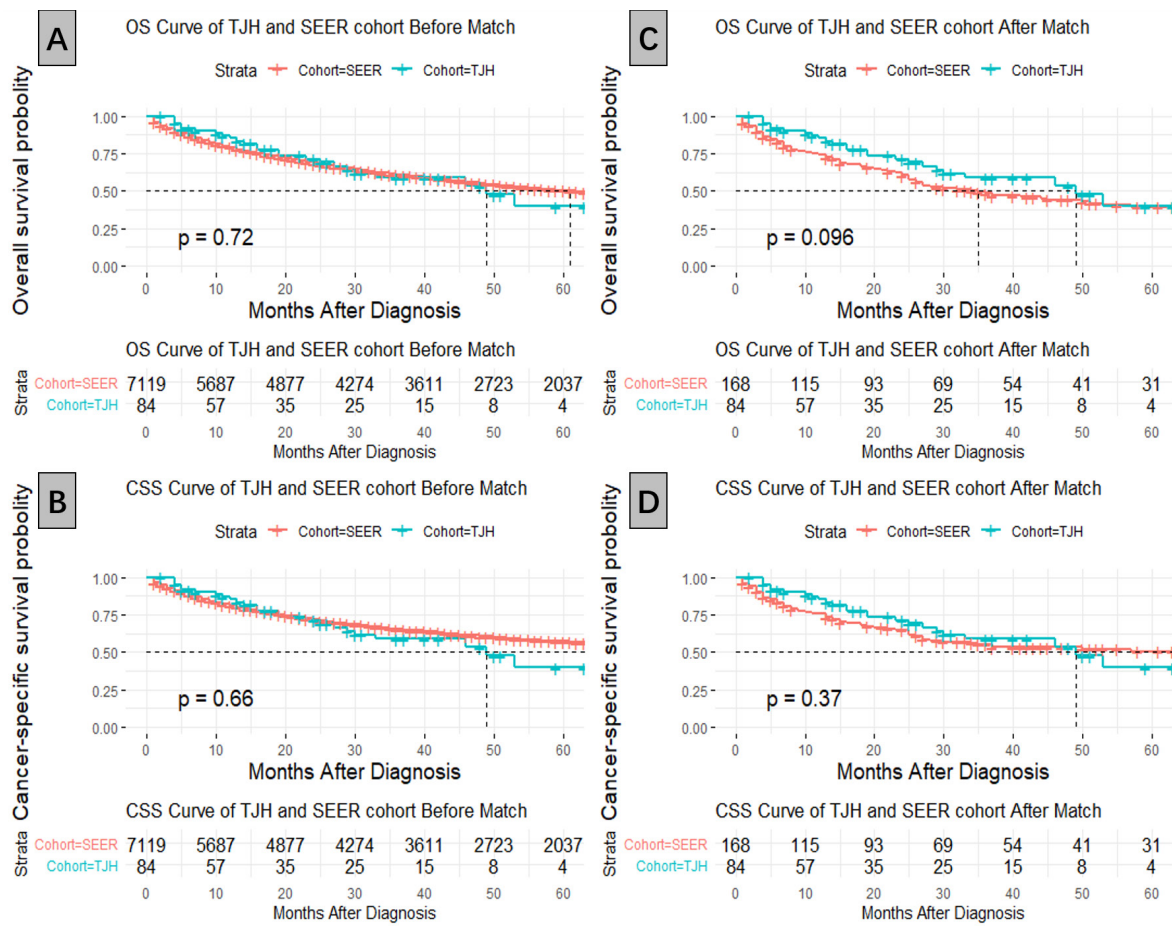


**Table S1** Comparison of characteristics before and after matching between TJH and SEER cases

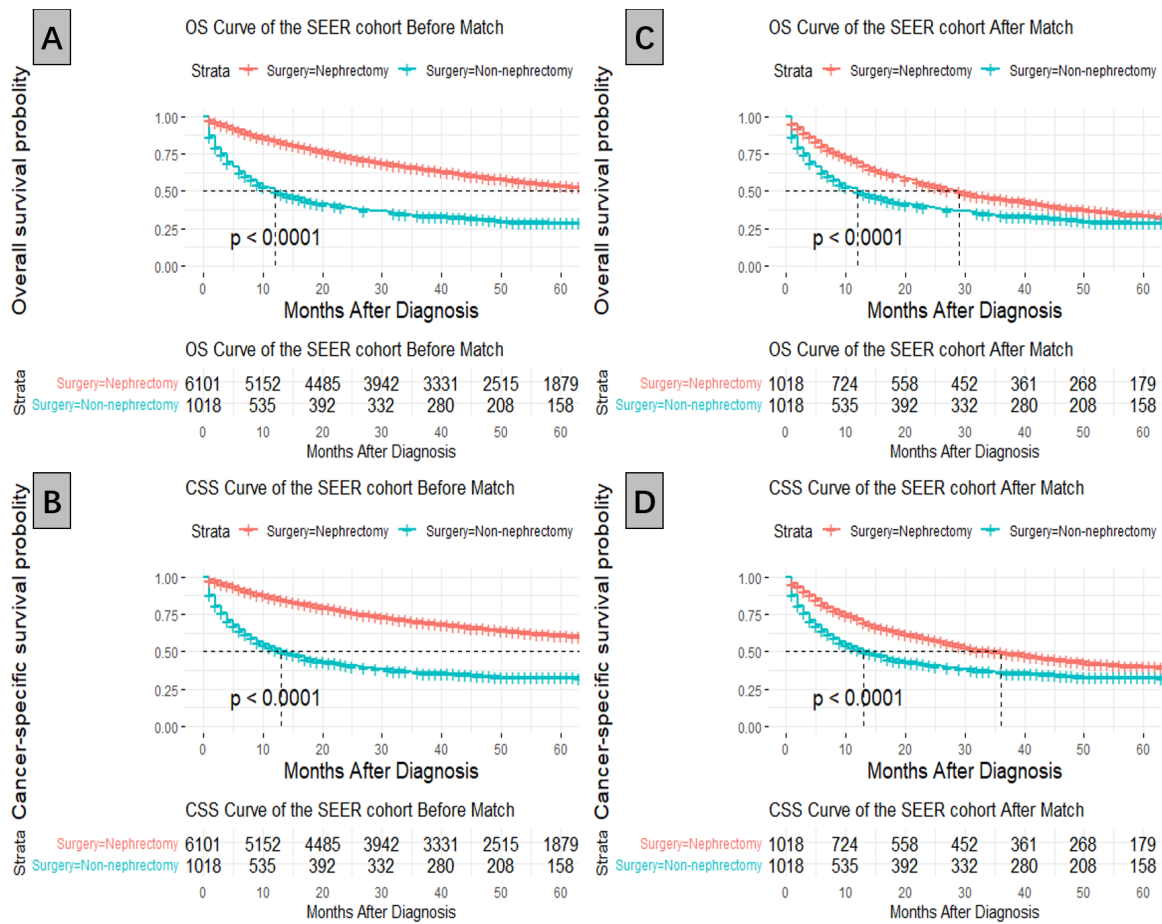
Characteristics	Before match			After match		
	SEER (n=7119)	TJH (n=84)	P	SEER (n=168)	TJH (n=84)	P
Age (years), median [IQR]	64.00 [56.00, 71.00]	59.50 [52.00, 65.00]	<0.001	56.50 [48.00, 64.00]	59.50 [52.00, 65.00]	0.251
Size (mm), median [IQR]	85.00 [60.00, 110.00]	85.25 [70.00, 100.75]	0.474	90.00 [65.00, 115.00]	85.25 [70.00, 100.75]	0.692
Race (%)			<0.001			<0.001
Black	514 (7.2)	0 (0.0)		19 (11.3)	0 (0.0)	
Other	509 (7.1)	84 (100.0)		11 (6.5)	84 (100.0)	
Unknown	40 (0.6)	0 (0.0)		0 (0.0)	0 (0.0)	
White	6056 (85.1)	0 (0.0)		138 (82.1)	0 (0.0)	
Sex (%)			0.479			0.661
Female	2236 (31.4)	23 (27.4)		52 (31.0)	23 (27.4)	
Male	4883 (68.6)	61 (72.6)		116 (69.0)	61 (72.6)	
Laterality (%)			0.014			0.950
Bilateral	25 (0.4)	1 (1.2)		2 (1.2)	1 (1.2)	
Left	3342 (46.9)	28 (33.3)		59 (35.1)	28 (33.3)	
Right	3752 (52.7)	55 (65.5)		107 (63.7)	55 (65.5)	
T (%)			<0.001			0.004
T3a	5310 (74.6)	22 (26.2)		33 (19.6)	22 (26.2)	
T3b	1165 (16.4)	41 (48.8)		114 (67.9)	41 (48.8)	
T3c	623 (8.8)	10 (11.9)		16 (9.5)	10 (11.9)	
T4	21 (0.3)	11 (13.1)		5 (3.0)	11 (13.1)	
N (%)			<0.001			0.767
N0	5772 (81.1)	49 (58.3)		92 (54.8)	49 (58.3)	
N1	1143 (16.1)	31 (36.9)		64 (38.1)	31 (36.9)	
NX	204 (2.9)	4 (4.8)		12 (7.1)	4 (4.8)	
M (%)			0.04			1.000
M0	5067 (71.2)	51 (60.7)		102 (60.7)	51 (60.7)	
M1	2052 (28.8)	33 (39.3)		66 (39.3)	33 (39.3)	
Location of VTT (%)			<0.001			0.362
Above diaphragm or invading the IVC wall	644 (9.0)	8 (9.5)		21 (12.5)	8 (9.5)	
Below the diaphragm	1165 (16.4)	53 (63.1)		114 (67.9)	53 (63.1)	
In the RV	5310 (74.6)	23 (27.4)		33 (19.6)	23 (27.4)	
Histology (%)			<0.001			0.561
ccRCC	5264 (73.9)	58 (69.0)		106 (63.1)	58 (69.0)	
ChRCC	117 (1.6)	0 (0.0)		0 (0.0)	0 (0.0)	
Other	1431 (20.1)	12 (14.3)		33 (19.6)	12 (14.3)	
PRCC	307 (4.3)	14 (16.7)		29 (17.3)	14 (16.7)	
Grade (%)			<0.001			0.755
Grade I	127 (1.8)	7 (8.3)		12 (7.1)	7 (8.3)	
Grade II	1660 (23.3)	27 (32.1)		59 (35.1)	27 (32.1)	
Grade III	2687 (37.7)	31 (36.9)		59 (35.1)	31 (36.9)	
Grade IV	1385 (19.5)	14 (16.7)		33 (19.6)	14 (16.7)	
Unknown	1260 (17.7)	5 (6.0)		5 (3.0)	5 (6.0)	
Radiation (%)			0.003			1.000
None/Unknown	6579 (92.4)	84 (100.0)		0 (0.0)	0 (0.0)	
Yes	540 (7.6)	0 (0.0)		168 (100.0)	84 (100.0)	
Systemic treatments (%)			0.065			1.000
No/Unknown	5536 (77.8)	58 (69.0)		117 (69.6)	58 (69.0)	
Yes	1583 (22.2)	26 (31.0)		51 (30.4)	26 (31.0)	
Surgery (%)			0.211			0.742
Nephrectomy	6101 (85.7)	68 (81.0)		132 (78.6)	68 (81.0)	
Non-nephrectomy	1018 (14.3)	16 (19.0)		36 (21.4)	16 (19.0)	

**Table S2** Characteristics of the training set and validation set cases

Characteristics	Training Cohort (n=1622)	Validation Cohort (n=414)	P
Age (years), median [IQR]	65.00 [58.00, 73.00]	64.00 [56.00, 72.00]	0.248
Size (mm), median [IQR]	81.00 [58.25, 107.00]	80.00 [54.00, 110.00]	0.460
Race (%)			0.043
Black	168 (10.4)	35 (8.5)	
Other	118 (7.3)	38 (9.2)	
Unknown	3 (0.2)	4 (1.0)	
White	1333 (82.2)	337 (81.4)	
Sex (%)			0.685
Female	560 (34.5)	138 (33.3)	
Male	1062 (65.5)	276 (66.7)	
Laterality (%)			0.904
Bilateral	18 (1.1)	5 (1.2)	
Left	749 (46.2)	188 (45.4)	
Right	855 (52.7)	221 (53.4)	
T (%)			0.349
T3a	1046 (64.5)	276 (66.7)	
T3b	378 (23.3)	83 (20.0)	
T3c	187 (11.5)	50 (12.1)	
T4	11 (0.7)	5 (1.2)	
N (%)			0.015
N0	981 (60.5)	230 (55.6)	
N1	532 (32.8)	165 (39.9)	
NX	109 (6.7)	19 (4.6)	
M (%)			0.192
M0	626 (38.6)	145 (35.0)	
M1	996 (61.4)	269 (65.0)	
Location of VTT (%)			0.345
Above diaphragm or invading the IVC wall	198 (12.2)	55 (13.3)	
Below the diaphragm	378 (23.3)	83 (20.0)	
In the RV	1046 (64.5)	276 (66.7)	
Histology (%)			0.204
ccRCC	1003 (61.8)	258 (62.3)	
ChRCC	23 (1.4)	7 (1.7)	
Other	523 (32.2)	121 (29.2)	
PRCC	73 (4.5)	28 (6.8)	
Grade (%)			0.647
Grade I	35 (2.2)	12 (2.9)	
Grade II	280 (17.3)	63 (15.2)	
Grade III	475 (29.3)	124 (30.0)	
Grade IV	277 (17.1)	78 (18.8)	
Unknown	555 (34.2)	137 (33.1)	
Radiation (%)			0.764
None/Unknown	1359 (83.8)	350 (84.5)	
Yes	263 (16.2)	64 (15.5)	
Systemic treatments (%)			0.501
No/Unknown	974 (60.0)	241 (58.2)	
Yes	648 (40.0)	173 (41.8)	
Surgery (%)			0.783
Nephrectomy	814 (50.2)	204 (49.3)	
Non-nephrectomy	808 (49.8)	210 (50.7)	



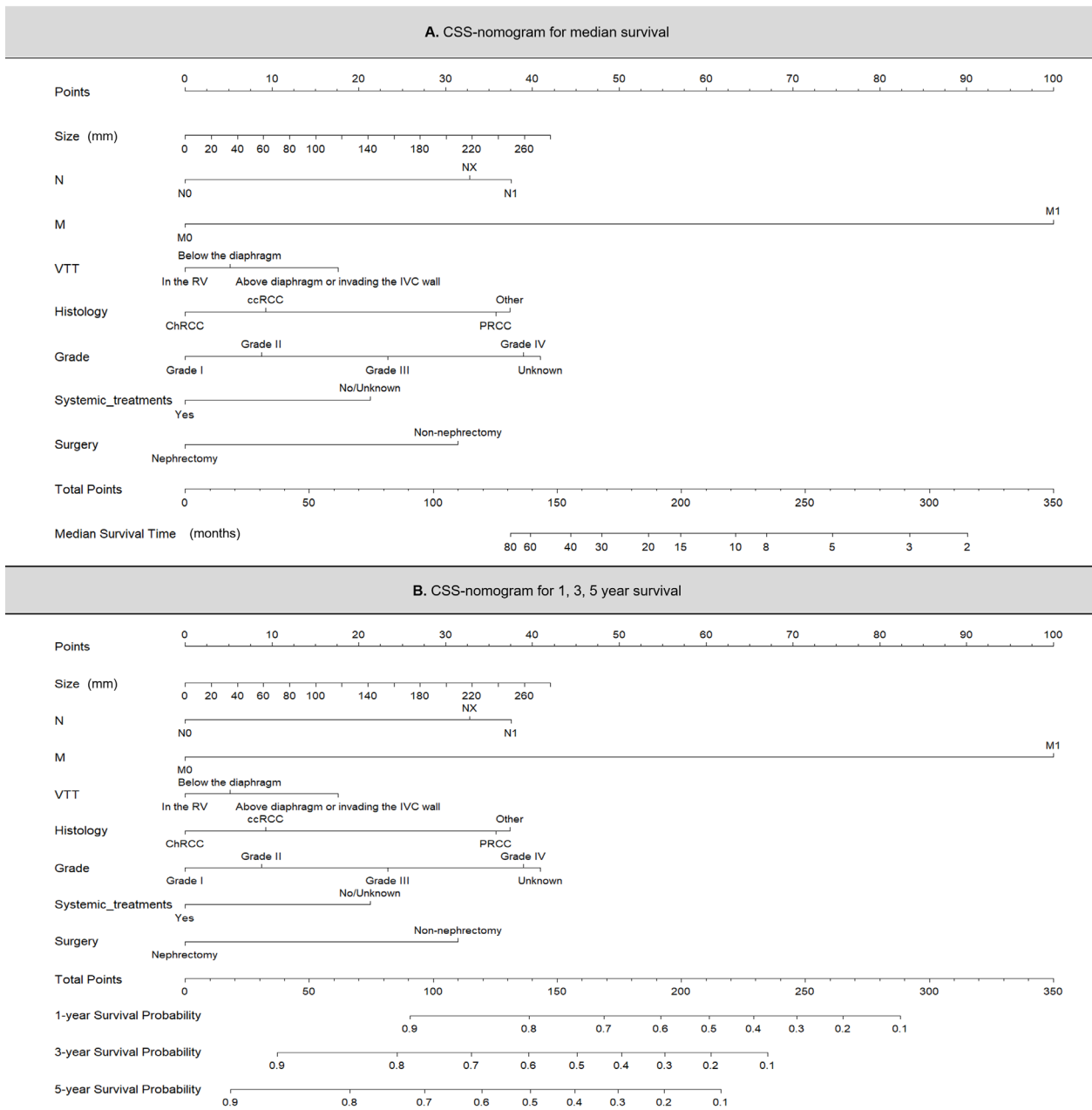
**Figure S1** OS and CSS curves of the SEER and TJH cases before and after PSM.



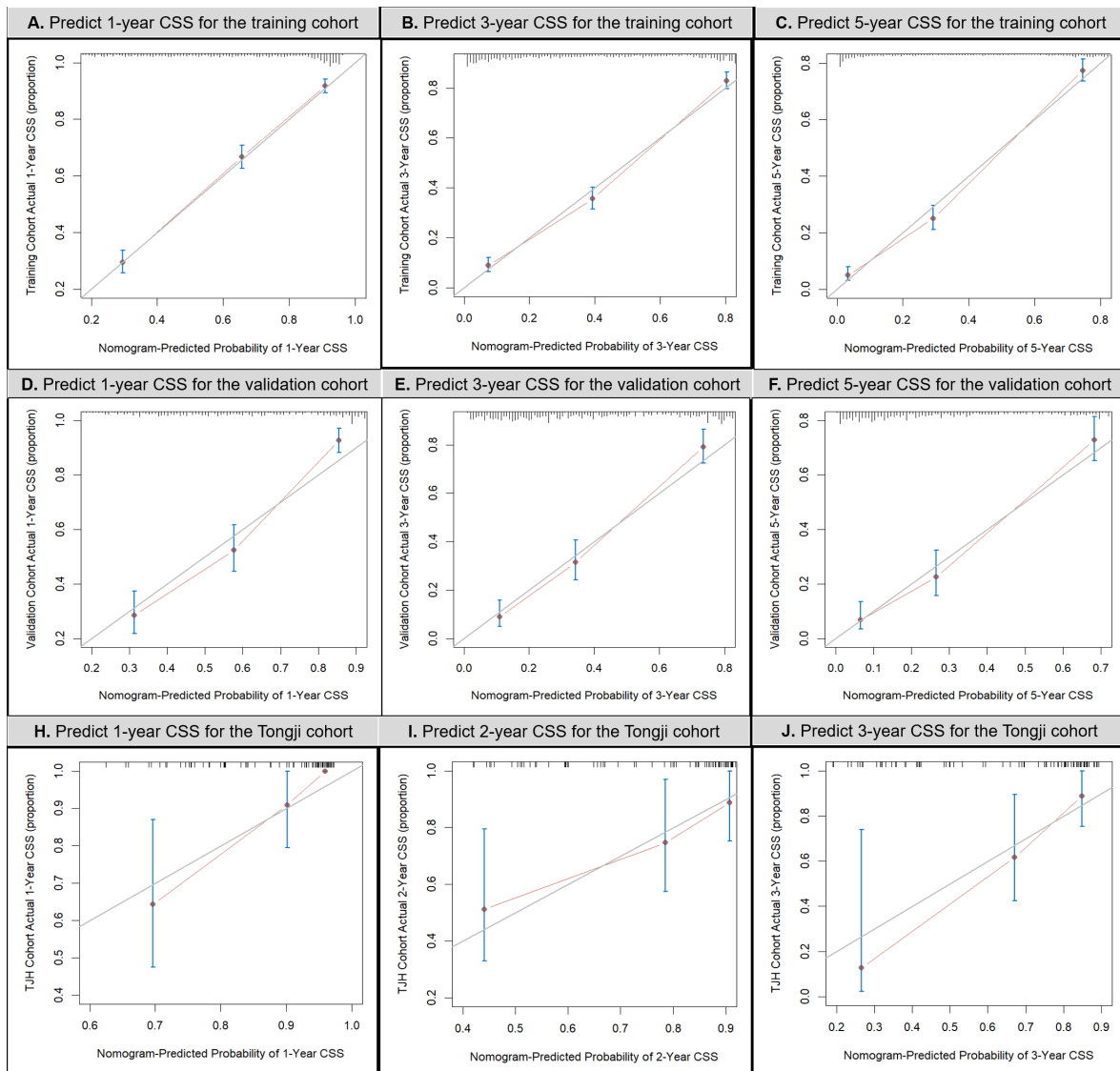
**Figure S2** The effect of surgery on OS and CSS before and after matching. After matching, the difference between OS (A-C) and CSS (B-D) in the nephrectomy group and the non-surgical group was reduced.

**Table S3** Univariate and multivariate Cox proportional hazards regression for CSS

Characteristics	Univariate			Multivariate		
	Hazard ratio	95% CI	P value	Hazard ratio	95% CI	P value
Systemic treatments						
No	1 (Reference)			1 (Reference)		
Yes	2.19	1.92-2.49	<0.001	0.71	0.61-0.82	<0.001
Grade			<0.001			<0.001
Grade I	1 (Reference)			1 (Reference)		
Grade II	0.84	0.48-1.47	0.539	1.18	0.67-2.09	0.557
Grade III	1.32	0.77-2.26	0.314	1.48	0.85-2.56	0.161
Grade IV	2.36	1.37-4.06	0.002	1.89	1.08-3.31	0.026
Unknown	3.30	1.94-5.63	<0.001	1.93	1.12-3.33	0.017
Histology			<0.001			<0.001
ccRCC	1 (Reference)			1 (Reference)		
ChRCC	0.59	0.29-1.19	0.139	0.87	0.43-1.76	0.701
Other	2.53	2.21-2.89	<0.001	1.58	1.36-1.82	<0.001
PRCC	1.86	1.39-2.50	<0.001	1.54	1.14-2.09	0.005
M						
M0	1 (Reference)			1 (Reference)		
M1	5.99	5.05-7.12	<0.001	4.59	3.71-5.69	<0.001
N						<0.001
N0	1 (Reference)			1 (Reference)		
N1	3.66	3.19-4.2	<0.001	1.82	1.56-2.12	<0.001
NX	2.80	2.21-3.54	<0.001	1.66	1.30-2.11	<0.001
Race			0.018			0.765
Black	1 (Reference)			1 (Reference)		
Other	0.80	0.59-1.08	0.142	1.09	0.80-1.48	0.598
Unknown	1.42	0.35-5.77	0.620	1.35	0.33-5.55	0.679
White	0.73	0.60-0.89	0.002	1.11	0.91-1.37	0.307
Radiation						
None/Unknown	1 (Reference)			1 (Reference)		
Yes	2.09	1.8-2.44	<0.001	1.16	0.99-1.36	0.072
Size (per 1 mm)	1.01	1.01-1.01	<0.001	1.00	1.00-1.00	0.007
Surgery						
Nephrectomy	1 (Reference)			1 (Reference)		
Non-nephrectomy	1.47	1.29-1.67	<0.001	1.63	1.38-1.92	<0.001
Location of VTT			<0.001			0.021
Above diaphragm or invading the IVC wall	1 (Reference)			1 (Reference)		
Below the diaphragm	0.74	0.60-0.91	0.004	0.83	0.67-1.03	0.085
In the RV	0.43	0.36-0.52	<0.001	0.76	0.63-0.92	0.005



**Figure S3** CSS nomogram for predicting the median overall survival and the 1-, 3-, and 5-year CSS probabilities. (A) CSS nomogram for predicting the median CSS. (B) CSS nomogram for predicting the 1-, 3-, and 5-year CSS probabilities.



**Figure S4** The CSS nomogram was validated in the training set, validation set, and TJH cohort.