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Early postoperative albumin level following total knee arthroplasty is associated with acute kidney injury

A retrospective analysis of 1309 consecutive patients based on kidney disease improving global outcomes criteria

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Abstract

Hypoalbuminemia has been reported to be an independent risk factor for acute kidney injury (AKI). However, little is known about the relationship between the albumin level and the incidence of AKI in patients undergoing total knee arthroplasty (TKA). The aim of our study was to assess incidence and risk factors for AKI and to evaluate the relationship between albumin level and AKI following TKA.

The study included a retrospective review of medical records of 1309 consecutive patients who underwent TKA between January 2008 and December 2014. The patients were divided into 2 groups according to the lowest serum albumin level within 2 postoperative days (POD2_alb level < 3.0 g/dL vs ≥3.0 g/dL). Multivariate logistic regression analysis was used to assess risk factors for AKI. A comparison of incidence of AKI, hospital stay, and overall mortality in the 2 groups was performed using propensity score analysis.

Of 1309 patients, 57 (4.4%) developed AKI based on Kidney Disease Improving Global Outcomes criteria. Factors associated with AKI included age (odds ratio [OR] 1.05; 95% confidence interval [CI] 1.01–1.09; $P=0.030$), diabetes (OR 3.12; 95% CI 1.65–5.89; $P<0.001$), uric acid (OR 1.51; 95% CI 1.26–1.82; $P<0.001$), beta blocker use (OR 2.65; 95% CI 1.48–4.73; $P=0.001$), diuretics (OR 16.42; 95% CI 3.08–87.68; $P=0.001$), and POD2_alb level < 3.0 g/dL (OR 1.92; 95% CI 1.09–3.37; $P=0.023$). After propensity score analysis, POD2_alb level<3.0 g/dL was associated with AKI occurrence (OR 1.82; 95% CI 1.03–3.24, $P=0.041$) and longer hospital stay ($P=0.001$).

In this study, we demonstrated that POD2_alb level<3.0 g/dL was an independent risk factor for AKI and lengthened hospital stay in patients undergoing TKA.

Abbreviations: ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker, AKI = acute kidney injury, AKIN = Acute Kidney Injury Network, ASA PS = American Society of Anesthesiologists physical status, BMI = body mass index, CI = confidence interval, DM = diabetes mellitus, FFP = fresh-frozen plasma, HR = hazard ratio, IPTW = inverse probability of treatment weighting, IQR = interquartile range, KDIGO = Kidney Disease Improving Global Outcomes, MBP = mean blood pressure, NO = nitric oxide, OR = odds ratio, POD2_alb level = the lowest serum albumin level within 2 postoperative days, PRBC = packed red blood cells, PS = propensity score, RIFLE = Risk, Injury, Failure, Loss, and End-stage kidney disease, sCr = serum creatinine, TKA = total knee arthroplasty, UA = uric acid.

Keywords: acute kidney injury, arthroplasty, hypoalbuminemia, knee

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1. Introduction

There has been a growing need for total knee replacement arthroplasty (TKA) as a life-changing surgery.[1,2] In elderly patients with osteoarthritis of the knee, TKA is the choice of treatment in advanced stages of the disease.[3] Metabolic syndrome, clustering of obesity, hypertension, and diabetes (DM) are not only considered as risk factors for osteoarthritis,[4] but are also related with postoperative morbidity and mortality.[5,6] Although TKA is known to be a safe surgery, a considerable number of patients undergoing TKA are susceptible to postoperative morbidity and mortality due to metabolic syndrome.

The incidence of acute kidney injury (AKI) varies from 0.8% to 10% in patients with noncardiac surgery, depending on which AKI definition is used.[7,8] Recently, the International Kidney Disease Improving Global Outcomes (KDIGO) criteria combined Risk, Injury, Failure, Loss, and End-stage kidney disease (RIFLE) and Acute Kidney Injury Network (AKIN) criteria.[9] Postoperative AKI is related with elongated hospital stay and increased morbidity and mortality after noncardiac surgery.[7,10] It has been shown that there are multiple risk factors for AKI, including perioperative hypotension, advanced age, high body mass index

(BMI), emergency surgery, use of vasopressor infusion, and administration of diuretics in various settings.[11–13]

Hypoalbuminemia has also reportedly been an independent risk factor for AKI.[14,15] The physiologic functions of albumin include free-radical scavenging, control of plasma volume by maintenance of colloid oncotic pressure, and effects on capillary membrane permeability.[16] Although the positive effect of albumin on renal function is not clearly understood, its renoprotective effect has been suggested in many previous studies.[17,18] Recently, it has been shown that early postoperative low albumin level was associated with AKI after liver transplantation.[19] However, little is known about the prevalence and risk factors for AKI following TKA. Moreover, the relationship between immediate postoperative hypoalbuminemia and AKI after TKA has not been elucidated. Therefore, the aim of this study was to assess the incidence and risk factors for AKI following TKA based on the KDIGO criteria. In addition, we assessed the influence of early postoperative serum albumin level on the development of AKI following TKA. We also evaluated the occurrence and risk factors for mortality after TKA.

2. Methods

2.1. Study population

The medical records of patients who underwent primary unilateral TKA between January 2008 and December 2014 in single center, a tertiary teaching hospital in Seoul, South Korea, were retrospectively reviewed. A total of 2579 consecutive patients who underwent primary unilateral TKA surgery (emergency and revision operations were excluded) were recognized through our electronic medical records system. Of these, 1270 were excluded, including those who underwent bilateral TKA, 1 or 2 weeks apart from each other (n=1,056), those who underwent a combined operation (n=3), those whose preoperative serum creatinine (sCr) level was >1.5 mg/dL or those who had chronic kidney disease (n=30), and those with incomplete data (n=181). There were no patients who had severe liver dysfunction. In the final analysis, 1309 patients were included. The included patients were divided into 2 groups by the lowest serum albumin level within 2 postoperative days (POD2_alb level) (≥ 3.0 g/dL [group 1, n=839] and < 3.0 g/dL [group 2, n=470]) (Fig. 1). This study was accepted by the

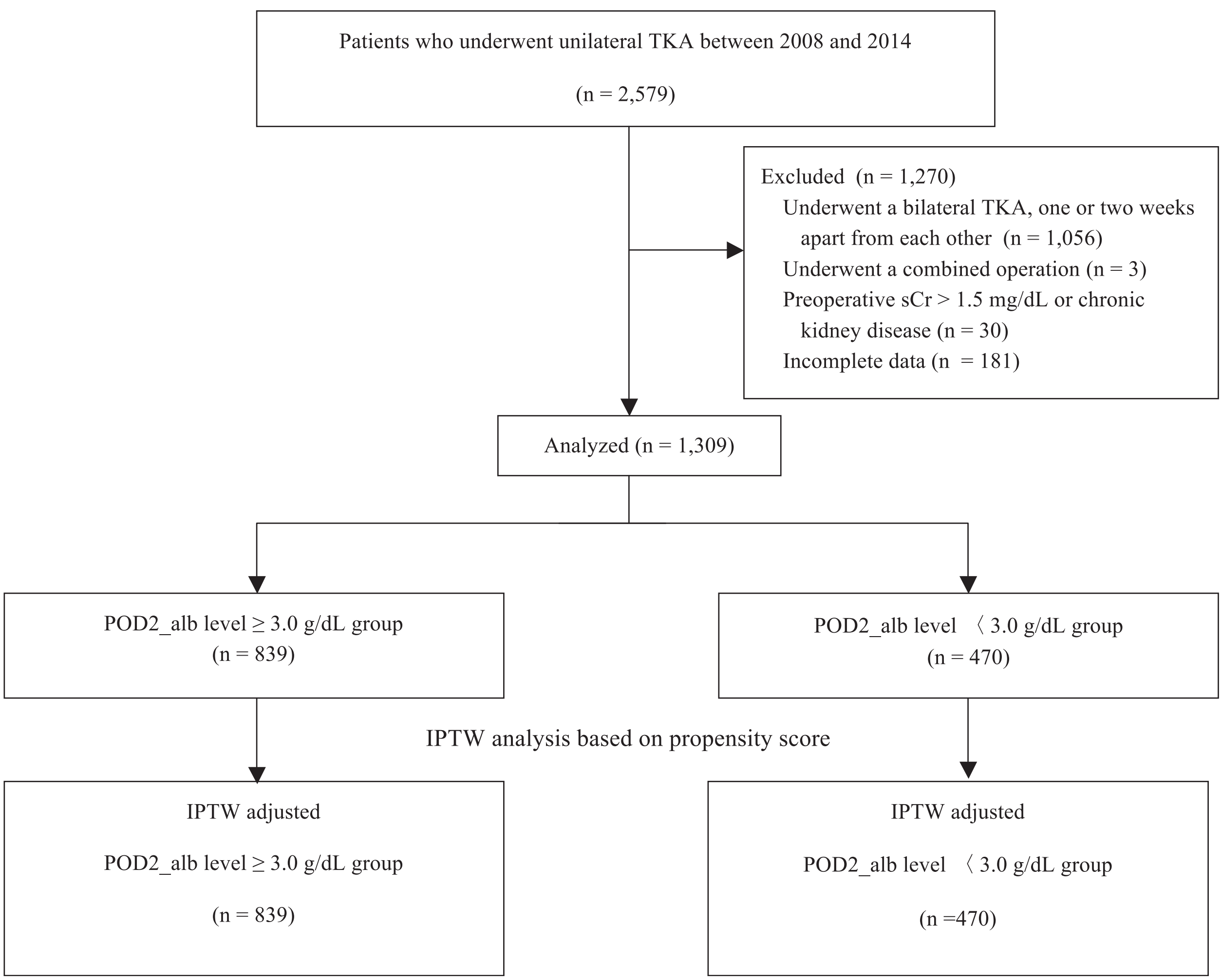

Figure 1. Study flow diagram. IPTW=inverse probability of treatment weighting, POD2_alb level=the lowest serum albumin level within 2 postoperative days, sCr=serum creatinine, TKA=total knee arthroplasty.

Institutional Review Board of the Asan Medical Center (2015-0472) and informed consent was waived as we only reviewed the electronic medical records in this current retrospective study.

2.2. Clinical data

We obtained the demographic and laboratory and perioperative data of patients from electronic medical records at our institution. The demographic data included age, sex, BMI, underlying disease (DM, hypertension, cerebrovascular accident, pulmonary disease, and ischemic heart disease), American Society of Anesthesiologists physical status (ASA PS), smoking history, and preoperative medications. Laboratory data included hemoglobin, platelet count, albumin, sCr, and uric acid (UA). Perioperative data included anesthetic technique (general vs regional anesthesia), intraoperative crystalloid and colloid amount, use of diuretics and vasopressors, the lowest mean blood pressure (MBP), transfusion (packed red blood cells [PRBC], fresh-frozen plasma [FFP], and platelets), urine output, anesthetic time, and tourniquet time.

2.3. Definition of outcomes

The main result of the present study was to define the incidence of AKI analyzed by KDIGO criteria.[9] The incidence of AKI was described by a change in the sCr level on postoperative days 1 to 7 compared with the baseline sCr level, described as the latest concentration measured before surgery. In relation to KDIGO criteria, AKI was diagnosed by alteration of sCr level ≥ 0.3 mg/dL within 48 hours, or rise in the sCr level ≥ 50% within the prior 7 days. AKI was staged for severity according to the KDIGO criteria; stage 1, 1.5 to 1.9-fold increase or ≥ 0.3 mg/dL increase in the sCr level from baseline; stage 2, 2.0 to 2.9-fold increase in the sCr level from baseline; stage 3, 3-fold increase in the sCr level from baseline or increase to ≥ 4.0 mg/dL in the sCr level or initiation of renal replacement therapy. The secondary aim was to evaluate the hospital stay and overall mortality. The information about in-hospital mortality was identified by the review of electronic medical records.

2.4. Statistical analysis

All data are presented as the mean ± standard deviation, median (interquartile range [IQR]), or number (percentages). Baseline characteristics and perioperative data were compared between the 2 groups by the chi-square or Fisher's exact test for categorical variables. Continuous variables were compared using Student's *t* test or the Mann–Whitney *U* test. To assess risk factors for AKI, multivariate logistic regression analysis by backward elimination included all the variables with a *P* value of <0.1 in univariate analysis. The Hosmer–Lemeshow test ($\chi 2$ = 10.557, df = 8, P = 0.228) was identified for the calibration of the multivariate logistic regression models in Table 2. Multivariate Cox proportional hazard regression analysis was utilized to calculate the adjusted hazard ratios (HR) of the associations between the albumin concentration and outcomes to evaluate risk factors for mortality. The proportional hazards assumption for each variable was identified by log–log survival curve and Schoenfeld residuals test. Cumulative survival rates were analyzed using the Kaplan–Meier analysis, and alterations between curves were estimated by the log-rank test.

The influence of possible confounding factors was reduced by performing inverse probability of treatment weighting (IPTW) based on the propensity score (PS) analysis.[20] For this technique, the weights for patients having ≥3.0 g/dL for postoperative albumin value were the inverse of 1 minus the propensity score, and weights for patients being <3.0 g/dL were the inverse of the propensity score. The optimal cutoff value of postoperative albumin was determined by the Youden index. The propensity scores were estimated using multiple logistic regression with postoperative albumin value as dependent variable. All the parameters presented in Table 1 were used to obtain the PS. Model discrimination was assessed with c statistics (0.712), and model calibration was assessed with Hosmer–Lemeshow statistics (χ^2 = 6.389; df = 8, P = 0.604). After the adjustment by IPTW, the outcome variables including incidence of AKI and survival probability were compared using weighted logistic regression and weighted Cox proportional hazards model with robust standard errors respectively, and the length of hospital stay was analyzed by a weighted *t*-test after log transformation. All *P* values < 0.05 were determined statistically significant. SAS Version 9.1 (SAS Institute Inc., Cary, NC) or R software version 2.10.1. was used in handling and analyzing data.

3. Results

A total of 1309 patients who underwent TKA were included in this study. The median follow-up of these patients was 4.2 years (IQR 2.4–5.7). AKI occurred in 57 (4.4%) patients. The incidences of stage 1 and 2 AKI were 53 (4.0%) and 4 (0.3%), respectively. There was no stage 3 AKI in our study population. The overall survival rates for 1 year, 3 years, and 5 years were 99.3 (95% CI: 98.7–99.6), 97.6 (95% CI: 96.5–98.4), and 94.9 (95% CI: 93.2–96.2), respectively. Table 1 shows the baseline characteristics including demographic and perioperative data of the patients categorized on the basis of POD2_alb level. Group 1 patients had higher incidence of DM, to be on preoperative aspirin and statin medication, and to be younger than group 2 patients. Moreover, patients in group 1 had higher BMI, hemoglobin, and albumin levels. As the patients who underwent elective TKA were relatively healthy (the majority of patients were ASA PS 1 or 2 [95.8%, Table 1]), 91.1% of the study population had their preoperative albumin levels within normal range (normal range: 3.5–5.2 g/dL in our center). Anesthetic time and tourniquet time were prolonged in group 1. After reducing the effect of confounding factors by the IPTW method, all standardized differences were <0.25.

Multivariate logistic regression analysis revealed that age (OR, 1.05; 95% CI, 1.01–1.09; P = 0.030), DM (OR, 3.12; 95% CI, 1.65–5.89; P < 0.001), preoperative beta blocker use (OR, 2.65; 95% CI, 1.48–4.73; P = 0.001), UA level (OR, 1.51; 95% CI, 1.26–1.82; P < 0.001), intraoperative diuretic use (OR, 16.42; 95% CI 3.08–87.68; P = 0.001), and POD2_alb level < 3.0 g/dL (OR, 1.92; 95% CI 1.09–3.37; P = 0.023) were risk factors for AKI by the KDIGO criteria (Table 2). In multivariate Cox proportional hazards analysis, AKI (HR, 3.41; 95% CI 1.69–6.86; P = 0.001), general anesthesia (HR, 2.27; 95% CI 1.09–4.72; P = 0.028), and age (HR, 1.09; 95% CI 1.05–1.13; P < 0.001) were independent predictors of mortality following TKA surgery (Table 3).

The intergroup differences of postoperative outcomes stratified by the POD2_alb level are shown in Table 4. Crude (univariate) analysis indicated that the POD2_alb level < 3.0 g/dL was related with the occurrence of AKI (OR, 1.77; 95% CI, 1.04–3.01; P = 0.036). The hospital stay was longer in patients with POD2_alb level < 3.0 g/dL than that of the POD2_alb level ≥ 3.0 g/dL group (16.6 ± 5.6 days vs 16.0 ± 4.2 days, respectively, P = 0.024). After IPTW adjustment, the POD2_alb level < 3.0 g/dL was also

Table 1

Demographic, laboratory, and intraoperative characteristics of all patients.

		The lowest serum albumin level within 2 postoperative days				
Characteristics	**Total (n = 1309)**	**≥3 (n = 839)**	**<3 (n = 470)**	***P***	**Standardized difference**	**Standardized difference***
Demographic						
Age, years	68.8±7.1	63.4±7.1	69.6±7.0	0.003	0.171	0.009
Sex, female	1155 (88.2)	735 (87.6)	420 (89.4)	0.344	0.055	0.036
Body mass index, kg/m^2	26.5±3.4	26.8±3.3	26.0±3.5	< 0.001	0.23	0.076
ASA PS 1–2/3–4	1254 (95.8)/55 (4.2)	807 (96.2)/32 (3.8)	447 (95.1)/23 (4.9)	0.442	0.096	0.035
Diabetes mellitus	181 (13.8)	128 (15.3)	53 (11.3)	0.045	0.118	0.02
Hypertension	414 (31.6)	269 (32.1)	145 (30.9)	0.651	0.026	0.012
Ischemic heart disease	120 (9.2)	83 (9.9)	37 (7.9)	0.224	0.071	0.007
Cerebrovascular accident	79 (6.0)	51 (6.1)	28 (6.0)	0.741	0.019	0.002
Pulmonary disease	55 (4.2)	34 (4.1)	21 (4.5)	0.719	0.021	0.031
Smoking history	93 (7.1)	59 (7.0)	34 (7.2)	0.930	0.08	0.003
Calcium channel blocker	517 (39.5)	339 (40.4)	178 (37.9)	0.368	0.052	0.015
ACEi/ARB	463 (35.4)	297 (35.4)	166 (35.3)	0.977	0.002	0.04
Beta blocker	232 (17.7)	151 (18)	81 (17.2)	0.729	0.020	0.027
Aspirin	314 (24.0)	223 (26.6)	91 (19.4)	0.003	0.172	0.013
Statin	360 (27.5)	251 (29.9)	109 (23.2)	0.009	0.153	0.016
Laboratory						
Hemoglobin, g/dL	12.7±1.2	12.8±1.2	12.6±1.3	0.015	0.139	0.019
Platelets, ×10^3/μL	243.3±62.3	243.2±60.6	243.4±65.2	0.952	0.003	0.009
Albumin, g/dL	3.9±0.3	4.0±0.3	3.8±0.3	< 0.001	0.582	0.021
Creatinine, mg/dL	0.7±0.2	0.7±0.2	0.8±0.2	0.385	0.05	0.006
Uric acid, mg/dL	4.8±1.3	4.8±1.3	4.7±1.3	0.181	0.077	0.011
Intraoperative						
General anesthesia	1084 (82.8)	700 (83.4)	384 (81.7)	0.426	0.046	0.025
Crystalloid, mL	750 (550–950)	750 (600–1000)	750 (500–950)	0.091	0.042	0.029
Colloid, mL	500 (300–600)	500 (300–600)	500 (300–550)	0.832	0.009	0.048
Vasopressor use	211 (16.1)	135 (16.1)	76 (16.2)	0.97	0.002	0.005
Diuretics use	11 (0.8)	8 (1.0)	3 (1.0)	0.755	0.035	0.03
Red blood cell transfusion	983 (75.1)	634 (75.6)	349 (74.3)	0.599	0.03	0.013
Urine output, mL	90 (45–210)	100 (45–210)	90 (43.8–200)	0.488	0.065	0.022
Anesthetic time, min	164.7±30.4	165.2±27.5	163.7±35.1	0.031	0.046	0.042
Tourniquet time, min	102.2±24.9	104.3±24.1	98.5±26.0	< 0.001	0.231	0.037
Lowest MBP, mmHg	71.3±9.1	71.3±9.1	71.4±9.1	0.948	0.004	0.006

Values are presented as the mean±SD, n (%), or median (interquartile range). All the laboratory data were obtained before the day of surgery.
ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker, ASA PS = American Society of Anesthesiologists physical status, MBP = mean blood pressure.
* Standardized difference adjusted IPTW.

Table 2

Univariate and multivariate analyses for AKI based on the KDIGO criteria.

	Univariate				Multivariate			
	OR	**95%**	**CI**	***P***	**OR**	**95%**	**CI**	***P***
Age	1.07	1.03	1.11	0.002	1.05	1.01	1.09	0.030
Sex	1.86	0.94	3.66	0.075				
Diabetes mellitus	2.82	1.56	5.09	0.001	3.12	1.65	5.89	<0.001
Hypertension	2.17	1.27	3.69	0.004				
Cerebrovascular accident	2.29	1.01	5.24	0.049				
ACEi/ARB	1.81	1.07	3.09	0.028				
Beta blocker	3.65	2.11	6.31	<0.001	2.65	1.48	4.73	0.001
Aspirin	1.91	1.10	3.32	0.022				
Hemoglobin	0.79	0.64	0.99	0.041				
Creatinine	8.08	2.35	27.80	0.001				
Uric acid	1.55	1.30	1.85	<0.001	1.51	1.26	1.82	<0.001
Intraoperative diuretics	5.02	1.06	23.80	0.042	16.42	3.08	87.68	0.001
POD2_alb < 3.0 g/dL	1.77	1.04	3.01	0.036	1.92	1.09	3.37	0.023

AKI = acute kidney injury, ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker, CI = confidence interval, KDIGO = Kidney Disease Improving Global Outcomes, OR = odds ratio, POD2_alb = the lowest serum albumin level within 2 postoperative days.

Table 3

Univariate and multivariate analyses of risk factors for overall mortality.

	Univariate				Multivariate			
	HR	95%	CI	*P*	HR	95%	CI	*P*
Age	1.11	1.07	1.15	<0.001	1.09	1.05	1.13	<0.001
Body mass index	0.90	0.84	0.97	0.004				
Hypertension	1.63	0.98	2.72	0.063				
Cerebrovascular accident	3.08	1.46	6.50	0.003				
ACEi/ARB	1.58	0.94	2.64	0.083				
Beta blocker	2.15	1.24	3.74	0.007				
Hemoglobin	0.83	0.68	1.00	0.052				
Creatinine	4.94	1.65	14.83	0.004				
General anesthesia	3.50	1.67	7.34	0.001	2.27	1.09	4.72	0.028
Acute kidney injury	5.23	2.65	10.33	<0.001	3.41	1.69	6.86	0.001
POD2_alb < 3.0 g/dL	1.67	1.00	2.77	0.050				

ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker, CI = confidence interval, HR = hazard ratio, POD2_alb = the lowest serum albumin level within 2 postoperativedays.

associated with AKI (OR, 1.82; 95% CI, 1.03–3.24; $P=0.041$) and longer hospital stay than POD2_alb level ≥ 3.0 g/dL (16.7 ± 5.5 days vs 15.9 ± 4.2 days, respectively, $P=0.001$). The Kaplan–Meier survival curve demonstrated that the incidence of overall mortality was higher in patients with AKI than in those without AKI (log-rank test, $P<0.001$, Fig. 2). However, no correlation was found between POD2_alb level < 3.0 g/dL and overall mortality after IPTW adjustment in patients who underwent TKA (HR, 0.99; 95% CI 0.58–1.68; $P=0.973$).

4. Discussion

In this study, we demonstrated that the prevalence of AKI was 4.4% in patients who underwent unilateral TKA. Multivariate analysis revealed that age, DM, preoperative beta blocker use, high UA level, intraoperative diuretic use, and POD2_alb level < 3.0 g/dL were related with AKI by KDIGO criteria. Even after IPTW adjustment, the POD2_alb level was an independent risk parameter for AKI based on the KDIGO criteria and longer hospital stay. However, no relationship was found between POD2_alb level and overall mortality.

Previous studies have reported that AKI occurred in 0.8 to 10% after noncardiac surgeries.[7,8,21] The prevalence of AKI in this study was within the range of previous reports. In spite of the previous studies, Kateros et al. and Grams et al. demonstrated that the occurrences of AKI after orthopedic surgeries were 8.9% and 11.2%, respectively.[21,22] However, due to disparity of the surgery types, the incidence of AKI in current study was ~50% less than the above 2 studies. We only included TKA and excluded emergent and revision surgery, which are known to be significant predictors of AKI.[11,23]

Although the mechanism has not been fully elucidated, studies have shown that albumin has a renoprotective effect.[17,18,24] The renoprotective effect may be mediated by antioxidant and anti-inflammatory properties. Albumin can act as an antioxidant by ligand-binding and free radical-trapping properties.[24] A previous study reported that albumin plays an important role in survival of renal tubular cells and macrophages by scavenging of reactive oxidative species.[17] Moreover, albumin stimulates the proliferation of renal tubular cells by activating phosphatidylinositide 3-kinase.[25] Albumin has been shown to possess a reservoir function for signaling molecules and donors of nitric oxide (NO).[26] NO generated from L-arginine raises renal blood flow and the glomerular filtration rate by dilation of vessels, and improves renal function.[27,28] Additionally, albumin tends to improve microcirculatory performance, thus supporting maintenance of major organ function.[29] Notably, the endothelial glycocalyx layer, an albumin-rich layer made of glycosaminoglycans, is known to be crucial to the endothelial barrier, and the disruption of the glycocalyx layer is associated with protein extravasation, tissue edema, and accelerated inflammation.[30] A recent study demonstrated that the endothelial glycocalyx layer might be damaged in patients with AKI in liver transplantation.[31] In relation to postoperative hypoalbuminemia, injury of the endothelial glycocalyx layer may contribute to change in oncotic pressure gradients, and albumin and fluid leakage into the interstitium, all of which could possibly result in AKI occurrence following TKA.

Wiedermann et al[14] provided evidence that hypoalbuminemia is a significant predictor of both AKI and mortality following AKI development in various settings. Lee et al[15] also reported that preoperative hypoalbuminemia is a major risk factor for AKI

Table 4

Comparison of the AKI incidence and overall mortality by the lowest serum albumin level within 2 postoperative days.

			Crude			IPTW		
Outcome	POD2_alb	Event/N	OR	95% CI	*P*	OR	95% CI	*P*
AKI	≥3.0	29/839	1			1		
	<3.0	28/470	1.77	1.04–3.01	0.036	1.82	1.03–3.24	0.041
			HR	95% CI	*P*	HR	95% CI	*P*
Overall mortality	≥3.0	29/839	1			1		
	<3.0	31/470	1.67	1.00–2.77	0.050	0.99	0.58–1.68	0.973

AKI = acute kidney injury, CI = confidence interval, HR = hazard ratio, IPTW = inverse probability of treatment weighting, OR = odds ratio, POD2_alb = the lowest serum albumin level within 2 postoperative days.

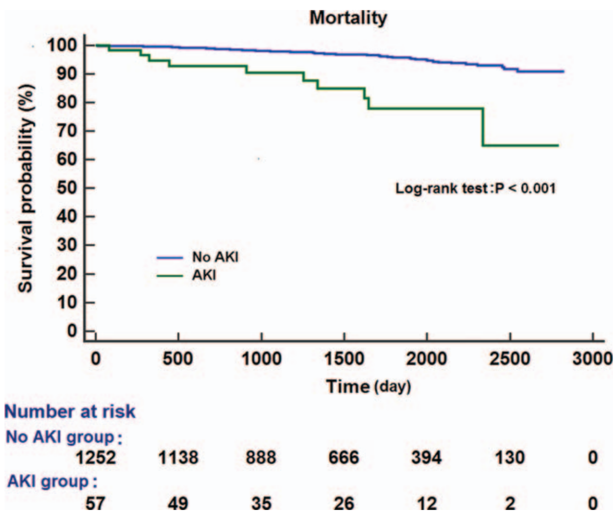

Figure 2. Kaplan–Meier survival curve. The survival rate of patients with acute kidney injury was significantly lower than in those without acute kidney injury (log-rank test, $P < 0.001$).

after off-pump coronary artery bypass surgery. In addition, Sang et al[19] showed that the POD2_alb level was a potent predictor of AKI defined according to both the AKIN and RIFLE criteria, and that AKI was related to overall mortality in patients with living donor liver transplantation. However, there is little information about the association with early postoperative albumin level and AKI occurrence in TKA. To our knowledge, the present study is the first to demonstrate the association between postoperative low albumin level and AKI in patients undergoing TKA surgery. We selected early postoperative hypoalbuminemia as a main factor for the development of AKI because early detection of risk factors for AKI would be beneficial in perioperative management and could improve the clinical outcome.[7,10] In this current study, the POD2_alb level turned out to be an independent risk parameter for AKI based on the KDIGO criteria in patients who underwent primary unilateral TKA.

Although administration of albumin had beneficial effects on renal function in a recent meta-analysis,[14] conflicting results have been demonstrated. Frenette et al identified a dose–response relationship between albumin administration and the risk for AKI in cardiac surgery patients.[32] Nonetheless, Caironi et al[33] showed that maintenance of albumin level >3 mg/L did not have an advantage in reducing renal dysfunction or in increasing overall survival in patients with severe sepsis. Further multicenter randomized controlled trials will be required to investigate whether administration of albumin could prevent renal injury.

In this study, general anesthesia, age, and AKI were risk factors for overall mortality following TKA. Among these, AKI was the most potent predictor of overall mortality. Many previous studies have already revealed that AKI is allied with mortality.[10,34] Moreover, in the present study, the POD2_alb level was an independent risk factor for AKI. As a result, the POD2_alb level may have indirectly influenced overall mortality by preceding AKI in patients undergoing TKA.

The present study had some limitations. We conducted our study as a retrospective observational analysis. Though we tried to take into account confounding factors and reduce bias through the IPTW method, it was impossible to exclude the effect of hidden factors. Additionally, because our study was an observational analysis, we could not determine a causal relationship between the POD2_alb level and the risk of postoperative AKI and overall mortality.

In conclusion, AKI occurred in 4.4% of patients who underwent unilateral TKA. POD2_alb concentration is an independent risk factor for AKI using the KDIGO criteria. Further prospective study will be necessary to approve the causal relationship between albumin and AKI in patients with TKA.

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