

Size, Focality, Invasion in Upper Tract Urothelial Cell Carcinoma (SFI-UTUC): A Novel Imaging-Based Morphometric Scoring System to Predict Survival Outcomes in UTUC

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BACKGROUND

- Upper tract urothelial cell carcinoma (UTUC) is an uncommon malignancy that is difficult to predict on routine preoperative imaging.
- We sought to develop a novel morphometric scoring system for prediction of oncologic and survival outcomes before nephroureterectomy (NU).

METHODS

- Multicenter retrospective analysis of UTUC patients undergoing NU for non-metastatic disease
- Preoperative CT-urography was used to evaluate a novel image-based morphometric score for outcomes, based on 3 factors (Tumor Size, Focality, Invasion of architecture) with a score of 1-3 based on degree of each factor (total score 3-9), figure.
- Primary outcome: overall survival (OS)
- Secondary outcome: recurrence free survival (RFS)
- Logistic regression (LR) and Kaplan–Meier (KMA) analyses were utilized.

RESULTS

- 244 patients: mean age 70.9, mean follow up 29.5 months.
- On MVA for recurrence, significance was noted for high nuclear grade (OR 3.7, p=0.043) and pT2+ (OR 3.6, p=0.001) .
- On MVA for all-cause mortality, age (OR 1.1, p=0.001), recurrence (OR 4.4, p<0.001) and SFI-UTUC Score 7-9 (OR 2.0, p=0.022) were significant .
- KMA for OS demonstrated 5 year OS of 57.0% for SFI-UTUC 3-6 and 34.1% for SFI-UTUC 7-9 (p=0.001).
- KMA for RFS demonstrated 5 year RFS of 69.8% for SFI-UTUC 3-6 and 59.9% for SFI-UTUC 7-9 (p=0.059).

CONCLUSIONS

- A novel morphometric scoring system for UTUC preoperative imaging may predict OS for tumors in renal and ureteral locations, as well as RFS. Prospective validation and refinement is requisite.

Table 1. Demographics

Variable	Entire cohort (n=244)	Score 3-6 (n=149)	Score 7-9 (n=95)	p-value
Mean Age (SD)	70.9 ± 10.6	70.4 ± 10.2	71.6 ± 11.3	0.383
Gender				0.564
Male	159 (65.2%)	95 (63.8%)	64 (67.4%)	
Female	85 (34.8%)	54 (36.2%)	31 (32.6%)	
Mean BMI (SD)	28.6 ± 5.6	28.8 ± 5.7	28.4 ± 5.3	0.631
HTN	151 (61.9%)	90 (60.4%)	61 (64.2%)	0.356
DM	54 (22.1%)	31 (20.8%)	23 (24.2%)	0.364
CAD	52 (21.3%)	32 (21.5%)	20 (21.1%)	0.455
Smoking history	148 (60.7%)	91 (61.1%)	57 (60.0%)	0.703
Clinic Tumor Size	3.2 ± 2.4	2.7 ± 2.2	4.0 ± 2.4	0.001
Tumor Location				0.053
Kidney	181 (74.2%)	104 (69.8%)	77 (81.1%)	
Ureter	63 (25.8%)	45 (30.2%)	18 (18.9%)	
SFI Score	6 (5 – 8)	5 (5 – 6)	8 (7 – 9)	<0.001
3	5 (2.0%)	5 (3.4%)	0 (0%)	
4	32 (13.1%)	32 (21.5%)	0 (0%)	
5	58 (23.8%)	58 (38.9%)	0 (0%)	
6	54 (22.1%)	54 (36.2%)	0 (0%)	
7	26 (10.7%)	0 (0%)	26 (27.4%)	
8	26 (10.7%)	0 (0%)	26 (27.4%)	
9	43 (17.6%)	0 (0%)	43 (45.3%)	
cN+	39 (16.0%)	12 (8.0%)	19 (20.0%)	0.041

SFI Scoring System

Renal Location		
Domain	Score	Criteria
Size of Tumor	1	<1 cm
	2	between 1-3 cm
	3	>3 cm
Focality	1	contained within pelvis or 1 calyx
	2	involving pelvis and 1 calyx
	3	extending into >2 sites (pelvis, ≥2 calyx)
Invasion of Renal Architecture	1	purely in collecting system, no hydro
	2	hydronephrosis
	3	infiltrates parenchyma

Ureteral Location		
Domain	Score	Criteria
Size of Tumor	1	<1 cm
	2	between 1-3 cm
	3	>3 cm
Focality	1	unifocal
	2	multifocal in 1/3 of ureter
	3	multifocal in more than 1/3 of ureter
Invasion of Renal Architecture	1	purely in ureter, no hydronephrosis
	2	hydronephrosis
	3	infiltrates periureteral tissue

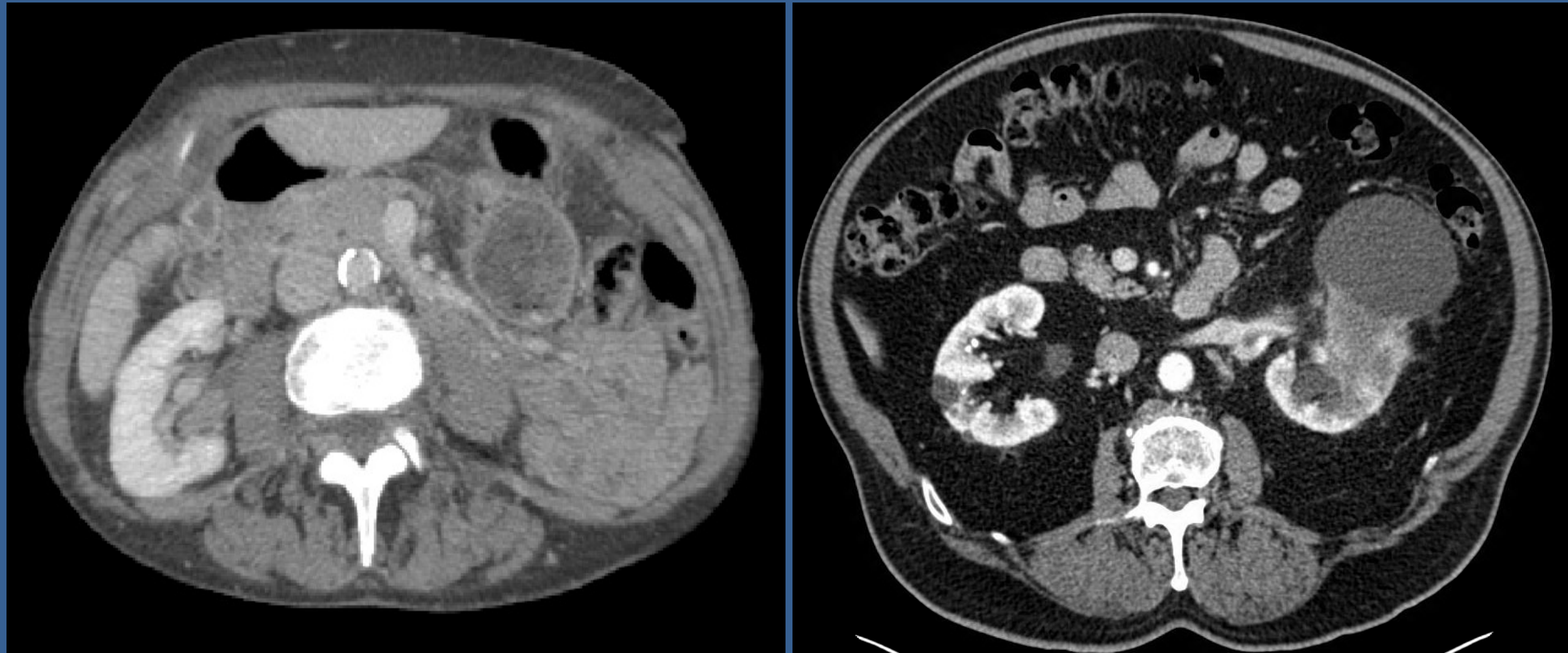
Table 2. Operative Outcomes and Survival

Variable	Entire cohort (n=244)	Score 3-6 (n=149)	Score 7-9 (n=95)	p-value
Surgical Approach				0.593
Open	60	33 (22.1%)	27 (24.6%)	
Robotic	64	43 (28.9%)	21 (22.1%)	
Lap/Open	120	73 (49.0%)	47 (49.5%)	
EBL (mL)	223 ± 316	214 ± 282	237 ± 376	0.598
LND	109 (44.7%)	56 (37.6%)	53 (55.8%)	0.006
Days in Hospital	5 (3 – 7)	5 (3 – 7)	5 (3 – 6)	0.660
Transfusion	34 (13.9%)	18 (12.1%)	16 (16.8%)	0.401
30 Day Complicat	49 (20.1%)	34 (22.8%)	15 (15.8%)	0.182
pTumor Size	4.0 ± 2.7	3.5 ± 2.4	4.7 ± 3.0	0.001
pT stage				0.001
T0	44	33 (22.1%)	11 (11.6%)	
Tis/Ta	37	26 (17.4%)	11 (11.6%)	
T1	43	26 (17.4%)	17 (17.9%)	
T2	23	18 (12.1%)	5 (5.3%)	
T3	79	42 (28.2%)	37 (38.9%)	
T4	18	4 (2.7%)	14 (14.7%)	
pN stage				0.002
pN0/x	200 (82.0%)	137 (91.9%)	72 (75.8%)	
pN+	44 (18.0%)	12 (8.1%)	23 (24.2%)	
Fuhrman Grade				0.413
Low (1&2)	51 (20.9%)	36 (24.2%)	15 (15.8%)	
High (3&4)	193 (79.1%)	113 (75.8%)	80 (84.2%)	
LVI	61 (25.0%)	29 (19.5%)	32 (33.7%)	0.064
Positive Margin	28 (11.5%)	14 (9.4%)	14 (14.7%)	0.203
Recurrence	59 (24.2%)	31 (20.8%)	28 (29.5%)	0.128
Bladder	42 (17.2%)	28 (18.8%)	14 (14.7%)	0.488
All Cause Mortality	88 (36.1%)	43 (28.9%)	45 (47.4%)	0.004
Follow Up (months)	29.5 ± 28.4	32.1 ± 29.7	25.4 ± 25.9	0.074

Examples of SFI Low vs. High Score

SFI Low Score (S2 + F2 +I1 = 5)

SFI High Score (S3 + F3 + I3 = 9)



Logistic Regression – All Cause Mortality

Variable	OR	95%CI Lower	95%CI Upper	p-value
Age	1.050	1.019	1.082	.001
HTN	.859	.461	1.600	.632
DM	.871	.431	1.762	.701
CAD	.874	.415	1.841	.724
SFI Score 7 – 9	1.989	1.104	3.581	.022
High Grade	1.634	.742	3.603	.223
Recurrence	4.375	2.246	8.524	<0.001

Logistic Regression – Recurrence

Variable	OR	95%CI Lower	95%CI Upper	p-value
Age	1.006	.976	1.038	.689
HTN	1.655	.832	3.291	.151
DM	1.125	.530	2.389	.759
CAD	.742	.327	1.686	.476
SFI Score 7 – 9	1.173	.619	2.223	.625
High Grade	3.742	1.040	13.467	.043
pT2+	3.589	1.743	7.393	.001

Figure: Kaplan Meier Analyses

