Original Article

Nomogram for predicting acute kidney disease in patients with upper tract urothelial carcinoma undergoing adjuvant chemotherapy following radical nephroureterectomy

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Background: Radical nephroureterectomy (RNU) with complete bladder cuff excision is the primary treatment for high-risk non-metastatic upper urinary tract urothelial carcinoma (UTUC). Gemcitabine-platinum combination chemotherapy is established as the preferred adjuvant therapy post-RNU; however, both RNU and platinum-based therapies can significantly impair renal function. This study aimed to construct a nomogram to predict acute kidney disease (AKD) occurrence in UTUC patients undergoing gemcitabine-platinum chemotherapy after RNU.

Methods: We collected data from patients who underwent RNU followed by adjuvant gemcitabine-platinum chemotherapy at Beijing Friendship Hospital, Capital Medical University, between September 2015 and September 2024. Demographic, perioperative, and pre-chemotherapy data were analyzed. After rigorous screening, 126 patients were included and randomly allocated to a development cohort (n=88, 70%) and a validation cohort (n=38, 30%) in a 7:3 ratio. Risk factors for AKD identified by univariate and backward stepwise multivariate logistic regression analyses were used to develop the nomogram. Its performance was assessed using calibration curves, Harrell's concordance index (C-index), decision curve analysis (DCA), and clinical impact curve (CIC) analysis.

Results: AKD occurred in 31 patients (24.6%). Multivariate logistic regression identified five significant independent predictors: age (P=0.04), diabetes mellitus (P=0.03), proteinuria (P=0.003), serum creatinine before chemotherapy (P=0.002), and postoperative acute kidney injury (AKI) (P=0.01). The nomogram demonstrated strong discriminatory power, with an area under the curve (AUC) of 0.895 [95% confidence interval (CI): 0.825–0.964] in the development cohort and 0.893 (95% CI: 0.776–1.000) in the validation cohort. DCA and CIC indicated good clinical utility.

Conclusions: Age, diabetes mellitus, preoperative proteinuria, serum creatinine before chemotherapy, and postoperative AKI are significant risk factors for AKD in UTUC patients receiving gemcitabine-platinum chemotherapy after RNU. The developed nomogram serves as an effective predictive tool for AKD in this population.

Keywords: Nomogram; acute kidney disease (AKD); urinary tract urothelial carcinoma (UTUC); nephroureterectomy; adjuvant chemotherapy

Submitted May 22, 2025. Accepted for publication Aug 04, 2025. This article was updated on Jun 15, 2026. The original version is available at: https://dx.doi.org/10.21037/tau-2025-361

doi: 10.21037/tau-2025-361

Introduction

Upper urinary tract urothelial carcinoma (UTUC) refers to malignancies arising in the renal calyces, renal pelvis, and ureters. In Western countries, its incidence is approximately 2 cases per 100,000 individuals, accounting for only 5–10% of all urothelial carcinomas (1). Notably, around 50% of patients present with non-muscle-invasive disease at diagnosis, while approximately 25% have metastatic involvement at initial presentation (2-4). The European Association of Urology guidelines recommend radical nephroureterectomy (RNU) with complete bladder cuff excision as the primary treatment for high-risk non-metastatic UTUC (1). Furthermore, gemcitabine-platinum combination chemotherapy is established as the preferred adjuvant therapy post-RNU; however, both RNU and platinum-based therapies can lead to significant renal function impairment (5).

Acute kidney disease (AKD) is distinct from acute kidney injury (AKI) and chronic kidney disease (CKD). AKD is diagnosed if serum creatinine increases by more than 50% from baseline within 7 to 90 days (6). AKI represents acute renal insufficiency, whereas CKD involves the long-term, progressive decline of kidney function. Some researchers propose that AKI and AKD represent different stages along the same pathophysiological continuum (7), with AKD serving as an intermediate stage. Therefore, monitoring for AKD may facilitate early intervention to prevent further loss of renal function, thereby potentially halting progression to CKD or even end-stage kidney disease (ESKD) (8,9).

The purpose of this study was to identify risk factors for AKD in UTUC patients undergoing adjuvant gemcitabine-platinum chemotherapy after RNU and to construct a nomogram predicting the likelihood of AKD occurrence. This tool aims to enable early intervention to mitigate renal function decline in treated patients and prevent the progression of renal insufficiency. We present this article in accordance with the TRIPOD reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-2025-361/rc).

Highlight box

Key findings

- Age, diabetes mellitus, proteinuria, pre-chemotherapy serum creatinine, and postoperative acute kidney injury (AKI) are associated with the development of acute kidney disease (AKD) in patients with upper urinary tract urothelial carcinoma (UTUC) undergoing adjuvant chemotherapy after radical nephroureterectomy (RNU). These factors can be used to construct a nomogram for predicting AKD occurrence.

What is known and what is new?

- Currently, no risk factors have been identified for renal function impairment in UTUC patients undergoing adjuvant chemotherapy following RNU.
- We identified age, diabetes mellitus, proteinuria, pre-chemotherapy serum creatinine, and postoperative AKI as risk factors for AKD development in this patient population.

What is the implication, and what should change now?

- This nomogram enables real-time assessment of AKD risk in routine clinical practice, facilitating early identification of high-risk patients prior to clinical deterioration and guiding timely interventions to prevent AKD onset.

Methods

Patients

We retrospectively analyzed patients who underwent RNU followed by adjuvant platinum-based chemotherapy (cisplatin or carboplatin) combined with gemcitabine at Beijing Friendship Hospital, Capital Medical University, between September 2015 and September 2024. After applying exclusion criteria, 126 patients were included. These patients were randomly allocated in a 7:3 ratio to a development cohort (n=88) and a validation cohort (n=38). Exclusion criteria were: (I) patients who did not undergo RNU but received alternative surgical treatments; (II) patients who did not receive postoperative adjuvant gemcitabine-platinum chemotherapy; (III) patients with incomplete clinical data; (IV) pretreatment estimated glomerular filtration rate (eGFR) < 30 mL/min/1.73 m^2; (V) Eastern Cooperative Oncology Group (ECOG) performance status >2; (VI) severe comorbidities contraindicating surgery or chemotherapy.

All data were extracted from the hospital medical record system. This study included patients who underwent laboratory tests and imaging studies during preoperative hospitalization. Laboratory tests were performed on postoperative days 1, 2, and 5, and before and during adjuvant chemotherapy. All patients had pathologically confirmed UTUC. Platinum-based adjuvant chemotherapy comprised cisplatin (n=110) or carboplatin (n=16), with follow-up endpoints defined as either AKD occurrence or 90 days after completing four chemotherapy cycles.

Data collection

This study was conducted in accordance with the

Declaration of Helsinki and its subsequent amendments. This study was approved by the Ethics Committee of Beijing Friendship Hospital (No. BFH20230925001) and individual consent for this retrospective analysis was waived. Patient demographic characteristics, perioperative data, and pre-chemotherapy parameters were collected using a standardized form. Demographic characteristics included gender, age, height, weight, body mass index (BMI), hypertension, diabetes mellitus, coronary artery disease, hydronephrosis, tumor location (renal pelvis or ureter), and preoperative angiotensin-converting enzyme inhibitor (ACEI) use. Perioperative data encompassed preoperative albumin, serum creatinine, hemoglobin, alkaline phosphatase (ALP); postoperative maximum lactate dehydrogenase (LDH), minimum albumin, hemoglobin (postoperative day 1), preoperative proteinuria status, perioperative proton pump inhibitor (PPI) and diphenhydramine use, postoperative AKI, intraoperative urine output, estimated blood loss (EBL), American Society of Anesthesiologists (ASA) physical status classification, and surgery duration. Pre-chemotherapy data included serum creatinine and albumin levels before the first chemotherapy cycle, The eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) creatinine formula, a 4-variable equation consisting of age, race, gender, and serum creatinine level.

Treatment program

All patients underwent RNU with complete bladder cuff excision, involving removal of the affected kidney, entire ipsilateral ureter, and a bladder cuff surrounding the ureteral orifice. Postoperative adjuvant chemotherapy consisted of gemcitabine combined with platinum agents. All patients received adjuvant chemotherapy initiated within 90 days postoperatively, with a planned regimen of four cycles administered in 21-day intervals. Patients with eGFR ≥50 mL/min/1.73 m^2 received the cisplatin regimen: gemcitabine (1,000 mg/m^2) intravenously on days 1 and 8, plus cisplatin (70 mg/m^2) on day 2. Patients with eGFR <50 mL/min/1.73 m^2 received the carboplatin regimen: carboplatin [area under the curve (AUC) =4.5] and gemcitabine (1,000 mg/m^2) intravenously on day 1, with gemcitabine (1,000 mg/m^2) repeated on day 8.

Outcome measurement

The primary outcome was AKD occurrence. AKD was defined per Acute Disease Quality Initiative (ADQI) 16 consensus as a serum creatinine increase ≥1.5 times baseline occurring between 7 days after initiating the first chemotherapy cycle and 90 days after completing the last cycle (5). This aligns with Kidney Disease: Improving Global Outcomes (KDIGO) criteria for AKI (serum creatinine increase ≥0.3 mg/dL [≥26.5 μmol/L] within 48 hours or ≥1.5 times baseline within 7 days) (10) but extends the observation window. Baseline creatinine denoted preoperative serum creatinine levels, while pre-chemotherapy creatinine referred to levels before the first chemotherapy cycle.

Statistical analysis

All data were analyzed using SPSS 23.0 statistical software (IBM Corp., Armonk, NY, USA) and R software (v. 4.1.3; R Foundation for Statistical Computing, Vienna, Austria). Univariate logistic regression analysis and backward stepwise multivariate logistic regression were used in order to identify risk factors for AKD. Finally, a nomogram prediction model was developed using the risk factors selected from the results of the multivariate analysis. P value <0.05 was considered statistically significant.

To assess the discrimination and calibration of the nomogram, AUC and calibration plots (bootstrap method) were generated. Decision curve analysis (DCA) and clinical impact curve (CIC) were used to determine the clinical value of the nomogram.

Results

Among the 126 patients included in this study, 31 (24.6%) developed AKD, and 35 (27.8%) experienced postoperative AKI. The baseline characteristics of all patients are summarized in *Table 1*.

In the development cohort, univariate analysis identified preoperative proteinuria (P=0.009), diabetes mellitus (P=0.02), postoperative AKI (P<0.001), and pre-chemotherapy serum creatinine (P<0.001) as significant risk factors for AKD (*Table 2*). Subsequent backward stepwise multivariate logistic regression analysis confirmed age (P=0.04), preoperative proteinuria (P=0.003), diabetes mellitus (P=0.03), postoperative AKI (P=0.01), and pre-chemotherapy serum creatinine (P=0.002) as independent risk factors for AKD (*Table 2*).

Based on the multivariate analysis results, we developed a nomogram model to predict AKD occurrence in

Table 1 All characteristics of UTUC patients undergoing adjuvant chemotherapy with platinum combined with gemcitabine after RNU

Variables	AKD (n=31)	Non-AKD (n=95)	P value[†]
Age (years)	64.7±7.7	67.9±7.4	0.04*
Gender			0.30
Male	18 (58.0)	45 (47.4)	
Female	13 (41.9)	50 (52.6)	
Height (cm)	165.1±7.8	165.4±7.7	0.84
Weight (kg)	67.0±8.0	67.8±10.6	0.69
BMI (kg/m^2)	24.6±2.8	24.7±3.0	0.86
Hypertension	16 (51.6)	47 (49.5)	0.68
Diabetes	14 (45.2)	13 (13.7)	<0.001***
Coronary heart disease	5 (16.1)	10 (10.5)	0.40
Hydronephrosis	19 (61.3)	74 (77.9)	0.07
Preoperative Scr (mg/dL)	1.0 [0.8–1.2]	1.0 [0.8–1.2]	0.51
Preoperative eGFR (mL/min/1.73 m^2)	71±19.5	68.5±16.3	0.48
Preoperative albumin (g/L)	39.4±2.8	39.4±3.5	0.96
Preoperative hemoglobin (g/L)	133 [125–138]	130 [117–143]	0.93
Preoperative ALP (U/L)	86 [71–98]	78 [70–97]	0.08
Postoperative maximum LDH (U/L)	195 [163–210]	199 [175–214]	0.44
Proteinuria	14 (45.2)	18 (18.9)	0.003
Postoperative hemoglobin (g/L)	113.1±14.6	113±14.7	0.99
Postoperative minimum albumin (g/L)	30.7 [29.0–32.4]	31 [29.5–33.1]	0.61
ACEI	4 (12.9)	17 (17.9)	0.52
PPI	24 (77.4)	70 (73.7)	0.76
Diphenhydramine	6 (19.4)	19 (20)	0.94
Pre-chemotherapy Scr (mg/dL)	1.3±0.2	1.0±0.2	<0.001***
Pre-chemotherapy eGFR (mL/min/1.73 m^2)	50.2 [40.4–60.1]	63.5 [56.1–76.2]	<0.001***
Pre-chemotherapy albumin (g/L)	38.2±4	38.9±5.3	0.47
Postoperative AKI	19 (62.3)	16 (16.8)	<0.001***
Tumor location			0.08
Pelvis	14 (45.2)	27 (28.4)	
Ureter	17 (54.8)	68 (71.6)	
Intraoperative urine output (mL)	350 [170–500]	400 [200–700]	0.09
Estimated blood loss (mL)	100 [50–200]	100 [50–200]	0.77
ASA classification			0.77
2	19 (61.3)	61 (64.2)	
3	12 (38.7)	34 (35.8)	
Surgery duration (min)	235 [195–267]	240 [210–290]	0.24

Data are presented as mean ± SD, n (%), or median [IQR]. [†], statistical tests: independent samples *t*-test, Mann-Whitney *U* test, or χ^2 test, as appropriate. *, P<0.05; **, P<0.01; ***, P<0.001. ACEI, angiotensin converting enzyme inhibitor; AKI, acute kidney injury; AKD, acute kidney disease; ALP, alkaline phosphatase; ASA, American Society of Anesthesiologists; BMI, body mass index; eGFR, estimated glomerular filtration rate; IQR, interquartile range; LDH, lactate dehydrogenase; PPI, proton pump inhibitor; RNU, radical nephroureterectomy; Scr, serum creatinine; SD, standard deviation; UTUC, upper urinary tract urothelial carcinoma.

Table 2 Univariate analysis and backward stepwise multifactorial analysis were conducted on patients in development cohort

Characteristics	AKD (n=22)	Non-AKD (n=66)	Univariable			Multivariable			Final		
			OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Age (years)	68.1±7.7	64.4±7.7	1.07	1.00–1.15	0.06	1.15	1.01–1.30	0.03*	1.13	1.00–1.26	0.04*
Gender			1.68	0.61–4.58	0.31						
Male	13 (61.9)	32 (49.2)									
Female	8 (38.1)	33 (50.8)									
Height (cm)	165.4±8.3	166.0±7.6	0.99	0.93–1.06	0.76						
Weight (kg)	68.0±7.9	67.4±10.3	1.01	0.96–1.06	0.81						
BMI (kg/m^2)	24.9±3.1	24.4±2.7	1.07	0.90–1.28	0.43						
Hypertension	10 (47.6)	29 (44.6)	1.13	0.42–3.03	0.81						
Diabetes	8 (38.1)	9 (13.8)	3.83	1.24–11.82	0.02*	8.13	1.34–49.22	0.02*	7.26	1.24–42.49	0.03*
Coronary heart disease	3 (14.3)	8 (12.3)	1.19	0.28–4.96	0.81						
Hydronephrosis	13 (61.9)	49 (75.4)	0.53	0.19–1.51	0.24						
Preoperative Scr (mg/dL)	1.0±0.2	1.0±0.2	1.00	0.97–1.02	0.71						
Preoperative albumin (g/L)	38.6±2.0	38.9±3.7	0.98	0.84–1.13	0.74						
Preoperative hemoglobin (g/L)	131.2±14.9	128.9±16.1	1.01	0.98–1.04	0.55						
Preoperative ALP (U/L)	84.0±21.4	78.3±15.3	1.02	0.99–1.05	0.19	1.01	0.947–1.06	0.61			
Postoperative maximum LDH (U/L)	198.8±56.1	199.1±43.7	1.00	0.99–1.01	0.98						
Proteinuria	11 (52.4)	14 (21.5)	4.01	1.42–11.35	0.009**	14.17	2.00–100.66	0.008**	18.99	2.79–129.11	0.003**
Postoperative hemoglobin (g/L)	115.5±14.3	112.7±15.2	1.01	0.98–1.05	0.46						
Postoperative minimum albumin (g/L)	30.9±3.4	31.2±3.6	0.98	0.85–1.13	0.76						
ACEI	1 (4.8)	11 (16.9)	0.25	0.03–2.02	0.19	0.19	0.01–2.84	0.23	0.19	0.01–2.34	0.19
PPI	18 (85.7)	46 (70.8)	2.48	0.65–9.41	0.18	2.16	0.28–16.51	0.46			
Diphenhydramine	5 (23.8)	13 (20.0)	1.25	0.39–4.04	0.71						
Pre-chemotherapy Scr (mg/dL)	1.3±0.2	1.1±0.2	1.06	1.03–1.09	<0.001***	1.06	1.02–1.11	0.004**	1.07	1.03–1.12	0.002**
Pre-chemotherapy albumin (g/L)	37.9±2.6	39.2±5.8	0.92	0.79–1.08	0.32						
Postoperative AKI	14 (66.7)	13 (20.0)	8.00	2.68–23.84	<0.001***	6.26	1.34–29.27	0.02*	6.51	1.46–28.96	0.01*
Tumor location			2.28	0.84–6.19	0.11	1.95	0.34–10.98	0.45			
Pelvis	12 (57.1)	24 (36.9)									
Ureter	9 (42.9)	41 (63.1)									
Intraoperative urine output (mL)	410.5±397.9	459.2±353.8	1.00	1.00–1.00	0.59						
Estimated blood loss (mL)	178.6±175.1	159.1±152.6	1.00	1.00–1.00	0.62						
ASA classification			0.98	0.26–2.71	0.98						
2	13 (61.9)	40 (61.5)									
3	8 (38.1)	25 (38.5)									
Surgery duration (min)	244.0±62.4	251.8±64.8	1.00	0.99–1.01	0.62						

Data are presented as mean ± SD or n (%). *, P<0.05; **, P<0.01; ***, P<0.001. ACEI, angiotensin converting enzyme inhibitor; AKI, acute kidney injury; AKD, acute kidney disease; ALP, alkaline phosphatase; ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; LDH, lactate dehydrogenase; OR, odds ratio; PPI, proton pump inhibitor; Scr, serum creatinine; SD, standard deviation.

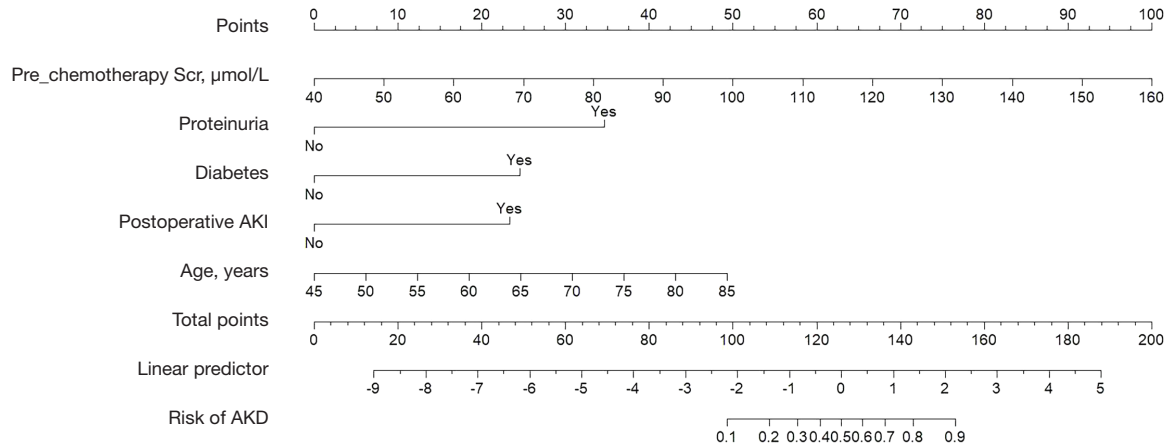

Figure 1 Nomogram of AKD in patients with UTUC who underwent gemcitabine combined with platinum-based chemotherapy after RNU. AKD, acute kidney disease; AKI, acute kidney injury; RNU, radical nephroureterectomy; Scr, serum creatinine; UTUC, upper urinary tract urothelial carcinoma.

UTUC patients receiving adjuvant gemcitabine-platinum chemotherapy after RNU (*Figure 1*). To evaluate the model's performance in the development cohort, a receiver operating characteristic (ROC) curve was plotted (*Figure 2A*). The model demonstrated strong discriminatory power, with an AUC of 0.895 [95% confidence interval (CI): 0.825–0.964] and a concordance index (C-index) of 0.891. In the validation cohort, the model achieved an AUC of 0.893 (95% CI: 0.776–1.000) and a C-index of 0.89 (*Figure 2B*). Furthermore, calibration curves showed good agreement between the nomogram-predicted probabilities and actual outcomes in both the development and validation cohorts (*Figure 2C*,*2D*). DCA assessed the clinical utility of the nomogram (*Figure 2E*), while CIC analysis further evaluated its predictive performance and clinical relevance (*Figure 2F*).

Discussion

This study aimed to identify risk factors for AKD in patients with UTUC undergoing adjuvant gemcitabine-platinum chemotherapy following RNU. We also constructed a nomogram to predict AKD probability, facilitating early intervention to prevent renal function decline and mitigate progression to renal insufficiency.

We investigated risk factors for AKD in UTUC patients receiving adjuvant gemcitabine-platinum chemotherapy post-RNU, analyzing baseline demographics, perioperative indices, and pre-chemotherapy parameters. Univariate analysis identified significant risk factors: diabetes mellitus, preoperative proteinuria, postoperative AKI, and serum creatinine levels before the first chemotherapy cycle. Multivariate logistic regression further confirmed age, diabetes mellitus, preoperative proteinuria, postoperative AKI, and pre-chemotherapy serum creatinine as independent risk factors. Previous studies have implicated age, hydronephrosis, postoperative AKI, and renal pelvis tumor location in post-RNU renal function decline (11,12). Another study predicting renal failure post-RNU or radical nephrectomy (RN) identified age, gender, BMI, diabetes mellitus, hypertension, and preoperative serum creatinine as predictive factors (13).

Furthermore, age, BMI, postoperative AKI, diabetes mellitus, hypertension, surgery duration, and preoperative proteinuria have been associated with renal function changes in patients undergoing partial nephrectomy (PN) or RN (11,14-16). Some studies suggest EBL and peak postoperative LDH level correlate with renal function changes after PN (17,18). ALP and albumin level have also been linked to postoperative renal function in RN patients (19).

In our cohort, factors such as gender, BMI, hypertension, operative duration, EBL, peak postoperative LDH, ALP, and albumin showed no significant association with AKD. This may reflect our limited sample size and lack of long-term renal function follow-up. Additionally, preoperative serum creatinine and hydronephrosis were not significant predictors, potentially because most patients received adjuvant chemotherapy, resulting in later TNM staging that correlated with more severe hydronephrosis and elevated

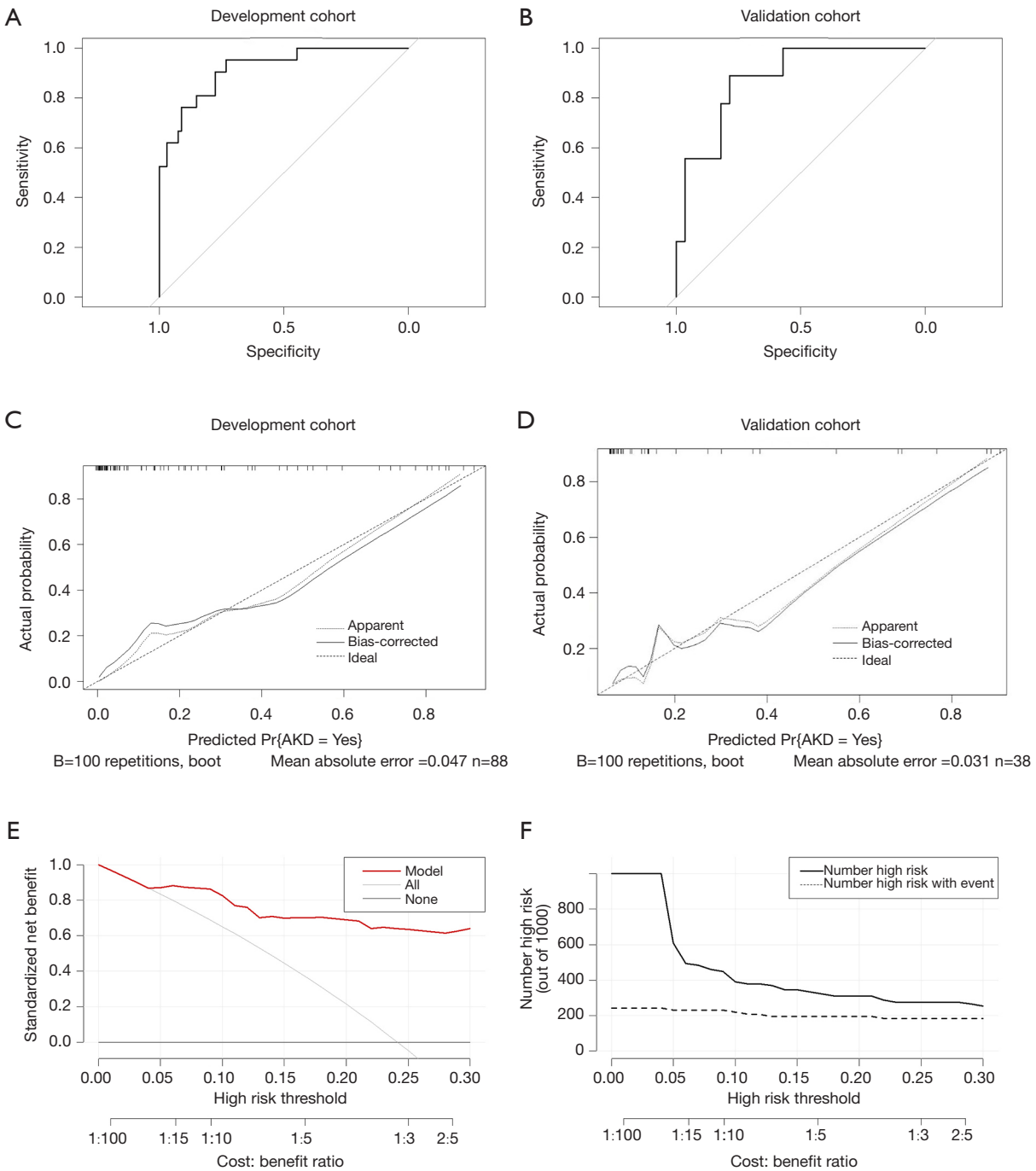

Figure 2 Assessment of the discrimination and calibration of the nomogram. ROC curves for development cohort (A) and validation cohort (B). Calibration curves depicting the performance of the model in the development cohort (C) and validation cohort (D). Decision curve of the model predicting the occurrence of AKD in patients with UTUC undergoing RNU followed by adjuvant chemotherapy with platinum in combination with gemcitabine (E). CIC analysis was used to assess the model (F). AKD, acute kidney disease; CIC, clinical impact curve; ROC, receiver operating characteristic; RNU, radical nephroureterectomy; UTUC, upper urinary tract urothelial carcinoma.

baseline serum creatinine levels.

Previous research suggests a potential association between PPI use and renal function decline (20). However, perioperative PPI use was not an influencing factor in our study, possibly due to shorter duration of exposure and sample size constraints. While one study indicates diphenhydramine may prevent cisplatin-induced nephrotoxicity (21), our findings did not demonstrate a protective effect of perioperative diphenhydramine against AKD, potentially because administration did not precede chemotherapy initiation.

A prior nomogram predicted renal insufficiency after RNU in UTUC patients (22), but it did not assess AKD specifically in patients receiving adjuvant gemcitabine-platinum chemotherapy. They developed the model by selecting variables including age, BMI, preoperative eGFR, and ureterohydronephrosis through least absolute shrinkage and selection operator (LASSO) regression. Our identification of AKD risk factors in this specific population and the development of a predictive nomogram represent novel contributions. This tool may facilitate early prevention and treatment strategies to reduce renal impairment in this patient group.

This nomogram provides clinicians with a real-time assessment of AKD risk in routine clinical practice, facilitating the early identification of high-risk patients prior to clinical deterioration. When indicators of elevated risk emerge, monitoring is intensified immediately—including daily creatinine tracking and rigorous urine output surveillance. Nephrotoxic medications (such as analgesics or certain antibiotics) are withheld, supplemental fluid administration is initiated when essential but potentially nephrotoxic agents must be continued, and hydration is optimized to ensure stable renal perfusion. Concurrently, stringent control of blood glucose and blood pressure is prioritized, and early consultation with nephrology specialists is implemented. Collectively, this integrated approach prevents the development of AKD, halts progression in mild cases, and protects long-term renal function.

While existing models often address binary 'treat or not' decisions (e.g., regarding chemotherapy), our tool addresses the more complex clinical scenario: a high-risk score necessitates a comprehensive suite of preventive measures rather than a single therapeutic intervention. The nomogram facilitates the prompt initiation of preventive strategies and enables the focused allocation of limited healthcare resources to patients at greatest need.

Important limitations should be acknowledged. The relatively small number of UTUC patients receiving adjuvant chemotherapy and the single-center design resulted in a limited sample size. The follow-up period was insufficient to capture chronic renal insufficiency development, potentially affecting result accuracy. Future multicenter studies with larger cohorts and extended follow-up are needed to validate these findings. Nonetheless, this research provides valuable insights for preventing and managing renal impairment in this population, ultimately aiming to reduce renal failure incidence and improve survival and quality of life.

Conclusions

Age, diabetes mellitus, proteinuria, pre-chemotherapy serum creatinine, and postoperative AKI were significantly associated with AKD development in UTUC patients receiving adjuvant gemcitabine-platinum chemotherapy after RNU. We therefore constructed a clinically applicable nomogram to predict AKD occurrence in this population, thereby enabling early intervention to preserve renal function and ultimately improve long-term quality of life.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the TRIPOD reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-361/rc

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-361/dss

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-361/prf

Funding: None.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-2025-361/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all

aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. This study was approved by the Ethics Committee of Beijing Friendship Hospital (No. BFH20230925001) and individual consent for this retrospective analysis was waived.

References

1. Rouprêt M, Seisen T, Birtle AJ, et al. European Association of Urology Guidelines on Upper Urinary Tract Urothelial Carcinoma: 2023 Update. Eur Urol 2023;84:49-64.
2. Jaime-Casas S, Tripathi A, Pal SK, et al. Clinical Implications of the Molecular and Genomic Landscape of Upper Tract Urothelial Carcinoma. Curr Urol Rep 2024;26:11.
3. Petros FG. Epidemiology, clinical presentation, and evaluation of upper-tract urothelial carcinoma. Transl Androl Urol 2020;9:1794-8.
4. Cha EK, Shariat SF, Kormaksson M, et al. Predicting clinical outcomes after radical nephroureterectomy for upper tract urothelial carcinoma. Eur Urol 2012;61:818-25.
5. Thompson LE, Joy MS. Understanding Cisplatin Pharmacokinetics and Toxicodynamics to Predict and Prevent Kidney Injury. J Pharmacol Exp Ther 2024;391:399-414.
6. Lameire NH, Levin A, Kellum JA, et al. Harmonizing acute and chronic kidney disease definition and classification: report of a Kidney Disease: Improving Global Outcomes (KDIGO) Consensus Conference. Kidney Int 2021;100:516-26.
7. Ostermann M, Lumlertgul N, Jeong R, et al. Acute kidney injury. Lancet 2025;405:241-56.
8. Yeh TH, Tu KC, Wang HY, et al. From Acute to Chronic: Unraveling the Pathophysiological Mechanisms of the Progression from Acute Kidney Injury to Acute Kidney Disease to Chronic Kidney Disease. Int J Mol Sci 2024;25:1755.
9. Levey AS. Defining AKD: The Spectrum of AKI, AKD, and CKD. Nephron 2022;146:302-5.
10. Ostermann M, Bellomo R, Burdmann EA, et al. Controversies in acute kidney injury: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Conference. Kidney Int 2020;98:294-309.
11. Fang D, Zhang Q, Li X, et al. Nomogram predicting renal insufficiency after nephroureterectomy for upper tract urothelial carcinoma in the Chinese population: exclusion of ineligible candidates for adjuvant chemotherapy. Biomed Res Int 2014;2014:529186.
12. Tafuri A, Odorizzi K, Di Filippo G, et al. Acute kidney injury strongly influences renal function after radical nephroureterectomy for upper tract urothelial carcinoma: A single-centre experience. Arch Ital Urol Androl 2021;93:9-14.
13. Nasrallah AA, Gharios C, Itani M, et al. Risk of Postoperative Renal Failure in Radical Nephrectomy and Nephroureterectomy: A Validated Risk Prediction Model. Urol Int 2022;106:596-603.
14. Zhang S, He M, Li Y, et al. Predictive Factors for Acute Kidney Injury and Long-Term Renal Function Loss After Partial Nephrectomy: A Prospective Single-Center Study. Urology 2023;172:138-43.
15. Bhindi B, Lohse CM, Schulte PJ, et al. Predicting Renal Function Outcomes After Partial and Radical Nephrectomy. Eur Urol 2019;75:766-72.
16. Ellis RJ, Kalma B, Del Vecchio SJ, et al. Chronic kidney cortical damage is associated with baseline kidney function and albuminuria in patients managed with radical nephrectomy for kidney tumours. Pathology 2019;51:32-8.
17. Hakimi AA, Rajpathak S, Chery L, et al. Renal insufficiency is an independent risk factor for complications after partial nephrectomy. J Urol 2010;183:43-7. Erratum in: J Urol. 2010;183:1650.
18. Takagi T, Kondo T, Iizuka J, et al. Predictors for postoperative renal function after open partial nephrectomy: including postoperative biomarkers. Int J Urol 2012;19:823-8.
19. Xu L, Li C, Zhao L, et al. Acute kidney injury after nephrectomy: a new nomogram to predict postoperative renal function. BMC Nephrol 2020;21:181.
20. Al-Aly Z, Maddukuri G, Xie Y. Proton Pump Inhibitors and the Kidney: Implications of Current Evidence for Clinical Practice and When and How to Deprescribe. Am J Kidney Dis 2020;75:497-507.

21. Hamano H, Ikeda Y, Goda M, et al. Diphenhydramine may be a preventive medicine against cisplatin-induced kidney toxicity. Kidney Int 2021;99:885-99.
22. Wu Z, Chen Q, Djaladat H, et al. A Preoperative Nomogram to Predict Renal Function Insufficiency for Cisplatin-based Adjuvant Chemotherapy Following Minimally Invasive Radical Nephroureterectomy (ROBUUST Collaborative Group). Eur Urol Focus 2022;8:173-81. Erratum in: Eur Urol Focus. 2024;10:502.

Cite this article as: Zhang X, Lv T, Tu Z, Liu Y, Qiu W. Nomogram for predicting acute kidney disease in patients with upper tract urothelial carcinoma undergoing adjuvant chemotherapy following radical nephroureterectomy. Transl Androl Urol 2025;14(9):2583-2592. doi: 10.21037/tau-2025-361