have no relevant financial interests.

ETHICAL APPROVAL

All procedures performed in our study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

INFORMED CONSENT

A formal written informed consent was obtained from all individual participants included in the study. The data of patients who did not consent was not used.

AUTHOR CONTRIBUTIONS

Selvi I: Conception and design, Acquisition of data, Analysis and Interpretation of data, Literature Search, Drafting of the manuscript, Critical revision of the manuscript for important intellectual content.
Arik AI: Acquisition of data, Critical revision of the manuscript for important intellectual content.
Baydilli N: Conception and design, Analysis and Interpretation of data, Literature Search, Critical revision of the manuscript for important intellectual content.
Basay MS: Acquisition of data, Critical revision of the manuscript for important intellectual content.
Basar H: Acquisition of data, Critical revision of the manuscript for important intellectual content.

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