



# The 28-day survive for critically ill cancer patients undergoing continuous renal replacement with postoperative acute kidney injure: a retrospective study of 86 cases

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**Background:** Advances in oncology led to a substantial increase in the number of patients requiring admission to the intensive care unit (ICU). It remains controversial to start continuous renal replacement therapy (CRRT) for acute kidney injure (AKI) in critically ill patients with cancer because of the poor outcome and high costs.

**Methods:** In this retrospective study, we collected data from patients with cancer with postoperative AKI-stage 3 [Kidney Disease: Improving Global Outcomes (KDIGO), 2012] undergoing CRRT in the ICU of Cancer Hospital, Chinese Academy of Medical Sciences from January 2010 to January 2019. Patients were followed up until the time of death or the point of 28-day after ICU admission. Univariate and multivariate analysis was performed to identify risk factors for 28-day survive.

**Results:** Of 8,030 cancer patients after surgical operation admitted by ICU, a total of 86 (1.1%) patients developed postoperative AKI: male/female: 62/24, median age 61 [27–82] years. The number of digestive tract/lung/other types of cancer was 59, 10 and 17, respectively. The median Simplified Acute Physiology Score III (SAPS III) was 65 [49–109] and the median Sequential Organ Failure Assessment (SOFA) score was 6 [1–19]. There were 35 deaths eventually and all the deaths occur within 28 days after ICU admission. Twenty-eight-day survive rate was 57.1%±5.8%. In multivariate cox regression analysis, two risk factors independently affected 28-day survive: SAPS III score ≥65 [hazard ratio (HR): 3.451 (1.272–9.365), P=0.015], the presence of shock at the start of CRRT [HR: 10.262 (2.210–47.660), P=0.003]. The cancer status (P=0.076), cancer types (P>0.05 for both) and neoadjuvant therapy associated with cancer (P=0.949) showed no effects on 28-day survive.

**Conclusions:** For cancer patients, postoperative AKI-stage 3 is a serious complication with a low 28-day survive rate. Patients with the presence shock at the start of CRRT or SAPS III ≥65 will have a poor 28-day survive. It should be emphasized that the cancer characteristics (status, types or treatment) don't affect 28-day survive.

**Keywords:** Cancer; postoperative; acute kidney injure (AKI); survive; continuous renal replacement therapy (CRRT)

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## Introduction

About 50% cancer patients develop acute kidney injury (AKI) and most of them require renal replacement therapy (RRT) in the intensive care unit (ICU) (1,2). AKI in these patients usually resulted from cancer itself (acute tumor lysis syndrome, urinary tract obstruction) and anticancer treatments (drug-induced nephropathy, major surgical procedures associated severe clinical complications such as ischemia, sepsis) (1-4). More and more cancer patients have opportunities to choose surgical therapy with the improvement of surgical techniques and neoadjuvant therapy (such as chemotherapy, radiotherapy before operation). Previous literature demonstrated the incidence of postoperative AKI varies from 1.1% to 17% (5-7), depending on the type of surgery. Postoperative AKI (especially in need of RRT) is a major cause of short-term mortality among surgical patients (8). There is few literature on the prognosis for critically ill cancer patients undergoing continuous renal replacement therapy (CRRT) with no-cardiac postoperative AKI (1,9-11).

Historically, the presence of malignant disease had been a common reason for refusal of admission to ICU because of poor prognosis and high costs, especially those cancer patients with organ failure. We performed this study to investigate the 28-day survive of critically ill cancer patients undergoing CRRT with postoperative AKI, which may help make cancer-related prognosis judgments and make corresponding clinical decisions. We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/tcr-20-1324>).

## Methods

### Setting and patients

This retrospective study was conducted in the ICU of Cancer Hospital, Chinese Academy of Medical Sciences from January 2010 to January 2019. The ICU is a 12-bed unit (mainly to treat critical ill cancer patients after surgery). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethics committees in our hospital approved the study (No. NCC2020C-162) and the need for informed consent was waived because there was no interference with decisions related to patient's care.

Clinical data were retrospectively retrieved from patients' charts: gender, age, type of cancer, cancer status, cancer therapy, reasons for ICU admission, systolic blood

pressure, the duration and the site of surgical operation, the presence of respiratory failure and/or shock at the time of the initiation of CRRT, the number of organ failures (including renal failure), the variables needed for calculating Sequential Organ Failure Assessment (SOFA) score and Simplified Acute Physiology Score III (SAPS III) in the first 24 hours after ICU admission. Global severity was assessed by SAPS III and SOFA. Laboratory data were collected at the start of CRRT from the medical records: serum albumin (ALB), creatinine (CRE), urea, procalcitonin (PCT), brain natriuretic peptide (BNP), troponin T (TnT), hemoglobin (HGB), white blood cell (WBC), platelets (PLT) (Table 1).

### Definition and decision for CRRT

These patients were proved malignant neoplasm pathologically. All patients enrolled were classified as stage 3 [Kidney Disease: Improving Global Outcomes (KDIGO)] (increase in serum CRE by 3.0 times baseline; or increase in serum CRE to 353.6 mol/L; or urine output <0.3 mL/kg/h for  $\geq 24$  hours; or anuria for  $\geq 12$  hours) according to 2012 KDIGO before the start of CRRT (12). Shock was defined as systolic blood pressure <90 or 40 mmHg lower than basic blood pressure for more than 1 hour in need of vasoactive drugs. Respiratory failure was defined as PaO<sub>2</sub>/FiO<sub>2</sub> ratio <300 mmHg or they were in need of mechanical ventilation (MV). SOFA score was based on six different scores, one each for the respiratory, cardiovascular, hepatic, coagulation, renal and neurological systems, extent of a patient's organ function as one to four (13). SAPS III was calculated based on guidelines provided by the SAPS III outcomes research group. Scores are generated using variables separated into three categories, all of which are available at time of admission (14).

Decision for CRRT was based on one (or more) of the following characteristics: uremia >33.2 mmol/L, hyperkalemia >6.5 mmol/L, severe metabolic acidosis (pH <7.20), clinical features of water overload, oliguria (urine output <0.3 mg/kg/h for  $\geq 24$  hours) after completely fluid resuscitation.

### CRRT operation

The CRRT modality was continuous venovenous hemofiltration (CVVH) performed in a FAD100 machine (Braun, Rio de Janeiro, Brazil) using PAN-650SF membranes (Asahi Medical, Tokyo, Japan). Femoral or

**Table 1** Characteristics of 85 enrolled patients with cancer with AKI requiring CRRT

Characteristics	N
Sex (male/female)	62/24
Age, median [range]	61 [27–82]
Types of tumor (locoregional/metastatic)	
Digestive tract	59
Lung	10
Others	17
Cancer status	
Locoregional	67
Metastatic	19
Neoadjuvant treatment given before ICU admission	
Chemotherapy	19
Radiotherapy	3
Causes of ICU admission	
Respiratory failure	16
Shock	23
Acute renal dysfunction	47
Complications	
Diabetes	16
Hypertension	35
Coronary heart disease	12
Respiratory failure at start of CRRT	53
Shock at start of CRRT	49
Sepsis shock	40
Ischemia shock	9
SAPS III at ICU admission, median [range]	65 [49–109]
SOFA score at ICU admission, median [range]	6 [1–19]
Number of organ failure at ICU admission	
One organ	17
More than one organ	69
Surgical site	
Thoracic surgery	20
Abdomen	59
Others	7

**Table 1** (Continued)**Table 1** (Continued)

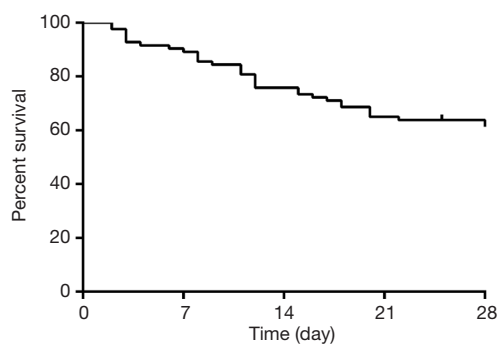
Characteristics	N
Time of surgical, median [range]	180 [60–500]
ALB (g/L), median (range)	28.0 (15.8–49.0)
CRE ( $\mu\text{mol/L}$ ), median (range)	341.0 (63.0–967.0)
Urea (mmol/L), median (range)	15.7 (1.2–109.0)
PCT (ng/mL), median (range)	4.0 (0.047–100.0)
BNP (pmol/L), median (range)	270.0 (4.3–4,128.0)
TnT (ng/mL), median (range)	0.066 (0.001–6.32)
HGB (g/L), median (range)	100.0 (49.0–192.0)
WBC ( $10^9/\text{L}$ ), median (range)	14.1 (0.9–48.2)
PLT ( $10^6/\text{L}$ ), median (range)	170.0 (5.0–655.0)

AKI, acute kidney injury; CRRT, continuous renal replacement therapy; ICU, intensive care unit; SAPS III, Simplified Acute Physiology Score III; SOFA, Sequential Organ Failure Assessment; ALB, albumin; CRE, creatinine; PCT, procalcitonin; BNP, brain natriuretic peptide; TnT, troponin T; HGB, hemoglobin; WBC, white blood cell; PLT, platelets.

internal jugular or subclavian vein catheter was used for vascular access. The blood flow was about 140 mL/min with sodium citrate (initially at 8,000 mg/h) for *in vitro* anticoagulation. Meanwhile 10% calcium gluconate was continuously pumped to body at the speed of 20 mL/h. The median cumulated overall CRRT duration was 50 (range: 14–290) hours.

### Statistical methods

Continuous variables were expressed as median and interquartile range (IQR). Patients were followed up until the time of death or the point of 28-day after ICU admission. Twenty-eight-day survival probability was estimated by the Kaplan-Meier methods. Log-rank tests were used to compare 28-day survival probability between groups. Variables yielding P values <0.05 by univariate analysis and those considered clinically relevant were entered into the multivariate cox regression analysis. Results of multivariate analysis was summarized by estimating hazards ratios (HRs) and respective 95% confidence intervals (CIs). P value <0.05 was considered statistically significant. Statistical analyses were carried out with SPSS for Windows, version 19.0 (SPSS Inc., Chicago, IL, USA).



**Figure 1** The survival rate of patients enrolled within 28 days in ICU. ICU, intensive care unit.

## Results

### *Clinical characteristics of the study population*

A total of 86 cancer patients with postoperative AKI-stage 3 treated with CRRT in the ICU were enrolled into our study. The median age was 61 (range: 27–82) years. The ratio of male to female patients was 2.58:1. The median SOFA score was 6 [1–19] and the SAPS III was 65 [49–109]. The causes for ICU admissions were divided into three categories, 16 (18.6%) patients presented with respiratory failure, 23 (26.7%) patients with shock and 48 (55.8%) patients with acute renal dysfunction. The percentage of digestive tract cancer (esophagus, stomach, colon, hepatobiliary, pancreas) and lung cancer were 68.6% and 11.6%, respectively. The remaining 19.8% of enrolled patients were other types of cancer (brain, head and neck, gynecology). Sixty-seven (77.9%) patients were presented with localized tumors and underwent a completely resection, whereas 19 (22.1%) patients were accompanied with distant metastasis and accepted palliative resection. Twenty patients were under the thoracic surgery, 59 patients were operated abdomen surgery. The remaining seven patients underwent head or neck or gynecology surgery. The median operation duration was 180 [50–100] minutes. Of 86 patients, 19 individuals were administrated with regimens of doxorubicin and ifosfamide, with or without dacarbazine. Three patients underwent 40–76 Gy of radiotherapy to primary and/or recurrent lesions within the last 90 days before operation. The number of comorbidities with diabetes, hypertension, coronary heart diseases was 16, 35, and 12, respectively. At the start of CRRT, 49 (57.0%) patients required vasopressors including 40 sepsis shock patients and nine ischemia shock patients. Fifty-three (61.6%) patients was given MV because of respiratory failure. The MV duration

was 3 [1–10] days overall. All patients enrolled received rehabilitation and general medicine services.

### *Twenty-eight-day survive for critically ill cancer patients undergoing CRRT with postoperative AKI*

Thirty-five of 86 patients died eventually after ICU admission within 28 days. The 28-day survival rate was  $57.1\% \pm 5.8\%$  (Figure 1). Among the 35 deaths, multiple organ failure was in 15 (42.9%), sepsis shock was in 10 (28.6%), respiratory failure was in 9 (25.7%), and cardiac arrest was in 6 (17.1%). Renal function was completely reestablished in 34 (66.7%) and partially reestablished in 12 (23.5%), and only 4 (9.8%) of survivors required chronic dialysis.

### *Univariate analyses of prognostic factors affecting 28-day survive*

Table 2 reported the results of the univariate analysis. Twenty-eight-day survive was associated with surgical site ( $P=0.036$ ), types of cancer ( $P=0.012$ ), serum albumin ( $P=0.017$ ), the presence of respiratory failure ( $P=0.003$ )/shock ( $P<0.001$ ) at the time of the initiation of CRRT, SAPS III ( $P<0.001$ ), SOFA score ( $P=0.021$ ), the number of organ failure ( $P=0.044$ ), causes of ICU admission ( $P=0.002$ ), the concentration of serum BNP ( $P<0.001$ ), the concentration of serum PCT ( $P<0.001$ ). The 28-day survival rate showed no significance between patients with locoregional tumor and metastatic tumor (Figure 2,  $P=0.208$ ).

### *Multivariate analysis of prognostic factors of 28-day survive (Table 3)*

In multivariate cox regression analysis: SAPS III score  $\geq 65$  [HR: 3.451 (1.272–9.365),  $P=0.015$ ] and the presence of shock at the start of CRRT [HR: 10.262 (2.210–47.660),  $P=0.003$ ] at the time of the initiation of CRRT independently affected 28-day survive. The 28-day survive rate of patients with SAPS III score  $<65$  and  $\geq 65$  were 81.3% (67.1–89.8%) and 27.6% (13.3–44.0%), respectively (Figure 3). For the whole group, SAPS III score  $\geq 65$  with a 2.451-fold increased risk of 28-day mortality than the patients with SAPS III score  $<65$  ( $P<0.001$ ). The 28-day survive rate of the patients with the presence of shock at the start of CRRT was 31.4% (17.9–45.8%), which was obviously lower than that of the patients without the presence of shock (Figure 4,  $P<0.001$ ).

**Table 2** Prognostic factors for hospital mortality—univariate analysis

Factors	N	Survive (95% CI), %	P
Age			0.975
≤60	38	54.6 (35.6–70.2)	
>60	48	59.6 (44.2–72.0)	
Gender			0.708
Male	49	58.3 (36.5–75.0)	
Female	37	56.6 (42.0–68.9)	
Cancer status			0.076
Locoregional	67	61.3 (47.2–72.7)	
Metastatic	19	42.1 (20.4–62.5)	
ALB (g/L)			0.017
<28	43	42.6 (26.2–58.2)	
≥28	43	72.1 (56.1–83.1)	
Respiratory failure			0.003
No	33	78.8 (60.6–89.3)	
Yes	53	43.7 (28.7–57.8)	
Shock			<0.001
No	37	91.9 (76.9–97.3)	
Yes	49	31.4 (17.9–45.8)	
SAPS III			<0.001
<65	48	81.3 (67.1–89.8)	
≥65	38	27.6 (13.3–44.0)	
SOFA			0.021
≤6	42	73.8 (57.7–84.6)	
>6	44	41.7 (25.5–57.0)	
Number of organ failure			0.044
One organ	17	82.4 (54.7–93.9)	
More than one organ	69	50.8 (37.4–62.8)	
CRE (mmol/L)			0.152
<350	46	48.5 (31.8–63.2)	
≥350	40	67.5 (50.7–79.7)	
Adjuvant treatment			0.949
No	64	56.4 (42.0–68.5)	
Yes	22	59.1 (36.1–76.2)	
Hypertension			0.781
No	51	53.2 (36.9–67.0)	
Yes	35	62.9 (44.8–76.5)	
Diabetes			0.894
No	70	55.8 (42.3–67.4)	
Yes	16	62.5 (34.9–81.1)	

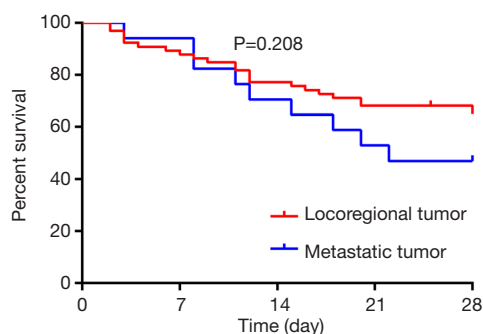
Table 2 (Continued)

Table 2 (Continued)

Factors	N	Survive (95% CI), %	P
Coronary heart disease			0.102
No	74	59.6 (46.3–70.6)	
Yes	12	41.7 (15.3–66.5)	
BNP (pmol/L)			<0.001
<270	44	75.0 (57.4–86.2)	
≥270	42	38.4 (22.9–53.6)	
TnT (ng/mL)			0.156
<0.1	52	59.8 (43.4–72.9)	
≥0.1	34	52.9 (35.1–68.0)	
PCT (ng/mL)			<0.001
<4	43	76.0 (61.6–85.6)	
≥4	43	31.9 (16.1–48.9)	
Urea (mmol/L)			0.373
<16	45	55.6 (40.0–68.6)	
≥16	41	58.9 (39.8–73.7)	
WBC (10 <sup>9</sup> /L)			0.905
<15	45	53.6 (36.1–68.4)	
≥15	41	61.0 (44.4–74.0)	
HGB (g/L)			0.674
<100	44	56.8 (41.0–69.9)	
≥100	42	57.5 (38.8–72.3)	
PLT (10 <sup>6</sup> /L)			0.483
<100	17	52.9 (27.6–73.0)	
≥100	69	58.1 (44.3–69.6)	
Time of surgical (min)			0.149
≤180	54	50.2 (34.8–63.9)	
>180	33	68.8 (49.7–81.8)	
Types of cancer			0.012
Lung	12	40.0 (12.3–67.0)	
Digestive system	59	66.1 (51.5–77.2)	
Others	15	36.6 (13.2–60.8)	
Surgical site			0.036
Thoracic	17	50.0 (24.5–71.1)	
Abdomen	57	63.3 (47.7–75.5)	
Others	12	38.5 (14.1–62.8)	
Causes of ICU admission			0.002
Respiratory failure	16	32.8 (10.3–57.9)	
Shock	23	39.9 (18.5–60.5)	
Acute renal dysfunction	47	74.5 (59.4–84.6)	

ALB, albumin; SAPS III, Simplified Acute Physiology Score III; SOFA, Sequential Organ Failure Assessment; CRE, creatinine; BNP, brain natriuretic peptide; TnT, troponin T; PCT, procalcitonin; WBC, white blood cell; HGB, hemoglobin; PLT, platelets; ICU, intensive care unit.





**Figure 2** The survival rate of patients with locoregional tumor and metastatic tumor showed no significance within 28 days ( $P=0.208$ )

## Discussion

AKI has been reported to occur in 5–7% of hospitalized patients, but it accounts for up to 20% of admissions in ICU (7). It is a common postoperative complication (15) defined by a sudden decline in the kidney function, ranging from subclinical AKI to AKI patients receiving RRT (16,17). Despite improvements in the general management of ICU patients with cancer, AKI worsens the prognosis. In patients with cancer requiring CRRT, hospital mortality rates are reported between 51% and 90% (18,19). The difference of the short-term survive may be partly attributed to the difference between solid tumors and hematological tumors. In our study, the 28-day survival rate was  $57.1\% \pm 5.8\%$ , which is higher than previous research.

RRT is an effective therapy for AKI-stage three patients to date. The KDIGO criteria advocates to start RRT when water overload becomes life-threatening or severe imbalances (such as hyperkalemia  $>6.5$  mmol/L, severe metabolic acidosis and uremia) occur (4). Historically, it remains controversial to start CRRT for AKI in critically ill patients with cancer because of the poor outcome and high costs (6,18,20–23). The rate of AKI in patients admitted to a comprehensive cancer center was higher than the rate in most noncancer settings (24). In most previous study performed in cancer patients admitted for medical complications in the ICU, the cancer characteristics were not predictive factors for hospital mortality (25). Benoit conducted a prospective cohort study in 14 ICUs from three tertiary care hospitals and founded that in general ICUs, the presence of cancer was not independently associated with hospital mortality (26). In our study, the types of cancer affected 28-day survive by univariate analysis ( $P=0.012$ ), however none of the cancer status ( $P=0.076$ ), neoadjuvant

therapy associated with cancer ( $P=0.949$ ), the types of cancer ( $P>0.05$  for both) was a prognostic factor of 28-day survive by multivariate analysis. As previously reported, short-term survive was linked to acute physiological changes induced by the complications leading to ICU admission while cancer characteristics influenced significantly survival after hospital discharge (27,28). When evaluating prognosis and the appropriateness of CRRT in these patients, cancer characteristics were not important variables to take into consideration.

Shock is often routinely considered as a poor prognostic factor. In our study, 49 patients developed shock including 40 sepsis shock and nine ischemia shock at the start of CRRT. The presence of shock at the time of the initiation of CRRT [HR: 10.262 (2.210–47.660),  $P=0.003$ ] independently affecting the 28-day-survive. Our finding was consistent with previous studies. Maccariello *et al.* (29) conducted an analysis of 150 patients and found patients with AKI in need of vasopressors to be associated with higher hospital mortality [odds ratio (OR): 3.58 (1.08–11.80)]. Another retrospective study conducted by Kim *et al.* (3), which included 4,718 patients with gastric cancer who underwent partial or total gastrectomy for gastric cancer between June 2002 and December 2011, reported that vasopressor usage was associated with a high 3-month mortality in patients with postoperative AKI.

A predictive model for short-term survive in AKI patients requiring CRRT may help clinicians' therapeutic decision-making. Sequential assessment of organ dysfunction during the first few days of ICU admission is a good indicator of prognosis (13). A single-center study conducted in a cancer-specialized ICU in Brazil reported that hospital mortality was 86.8% for AKI patients (KDIGO stage 3). SOFA and SAPS III were independent factors for mortality in this population by logistic regression analysis (30). In our study, we accepted the score of SOFA and SAPS III within the first 24 hours of admission to assess the criticality of patients. The SAPS III calculated within the first 24 hours of admission was significantly ( $P<0.001$ ) related to 28-day survive when the SAPS III was higher than 65.

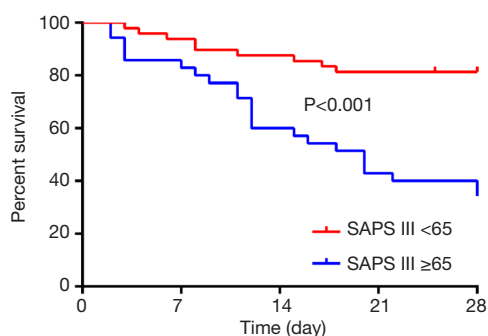
PCT is a polypeptide composed of 116 amino acids synthesized by parafollicular cells of the thyroid and the neuroendocrine cells of the lung and the intestine. It is a promising sepsis marker (31) which is suggestive of sepsis (32). Many previous studies have found that PCT levels in survivors were lower than that in non-survivors (33,34). But PCT is not an early biomarker for prognosis in septic patients because that renal function

**Table 3** Prognostic factors for hospital mortality—multivariate analysis

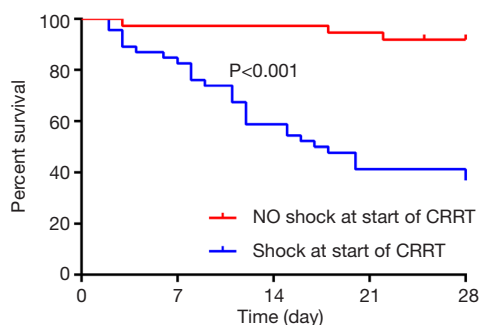
Factors	B	SE	Wald	HR	95% CI	P
Surgical site						
Abdomen						
Thoracic	-0.909	0.767	1.404	0.403	0.090–1.812	0.236
Others	1.892	0.915	2.474	6.635	1.103–39.903	0.039
Types of cancer						
Digestive system						
Lung	1.7801	0.984	3.270	5.927	0.861–40.783	0.071
Others	-0.331	0.806	0.169	0.718	0.148–3.489	0.681
ALB (g/L)						
<28						
≥28	0.189	0.480	0.154	1.207	0.471–3.092	0.694
Respiratory failure						
No						
Yes	1.036	0.577	3.225	2.817	0.910–8.721	0.073
Shock						
No						
Yes	2.328	0.783	8.832	10.262	2.210–47.660	0.003
SAPS III						
<65						
≥65	1.239	0.509	5.914	3.451	1.272–9.365	0.015
SOFA						
≤6						
>6	0.310	0.488	0.403	1.363	0.524–3.549	0.526
Number of organ failure						
<1						
≥1	0.055	0.840	0.004	1.057	0.204–5.482	0.948
BNP (pmol/L)						
<270						
≥270	0.726	0.447	2.631	2.066	0.860–4.966	0.105
PCT (ng/mL)						
<4						
≥4	0.553	0.476	1.352	1.739	0.684–4.422	0.245
Causes of ICU admission						
AKI						
Respiratory failure	0.217	0.623	0.121	1.242	0.366–4.215	0.728
Shock	-0.498	0.556	0.804	0.607	0.204–1.805	0.607

HR, hazard ratio; CI, confidence interval; ALB, albumin; SAPS III, Simplified Acute Physiology Score III; SOFA, Sequential Organ Failure Assessment; BNP, brain natriuretic peptide; PCT, procalcitonin; ICU, intensive care unit.





**Figure 3** The patients with SAPS III  $\geq 65$  with a poor prognosis compared with SAPS III  $< 65$ . SAPS III, Simplified Acute Physiology Score III.



**Figure 4** The survival rate of patients with or without shock at start of CRRT showed significance within 28 days ( $P < 0.001$ ). CRRT, continuous renal replacement therapy.

is an important determinant of PCT levels and thus different thresholds should be applied according to the renal function impairment (35). TnT is higher than normal in a large percentage of patients with acute heart failure, indicating the presence of myocardial damage and is a good independent predictor of 1-year mortality (36). BNP is known to relate with the dysfunction of the cardiovascular system (37). Previous studies have also reported the use of BNP for the assessment of volume status in critically ill patients. Elevated BNP concentrations at admission in the setting of acute coronary syndrome are associated with poor prognosis (38). There is a wealth of data on their significance as poor prognostic factors. In the present study, the concentration of PCT ( $P < 0.001$ ) and BNP ( $P < 0.001$ ) affected the 28-day survive by univariate analysis. However, none of the three was independent prognostic factors for 28-day survive.

Our study has some shortcomings. Firstly, it is a single-center, retrospective study. The type of tumor has not been further subdivided into organs and even histopathology. Secondly, when studying the impact of tumor properties on prognosis, due to the limitation of oncology hospitals, non-tumor patients could not be selected for comparison. Thirdly, due to the low incidence and long case span, previous support measures were limited, which may affect the prognosis.

## Conclusions

In conclusion, for cancer patients with postoperative AKI-stage 3 in ICU, 28-day survive rate is low and some factors may indicate poor prognosis, which was in consistent with general hospital. For these patients with advanced cancer, we should not treat them differently from patients with locoregional cancer because of undifferentiated short-term prognosis. These patients can also benefit from ICU care and advanced organ support. The presence of cancer characteristics by itself is not a reason to withhold CRRT in ICU patients with postoperative AKI.

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## Footnote

*Reporting Checklist:* The authors have completed the STROBE reporting checklist. Available at <http://dx.doi.org/10.21037/tcr-20-1324>

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*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. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethics committees in our hospital approved the study (No. NCC2020C-162) and the need

for informed consent was waived because there was no interference with decisions related to patient's care.

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