Original Article

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Prognostic Impact of Pre-operative Computed Tomography Quantification of Body Composition in Bladder Cancer Patients Undergoing Radical Cystectomy

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Abstract

Objective: To investigate the association between preoperative computed tomography (CT)-based abdominal muscle-fat composition and length of hospital stay, post-operative complications and cancer-specific survival in patients with bladder cancer undergoing radical cystectomy.
Materials and Methods: Preoperative CT scans of 128 patients undergoing radical cystectomy for bladder cancer between 2013-2018 were reviewed. Densitometric quantification of total, visceral (VFA), subcutaneous (SFA) and inter-muscular fat-area (IMFA), mean muscle density (between -29HU and 150HU)
(MD150) and muscle area (between -29HU and 150HU) (MA150) measurements were performed retrospectively on an axial CT image at the level of L3 vertebra. The length of hospital stays and Clavien-Dindo score was noted. In the survival analysis, 12- and 30-months were taken as the threshold values. The primary outcome measure was cancer-specific survival.
Results: A total of 96 patients (92 men and 4 women, mean age 66 years, age range 49-86 years) were included. Patients with length of hospital stay more than 10 days had significantly higher VFA/SFA ratio (p=0.03) and higher IMFA (p=0.01). In the cohort, 74% of patients had low Clavien-Dindo scores (≤2) with significantly higher MA150 (p=0.02), MD150 (p<0.01) and lower IMFA (p=0.01) compared to group with high scores. In the survival analysis, MA150 and MD150 values were significantly higher (p=0.01 and p<0.01, respectively) in survivors more than 12 months. Only MD 150 value was significantly higher in survivors more than 30 months (p<0.01).
Conclusion: Preoperative CT-based body composition parameters, particularly MD150 and MA150, can be used as non-invasive prognostic markers in patients undergoing radical cystectomy. These muscle-related parameters are strongly correlated with fewer surgical complications and longer cancer-specific survival, suggesting a promising role in preoperative risk stratification and patient support.
Keywords: Bladder cancer, computed tomography, cystectomy, survival

Introduction

Bladder cancer is the ninth most frequently diagnosed cancer, with approximately 83,190 estimated new cases and 16,840 estimated deaths for 2024 (1). Southern Europe has higher incidence rate both for men and women than any other region worldwide, where Spain is the most prevalent region (2). In men, the burden and rates are considerably higher than in women, with ranking it as the sixth most prevalent cancer (2).

Radical cystectomy still stands as the reference standard treatment for high-risk bladder cancer cases. Yet the development of surgical technology and less invasive procedures such as robot-assisted techniques, potential postoperative morbidity may be inevitable, especially for elderly patients or in cases of advanced disease (3). Therefore, the identification of novel risk factors specific to individuals for complications may lead to better treatment decisions and perioperative care.

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In the last decade, studies focusing on the impact of body composition on the postoperative outcomes of oncology patients have increased significantly (4,5). Sarcopenia, sarcopenic obesity and visceral obesity, which are the different measures of body composition, have been defined as adverse prognostic factors in cancer patients (6). The excess accumulation of visceral fat in the abdominal cavity is known as visceral obesity. Sarcopenia is defined as progressive and generalised skeletal muscle disorder that occurs as a result of low muscle mass and impaired muscle strength and quality (7). The combination of sarcopenia and obesity is defined as sarcopenic obesity.

Several studies have investigated the role of body composition parameters on the outcomes of urinary bladder cancer patients with particularly the negative impact of excess visceral fat and loss of skeletal muscle mass (8-10). Those studies mostly used computed tomography (CT) due to high accuracy and reproducibility. It is possible to define lean body mass, subcutaneous (SFA) fat and visceral fat with CT, which are reported to be prognostic parameters over that of body mass index (BMI) (6). As the outcome, studies mainly focused on complications after the surgery or the overall survival (11). However, few data exist regarding the association of those parameters on a complete mortality and morbidity assessment including hospital stay, adverse perioperative events and oncologic outcomes.

Our aim in this study was to investigate the association between preoperative CT-based abdominal skeletal muscle-fat composition and length of hospital stay, post-operative complications and cancer-specific survival in patients with bladder cancer undergoing radical cystectomy.

Materials and Methods

Patient Population and Study Setting

This retrospective single-centre study was Institutional Review Board of University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital approved, with the need for informed consent for data analysis waived (decision number 2020/8-6, date: 08.07.2020). One hundred and twenty-eight patients undergoing radical cystectomy for bladder cancer in our institution between the years 2013 and 2018 were reviewed. The inclusion criteria were 1) adult patients with radical cystectomy for bladder cancer in our urology department 2) presence of preoperative abdominopelvic CT scan for staging purposes. The study flow with exclusion criteria is summarised in Figure 1.

CT Protocol

Routine thorax and abdominopelvic contrast-enhanced CT scans for staging were performed prior to surgery as a standard of care. For the analysis of muscle and fat distribution, only abdominopelvic CT scans were evaluated. CT examinations were performed by a 128-dedector (SOMATOM Definition AS, Siemens Healthineers) or 64-dedector (Aquilion, Toshiba Medical Systems) CT scanner. A total of 80-100 mL of contrast media with high iodine concentration (350-370 mg/mL) was injected with a flow rate of 3-4 mL/s, followed by a 40-60 mL saline influx. All the CT scans were held in the portal venous phase. The scanning parameters were as follows; 120 kV, 225 mA, section thickness 0.5 mm, and reconstruction interval 0.5 mm.

CT Image Analysis

For the analysis of muscle-fat distribution, abdominopelvic CT images were sent to a commercially available software (Aquarius Workstation, TeraRecon, San Mateo, California, USA). By using fat analysis module, densitometric quantification of total, visceral (VFA), SFA and inter-muscular fat-area (IMFA), mean muscle density and skeletal muscle area measurements were performed retrospectively on a single axial CT image at the level of third lumbar vertebra. Automatic measurement was done for fat area measurements using reference lower and upper thresholds of Hounsfield unit (HU) given in the literature (Supplementary Table 1) (6,12,13). The border of each segmentation was checked, and manual correction was done whenever necessary. For the measurement of skeletal muscle area (between -29HU and 150HU) (MA150), muscle density (between -29HU and 150HU) (MD150) and IMFA, manual segmentation was done to encircle paravertebral and abdominal wall muscles, where 150 HU was taken as the upper threshold for those muscle-related measurements. VFA/SFA and VFA/MA150 were calculated. An example of measurement of fat distribution is given in Supplementary Figure 1.

Assessment of Postoperative Period, Follow-up, and Survival

All patients underwent radical cystectomy and urinary diversion or neobladder procedures. After the surgery, the length of total hospital stay, and intensive care unit (ICU) stay (in days) were noted from hospital records.

Surgical complications were stratified using Clavien-Dindo classification which was originally described in 2004 (14). This classification system is a five-scale system to grade adverse events (i.e., complications) which occur after surgical procedures and widely used in many surgical specialities (Supplementary Table 2). In the study, the grading system was dichotomised as low (Clavien-Dindo 0,1,2) and high (Clavien-Dindo 3,4,5) grades for the analysis of complications where invasive procedures are needed for the high grades.

Patients were followed up after the surgery. In the 96-patient group, six patients died from causes other than bladder cancer. They were excluded from the survival analysis to investigate the relationship between CT-based body composition parameters and cancer-specific survival. Of the 90 patients with associated disease, 47 (52.2%) died. The 43 patients still alive had a minimum follow-up of 33 months (average 56 months, maximum 96 months). For short-term survival analysis, 12 months was chosen as the threshold. For long-term survival analysis, the minimum follow-up period among patients who are still alive (i.e., 33 months in our cohort) was considered to ensure that all living patients were included, and 30 months was taken as the threshold.

Statistical Analysis

All the data were statistically analysed using IBM SPSS version 25.0. Continuous variables are summarized as the mean ±

standard deviation, and categorical variables are summarized as the frequency and percentage. For discontinuous variables, Pearson chi-square test and Fisher's exact test was used. According to the distribution of the data, Mann-Whitney U test or Student's t-test was used where appropriate, for comparison of groups. Receiver operating characteristics (ROC) curve was used for diagnostic power evaluation. For the parameters that were statistically significant, Kaplan-Meier curves were created to determine the difference in cancer-specific survival between the groups. A value of $p<0.05$ was considered to indicate statistical significance.

Results

Clinicopathologic Characteristics

A total of 96 patients with a mean age of 66.6±8.6 years (range 49-86 years) were included in the final cohort. There were 92 (95.8%) men and 4 (4.2%) women. None of the patients included in the study received neoadjuvant chemotherapy before radical cystectomy. All the patients had the pathological confirmation of urothelial bladder cancer, without variant pathology, after radical cystectomy and most of the study group (87.5%) had high grade of cancer. Forty-seven percent of the patients had stage 3 disease with invasion beyond the muscularis propria to the perivesical soft tissue. Detailed demographics of patients, follow-up data, and histopathological results are given in Table 1.

After the surgery, mean hospital stay of the patients were 14.3±13.6 days (range 0-121). Forty (41.6%) patients were followed in ICU unit (mean 8.3±19.3 days). Among all group, 10 (10.4%) patients died in the first 30 days of postoperative period (8 patients in the ICU).

Relation of Body Composition Parameters and Hospital Stay

For the analysis of length of hospital stay, "10 days" was determined as cut-off value for binary assessment of the duration (i.e., less than 10 days and more than 10 days). In the whole cohort, 8 patients died in the first 10 days. Therefore, those patients were excluded from the hospital stay analysis to avoid false positivity and not to include them in the good prognostic group with short hospital stay.

In the study, patients with length of hospital stay less than 10 days had higher muscle-related parameters, however those were not statistically significant (MA150 and MD150, p=0.35 and p=0.27, respectively). All the other parameters were higher

Table 1. Demographic characteristics of patients, follow-up data, and histopathological results after radical cystectomy

	Number (n)	Percentage (%)
Sex		
Male	92	95.8
Female	4	4.2
Mean age (year) ± SD (range, years)	66.6±8.6 (49-86)	
Mean hospital stay (days) ± SD (range, days)	14.3±13.6 days (0-121)	
ICU stay (days) ± SD (range, days) (n=40, 41.6%)	8.3±19.3 days (0-121)	
Clavien-Dindo score		
Low (0,1,2)	71	74
High (3,4,5)	25	26
Mean follow-up (months) (range, months)	14 (0-90)	
Exitus in the first 30 days of the postoperative period	10	10.4
Total exitus	53	55.2
Histologic grade of urothelial bladder cancer High Low	 84 12	 87.5 12.5
Tumor stage Ta Tis T1 T2 T3a T3b	 5 2 18 27 28 17	 5 2 19 28 29 18
Lymphovascular invasion Absent Present	 54 42	 56 44

Ta: Non-invasive papillary urothelial carcinoma, Tis: Urothelial carcinoma *in situ*, SD : Standard deviation, ICU: Intensive care unit

in the group with more than 10 days of hospital stay, with a statistically significant VFA/SFA ratio (p=0.03) and IMFA (p=0.01) (Table 2).

Relation of Body Composition Parameters and Postoperative Complications

In the whole cohort, 71 (74%) patients had low Clavien-Dindo score, while 25 (26%) had high Clavien-Dindo score (Score 0,1,2,3,4,5 are 34,18,19,13,2,10 patients, respectively).

Patients with low Clavien-Dindo scores (≤2) had significantly higher MA150 (p=0.02), MD150 (p<0.01) and lower IMFA (p=0.01) (Table 3). Although this group had higher SFA and lower VFA, VFA/SFA, VFA/MA150 values when compared to group with high Clavien-Dindo score, they were not statistically significant. When ROC analysis was performed for muscle-related parameters, area under the curve values were 0.653 for MA150 and 0.680 for MD150 (Figure 2).

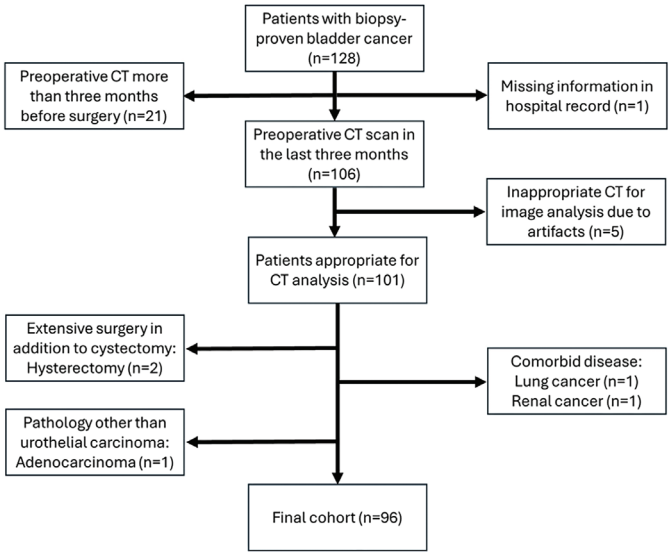

Figure 1. REMARK diagram illustrating the patient flow in the study
CT: Computed tomography

Relation of Body Composition Parameters and Cancer-specific Survival

In total, 53 (55.2%) patients died in the follow-up. After exclusion of 6 patients who were deceased due to causes other than bladder cancer (traffic accident, n=1; myocardial infarction, n=2; cardiac insufficiency, n=1; renal insufficiency, n=1; intracranial hemorrhage, n=1), remaining 90 patients were included in the survival analysis. Mean follow-up was 14 months for this group (range 0-90 months). Twenty-nine (32.2%) patients died in the first 12 months and 11 (12.2%) patients died between 12-30 months.

In the survival analysis with the 12-months cut-off, MA150 and MD150 values were significantly higher (p=0.01 and p<0.01, respectively) in the patients with survival more than 12 months (Table 4). Although VFA, IMFA, VFA/SFA and VFA/MA150 were higher in the patients with survival less than 12 months, they were not statistically significant.

In the survival analysis with 30-months cut-off, only MD150 value was significantly higher (p<0.01) in the patients with survival more than 30 months (Table 5). Box-plots according to survival period and accompanying ROC curves are given in Figure 3.

For Kaplan-Meier survival analysis; median values of MA150 and MD150 were taken as thresholds (135 cm^2 and 28.6 HU, respectively). Both parameters have difference in cancer-specific survival curves with longer survival in patients with higher muscle area and muscle density. The difference was more evident for the parameter MD150 (Figure 4).

Table 2. Comparison of CT-based body composition parameters according to the length of hospital stay

	Length of hospital stay (days)	Number of patients*	Mean value	SD	p-value
VFA (cm^2)	<10	37	171.6	124.3	0.37
	>10	51	193.1	97.6	
SFA (cm^2)	<10	37	132	62.8	0.68
	>10	51	138.5	77.54	
IMFA (cm^2)	<10	37	9.04	5.53	0.01
	>10	51	11.27	10.58	
MA150 (cm^2)	<10	37	141.5	32.36	0.35
	>10	51	135.3	29.92	
MD150 (HU)	<10	37	30.34	7.56	0.27
	>10	51	28.5	7.71	
VFA/SFA	<10	37	1.26	0.62	0.03
	>10	51	1.49	1.53	
VFA/MA150	<10	37	1.18	0.74	0.09
	>10	51	1.43	0.72	

*: Eight patients who died in the first 10 days after the surgery were excluded and the analysis was done on 88 patients, IMFA: Inter-muscular fat-area, MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), SFA: Subcutaneous fat area, TFA: Total fat area, VFA: Visceral fat area, SD: Standard deviation, CT: Computed tomography

Table 3. Comparison of CT-based body composition parameters according to Clavien-Dindo score					
	Clavien-Dindo score*	Number of patients	Mean value	SD	p-value
VFA (cm^2)	Low	71	183.8	112.4	0.90
	High	25	186.9	97.6	
SFA (cm^2)	Low	71	137.5	69.3	0.54
	High	25	127.6	72.2	
IMFA (cm^2)	Low	71	10.2	9.64	0.01
	High	25	13.6	8.83	
MA150 (cm^2)	Low	71	140.5	31.3	0.02
	High	25	124.6	26.84	
MD150 (HU)	Low	71	29.8	7.62	<0.01
	High	25	24.9	7.95	
VFA/SFA	Low	71	1.37	0.60	0.25
	High	25	1.46	1.20	
VFA/MA150	Low	71	1.29	0.73	0.31
	High	25	1.58	0.94	

*: Low refers to Clavien-Dindo score 0,1,2 and high refers to Clavien-Dindo score 3,4,5, IMFA: Inter-muscular fat-area, MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), SFA: Subcutaneous fat area, TFA: Total fat area, VFA: Visceral fat area, SD: Standard deviation, CT: Computed tomography

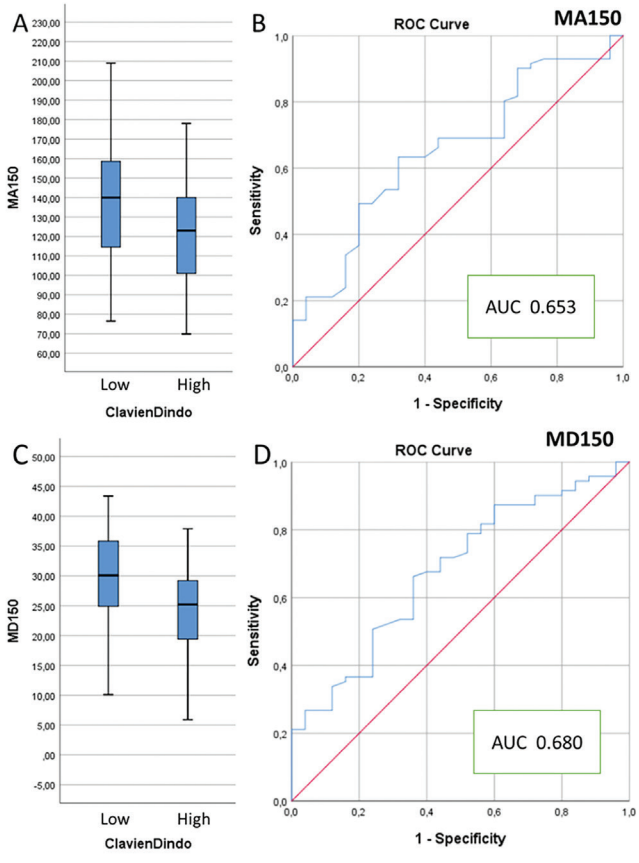

Figure 2. Box-plots of "low" and "high" Clavien-Dindo scores for MA150 (A) and MD150 (C) and accompanying ROC analysis curves (B, D, respectively) for discrimination of two groups. AUC is 0.653 for MA150 and 0.680 for MD150

MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), AUC: Area under the curve, ROC: Receiver operating characteristics

Discussion

In this study, we aimed to evaluate prognostic impact of preoperative CT-based body composition parameters (i.e., visceral/subcutaneous fat area, skeletal muscle area and density) in patients with bladder cancer and assess the relationship between those parameters and postoperative comorbidities and survival. We found that abdominal muscle area, muscle density and IMFA is significantly related to Clavien-Dindo scoring system. Only muscle density was significantly related to the long-term survival (i.e., 30 months) of the patients after the surgery. However, no significant association of VFA or SFA was found with complications or survival. Only VFA/SFA ratio and IMFA were associated with long-term (i.e., >10 days) hospital stay.

BMI and sarcopenia affect a wide range of cancer and non-cancerous patients (4,6). There are many studies that show both measures have prognostic value in different patient groups (12,15,16). Although BMI and muscle area/density measurements are used in determination of sarcopenia, there are no well-established threshold values for skeletal muscle area or muscle density in the European Working Group on Sarcopenia in Older People guidelines (7,17). The measurement techniques in different modalities and the level of measurements also vary between studies (18). In several studies, at the level of L3 vertebrae, measured psoas muscle area or total skeletal muscle area is divided into BMI to calculate normalized muscle area. For instance, Smith et al. (8) measured total psoas area using threshold of -30HU and +110 HU, divided the area to BMI and calculated cut-off values of 653 cm^2/m^2 and 523 cm^2/m^2, in men and women, respectively. Psutka et al. (15) measured total muscle area at the level of L3 using threshold of -29 HU and +150 HU, divide into BMI, found skeletal muscle index (SMI) and determined cut-off values of 55 cm^2/m^2 in men and 39 cm^2/m^2 in women for SMI.

Table 4. Comparison of CT-based body composition parameters in groups according to 12 months threshold value in survival					
	Survival (mo)	**Number of patients***	**Mean value**	**SD**	**p-value**
VFA (cm^2)	>12	61	178.2	110.9	0.65
	<12	29	189.5	110.4	
SFA (cm^2)	>12	61	138.7	77.2	0.35
	<12	29	123.8	55.3	
IMFA (cm^2)	>12	61	10.5	10.2	0.08
	<12	29	12.3	8.3	
MA150 (cm^2)	>12	61	141.5	31.4	0.01
	<12	29	124	26.6	
MD150 (HU)	>12	61	30.3	7.87	<0.01
	<12	29	24.1	7.04	
VFA/SFA	>12	61	1.33	0.58	0.50
	<12	29	1.43	0.60	
VFA/MA150	>12	61	1.25	0.71	0.46
	<12	29	1.44	0.84	

*: Six patients, who died due to causes other than bladder cancer, were excluded and the analysis regarding cancer-specific survival was done on 90 patients, IMFA: Intermuscular fat-area, MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), SFA: Subcutaneous fat area, TFA: Total fat area, VFA: Visceral fat area, SD: Standard deviation, CT: Computed tomography

Table 5. Comparison of CT-based body composition parameters in groups according to 30 months threshold value in survival					
	Survival (mo)	**Number of patients***	**Mean value**	**SD**	**p-value**
VFA (cm^2)	>30	50	166.2	90.4	0.13
	<30	40	201.4	129.5	
SFA (cm^2)	>30	50	138.6	81.5	0.48
	<30	40	128.1	55.5	
IMFA (cm^2)	>30	50	10.4	10.8	0.80
	<30	40	12	8	
MA150 (cm^2)	>30	50	139	30.6	0.28
	<30	40	131.9	33.2	
MD150 (HU)	>30	50	30.7	7.43	<0.01
	<30	40	25.3	8.04	
VFA/SFA	>30	50	1.28	0.53	0.21
	<30	40	1.47	0.64	
VFA/MA150	>30	50	1.19	0.60	0.34
	<30	40	1.46	0.89	

*: Six patients, who died due to causes other than bladder cancer, were excluded and the analysis regarding cancer-specific survival was done on 90 patients IMFA: Intermuscular fat-area, MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), SFA: Subcutaneous fat area, TFA: Total fat area, VFA: Visceral fat area, SD: Standard deviation, CT: Computed tomography

Skeletal muscle density (SMD), which was abbreviated as MD150 in this study, is a new measurement parameter which is frequently encountered in recent studies (4,11,19). It is reported to represent the myosteatosis, in which lower density of skeletal muscle shows a higher adipose tissue content of muscle (11). However, proposed thresholds to define low SMD still vary between studies. As an example, in the study of Zhuang et al. (20), sex-specific cut-off values for low SMD were <38.5 HU for males and <28.6 HU for women. Nonetheless, those thresholds were set as <35.5 HU for males and <32.5 HU for women in the study of Xiao et al. (21). In our study, instead of using muscle density as a representative of myosteatosis, we directly measured IMFA, using a densitometric limit of -190 to -30 HU, to show only adipose tissue within muscle compartments, which was also used in a previous study (22). IMFA was found to be significantly correlated with low Clavien-Dindo scores (i.e., ≤2) and longer hospital stay (i.e., >10 days) in our study. On the other hand, although MD150 was also associated with Clavien-Dindo score, we could not find significant relation of muscle density with the hospital stay. Therefore, we believe that IMFA may better demonstrate myosteatosis than muscle density measurements. To the best of our knowledge, IMFA has not been studied as a prognostic factor in bladder cancer patients undergoing radical cystectomy, therefore we cannot make a comparison with the literature.

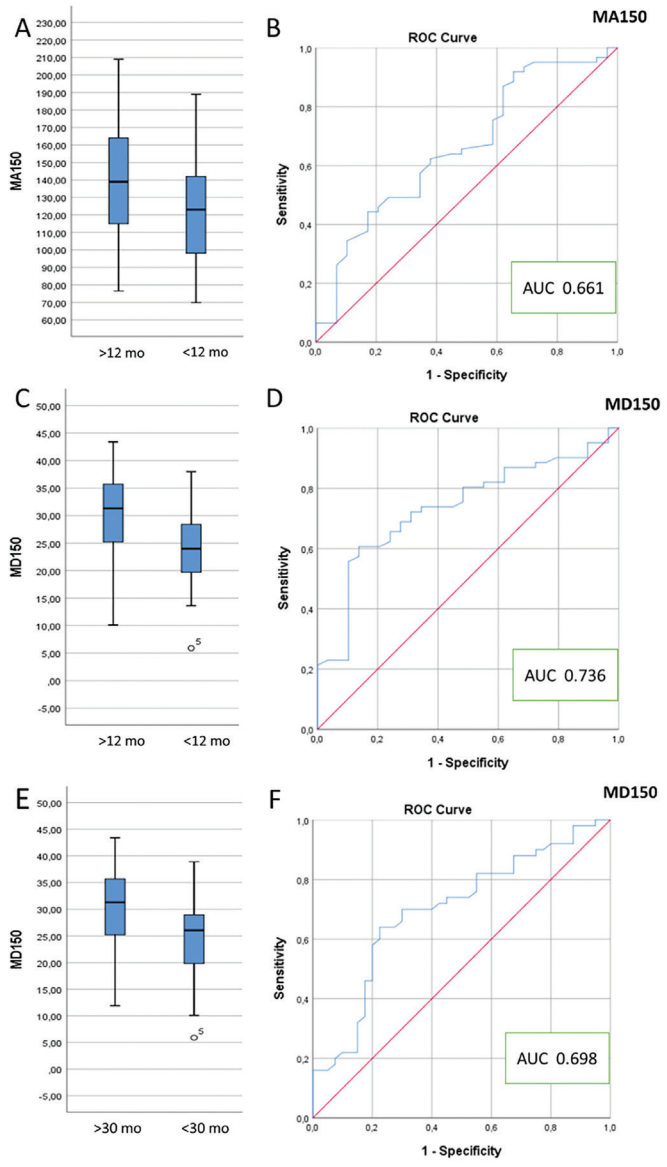

Figure 3. Box-plots of survival according to given thresholds for MA150 (12-months, (A) and MD150 (12-months, (C); 30-months, (E) and accompanying ROC analysis curves (B, D, F, respectively) for discrimination of two groups. Area under the curve is 0.661 for MA150 (12-months) and 0.736 and 0.698 for MD150 (12-months and 30-months, respectively)

MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU), AUC: Area under the curve, ROC: Receiver operating characteristics

Bladder cancer patients represent a population with high-risk of comorbidities, considering not only their advanced age, but also major underlying health conditions, poor performance status and tobacco use. At present, there are several existing studies on sarcopenia and body composition on bladder cancer. According to those studies, sarcopenia was found to be a strong indicator of reduced overall and cancer-specific survival (23,24). Moreover, psoas muscle area was shown to be associated with major complications and psoas muscle index was shown to be an independent risk factor for survival after cystectomy (8,11). Similarly, our findings suggested that skeletal MA150 was significantly associated with major postoperative complications and 12-months survival after radical cystectomy. However, although trends regarding high SFA in the group with good prognosis and low VFA or VFA/SFA in the group with bad prognosis was found, there was no confirmed statistical significance in our study. Those results were also consistent with the study of Engelmann et al. (11). Moreover, myosteatosis, measured as psoas muscle or abdominal SMD was shown to predict poor cancer-specific survival in bladder cancer patients (25,26). Comparably, muscle density (i.e., MD150) was associated with both 12- and 30-months survival as well as postoperative complications after cystectomy, according to our results. Nevertheless, the prognostic roles of muscle density and IMFA, regarding myosteatosis and declined muscle quality, are warranted to be studied and validated in larger future studies to integrate them into the routine clinical practice as novel parameters in those bladder cancer patients.

Overall, preoperative assessment of sarcopenia in bladder cancer patients is essential to have an insight into the possible disease course and guide perioperative management. Early nutritional support with regulation of protein intake and prehabilitation programs, including resistance exercise, may have a significant role in improving muscle quality, hence reducing postoperative complications in sarcopenic patients. According to the European Society for Clinical Nutrition and Metabolism guidelines, in surgical patients with cancer, body composition should be assessed preoperatively, and when CT software is available, it should be used as a gold standard (27). Therefore, incorporation of CT-based body composition parameters into the routine preoperative assessment and radiology reports is of paramount importance to help stratify patients at risk and allow timely referral to nutritionists and physiotherapists in this vulnerable patient group.

Study Limitations

Our study has several limitations. First, it was a single-center retrospective study. Second, we were not able to investigate sex-specific differences due to very few numbers of female patients in our study cohort. Third, patients with muscle-invasive and muscle non-invasive bladder cancer were not further analysed. Fourth, follow-up information to assess progression-free survival was not accessible in all patients due to retrospective nature of the study and missing hospital records. Fifth, the patients' comorbidity status and scores were not available in our dataset due to insufficient data in the digital hospital records, which limited our ability to assess the impact of our results on overall survival fully. Lastly, BMI, SMI, and sarcopenia were not directly evaluated in our study due to missing patient information, particularly the weight or the height.

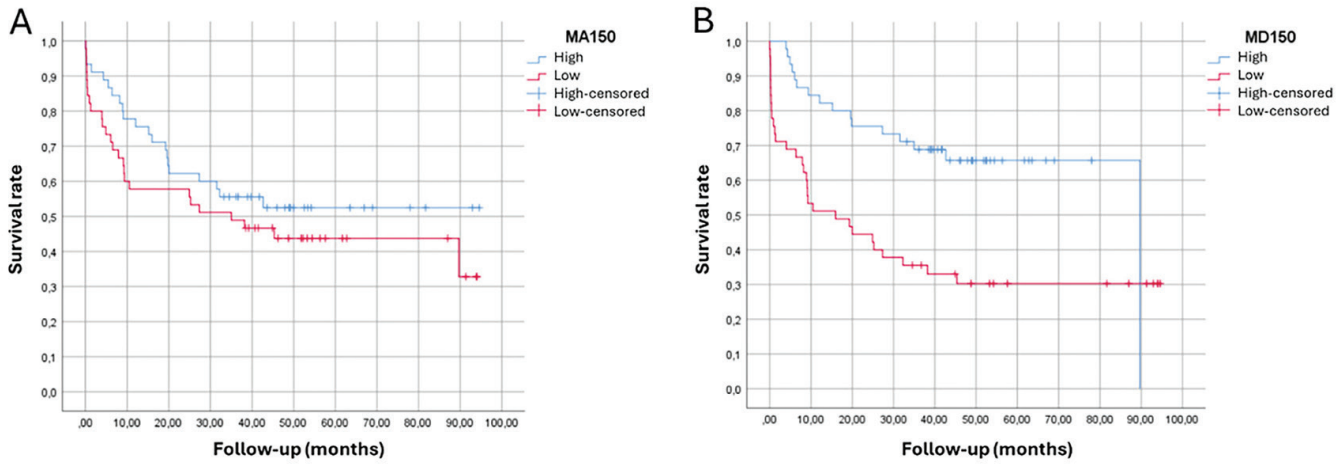

Figure 4. Kaplan Meier curves of MA150 (A) and MD150 (B) on long-term cancer-specific survival in patients with high and low values. High MA150 or MD150 were defined by the higher half

MA150: Muscle area (between -29HU and 150HU), MD150: Muscle density (between -29HU and 150HU)

Conclusion

Non-invasive and semiautomatic quantification of CT-based body composition parameters in the pre-operative CT scans may predict prognosis and improve risk stratification in bladder cancer patients undergoing radical cystectomy. This is particularly important not only in treatment planning and in decision-making regarding fitness and nutritional support for surgery, but also in counseling patients regarding expected outcomes after cystectomy.

Ethics

Ethics Committee Approval: This retrospective single-centre study was Institutional Review Board of University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital approved (decision number 2020/8-6, date: 08.07.2020).

Informed Consent: Retrospective study.

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Contribution: There is not any contributors who may not be listed as authors.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.K., Concept: B.Ç.T., H.Ş., Design: B.Ç.T., E.K., H.Ş., Data Collection or Processing: B.Ç.T., E.K., Analysis or Interpretation: B.Ç.T., H.Ş., Literature Search: B.Ç.T., Writing: B.Ç.T., H.Ş.

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