Acute Kidney Injury In Turkey: Epidemiological Characteristics, Etiology, Clinical Course And Prognosis

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Abstract

Background: In this study, we aimed to evaluate the etiology, comorbidities and outcome of acute kidney injury (AKI) in our country, and if there is, to demonstrate any potential differences in different geographical parts of the country.

Methods: This prospective observational study was carried on by Acute Kidney Injury Working Group of Turkish Society of Nephrology. Demographical and clinical data of AKI patients at the time of diagnosis, at the 1st week and 1st, 3rd and 6th months were evaluated to determine patient and renal survival, and factors associated with prognosis.

Results: 776 patients were included (54.7% male, median age: 67 years). Prerenal causes were more frequent, namely dehydration, heart failure and sepsis. 58.9% of patients had at least one renal etiology, most frequently nephrotoxic agent exposure. Etiologic factors were mostly similar through the country. 33.6% of patients needed renal replacement therapy. At the 6th month of diagnosis, 29.5% of patients had complete, 34.1% had partial recovery, end stage kidney disease ensued in 9.5% and 24.1% died. Death rate was higher in patients from Eastern Anatolian region, those in intensive care unit, patients with prerenal, renal and postrenal etiologies together, stage-3 AKI, sepsis, cirrhosis, heart failure, malignancy, need for renal replacement therapy and those without chronic kidney disease.

Conclusion: Physicians dealing with AKI should be alert against dehydration, heart failure and sepsis, nephrotoxic agent exposure while taking care of these patients. Being aware of the characteristics of AKI patients and outcomes in their country would help to prevent AKI and treating better.

Background

Acute kidney injury (AKI) is an important part of nephrology practice in both inpatient and outpatient clinics including emergency departments. There have been different criteria suggested to be used for the diagnosis of AKI during the last decade. The most recent description of AKI has been developed by Kidney Disease Improving Global Outcomes (KDIGO) in 2012 as a sudden decline (within 48 hours) in kidney function (serum creatinine > 0.3 mg/dl, or >50% increase in serum creatinine in 7 days, or decreased urine output of < 0.5 ml/kg/hour for more than six hours) [1].

The incidence of AKI has been reported variably in different studies, possibly in part due to changing criteria for the diagnosis and diversity of the study population. AKI is a multifactorial condition; there are many clinical conditions and medications which are responsible for the development of AKI. But more importantly, whatever the etiology is, AKI was found to be associated with increased morbidity and mortality and worst outcome [2]. Both the etiology and the prognosis of AKI may show differences in various regions with different socio-economic status. AKI is not important for only the short term prognosis, but also for long term mortality. Lafrance et al [2] retrospectively analyzed 82711 hospitalized US veteran patients with AKI. 17.4% of patients who survived at least 90 days after AKI were reported to die during follow-up, and mortality was higher in those with more severe AKI. Besides patient mortality, AKI was found to be associated with worse renal survival, and may lead to chronic kidney disease (CKD). Iram et al [3] reported that 4.35% of their AKI patients died and CKD developed in 28.69%. There are similar reports about this subject in the literature [4–6].

In this study, we aimed to evaluate etiology and outcome of AKI in our country, and to analyze any potential differences in different geographical regions.

Methods

This prospective observational study was carried on by the Acute Kidney Injury Working Group of Turkish Society of Nephrology. The investigators were asked to evaluate their AKI patients according to the criteria proposed by KDIGO at inpatient and emergency clinics as well as intensive care units (ICU). All the parameters of AKI patients who gave informed consent were recorded into a web based database. Duration of the study was one year.

The demographical parameters including age and gender, the date and place of AKI diagnosis, the clinic where the patient was diagnosed to have AKI, status of hospitalization, the duration between initial hospitalization and the diagnosis of AKI, basal creatinine and estimated glomerular filtration rate (eGFR) were recorded for each patient. Serum creatinine level before 48 hours was accepted as the basal creatinine in patients with AKI during hospital follow-up, and in patients with AKI at the time of admission the creatinine level at the previous week in any was accepted as the basal level. The stage of AKI defined by KDIGO was recorded.

The etiology of AKI was recorded and classified in three major subgroups as prerenal, renal and postrenal causes. Prerenal causes included dehydration, gastrointestinal losses, heart failure, burns, sepsis, liver cirrhosis and ascites. Renal factors were classified as ischemic events, nephrotoxin exposure, glomerulonephritis, vasculitis, tubulointerstitial nephritis and diabetic nephropathy. Nephrotoxic agents were listed as aminoglycosides, radiocontrast material, non-steroidal anti-inflammatory drugs (NSAID), renin-angiotensin-aldosterone system (RAS) blockers, colistin, amphotericin, chemotherapeutic agents and other. Postrenal factors were recorded as stone and malignancies of the urinary tract, prostatic disease, retroperitoneal fibrosis, and vesicoureteral reflux (VUR). The clinicians were free to select more than one option.

The clinicians were asked to select one or more causes for hospitalization that were grouped as respiratory, cardiovascular, cerebrovascular diseases, hematological, gastroenterological and hepatological diseases, genitourinary system diseases, infections, immunosuppressive status, cardiovascular surgery, major or minor non-cardiac surgery. Co-morbidities included diabetes mellitus (DM), hypertension, ischemic cardiovascular disease, CKD, chronic obstructive pulmonary disease (COPD), heart failure, liver cirrhosis and malignancies. Co-morbidities were described based on the medical history of the patients.

The clinicians were asked to fill data about sepsis and SIRS. SIRS criteria were defined as body temperature over 38°C, or below 36°C, heart rate over 90/min, respiratory rate over 20/min, PaCO_2 above 32 mmHg, white blood cell count more than 12000/mm³ or below 4000/mm³, or ratio of bands over 10%. Sepsis was diagnosed when the evidence of infection and organ dysfunction was added [7, 8].

Besides the first evaluation, follow-up visits were performed as 1st week, 1st month, 3rd month and 6th month of the diagnosis of AKI. The clinicians recorded the outcome as complete recovery, partial recovery, end stage kidney disease (ESKD) and death as well as data related to kidney replacement therapy (KRT) if needed at each visit. Complete recovery was defined as creatinine levels falling to the basal level while partial recovery was defined as more than 50% decrease in creatinine levels that did not reach basal level. The types of KRT being

intermittent hemodialysis (IHD), continuous kidney replacement therapies (CKRT), peritoneal dialysis (PD) were recorded. More than one option could be chosen if used during the follow-up. Demographical and clinical parameters that determined the prognosis of AKI have been searched with Cox regression analysis.

Statistical analysis: Descriptive parameters were expressed as number and percentages for categorical variables and median and interquartile range for numerical ones. The comparison of the numerical parameters of two independent groups was performed with Mann Whitney U test as these were unevenly distributed. Chi square test was used for comparison of categorical variables. Risk factors for AKI were analyzed by Cox regression analysis. Statistical alpha significance was defined as $p < 0.05$.

Results

776 patients were analyzed totally after excluding those with missing data. 420 (54.1%) of them were male, all were Caucasian except one black patient. The median age was 67 years (IQR: 56–77 years). The centers providing data were classified according to the region of the country as Marmara-1, Marmara-2, Central, Southern and Eastern Anatolian regions. The names of the regions, centers and the number of patients included by each region are presented in Table-1.

AKI was diagnosed in 357 (47.9%) inpatients, 126 (16.9%) ICU patients and in 262 (35.2%) emergency clinic patients. The median duration between hospitalization and AKI diagnosis was 0 (IQR: 0–1) day. The median basal creatinine and eGFR values of the patients, excluding 153 patients with no data, were 1.20 (IQR: 0.89–1.80) mg/dl and 47 (IGR: 25–80) ml/min/1.73m², respectively.

The etiology of AKI is presented in Table-2. Prerenal causes were more frequent, dehydration being the most prevalent among them. This was followed by heart failure and sepsis. 58.9% of patients had at least one renal etiology among which exposure to a nephrotoxic agent was the most frequent. NSAIDs, RAS blockers and radiocontrast agents were in the first three among these toxic agents. Postrenal causes were recorded in 13.5% of patients. 275 (35.4%) patients had both prerenal and renal factors, 56 (7.2%) patients had prerenal and postrenal factors, 35 (4.5%) had renal and postrenal factors while 25 (3.2%) patients had etiological factors from all three subgroups.

Prerenal factors were more prevalent in the Marmara-2 and Southern Anatolian regions. Dehydration and heart failure were more frequent in Marmara-2 group while sepsis was more prevalent in Southern Anatolian region. Renal factors were also more frequent in the Marmara-2 and Southern Anatolian regions. Ischemic factors were more frequently reported in Marmara-2 region, and exposure to nephrotoxic agents, mostly radiocontrast material and RAS blockers were more prevalent in Southern Anatolian region compared to other groups. The frequency of postrenal factors was similar in all regions.

Causes for hospitalization and comorbidities are presented in Table-3. The most frequent cause of hospitalization was genitourinary diseases followed by infections and cardiovascular diseases. The most frequent comorbidities were hypertension and DM. 33.6% of patients were reported to have CKD.

The number of patients with Stage-1, -2 and - 3 AKI according to KDIGO classification were 185 (23.9%), 259 (33.4%) and 331 (42.7%), respectively. The mean creatinine values of patients with stage-1, -2 and - 3 AKI were 2.46 ± 1.26 mg/dl, 3.17 ± 1.40 mg/dl and 5.89 ± 3.60 mg/dl, respectively. The corresponding eGFR values were

74.0 ± 55.4 ml/min/1.73m², 48.3 ± 34.8 and 47.8 ± 41.0 ml/min/1.73m² in order. Regarding SIRS criteria, body temperature more than 38°C or less than 36°C was recorded in 135 patients (17.4%), heart rate above 90/min in 190 patients (24.5%), respiratory rate exceeding 20/min or P_aCO₂ above 32 mmHg in 133 patients (17.1%) and white blood cell count above 12000/mm³ or below 4000/mm³ or the ratio of band forms more than 10% in 214 patients (27.6%). There were none of the SIRS criteria in 491 patients (63.3%), while 87 patients (11.2%) had one, 63 patients (8.1%) had two, 81 patients (10.4%) had three and 54 patients (7.0%) had four of the SIRS criteria. Sepsis was recorded in 179 patients (23.1%).

During follow-up, 254 patients (33.6%) needed KRT as IHD in 229 patients, IHD and CKRT in eight patients, IHD and PD in three patients and PD in one patient. The regions were different significantly ($p < 0.001$) regarding the frequency of use of KRTs (Table-4). These methods were more commonly needed for patients in Central Anatolia and least in Marmara-2 regions.

At the first visit of 776 patients included, 174 had recovered completely, 409 had partial recovery, 80 were on KRT and 67 were deceased. Regarding the outcome data at the last visit at the 6th month of diagnosis, 229 patients (29.5%) had complete, 265 patients (34.1%) had partial recovery while ESKD ensued in 74 patients (9.5%) and 187 patients (24.1%) died. Death was related to AKI in 124 patients (66.3%) and unrelated in 63 of them (33.7%). The outcome data could not be reached for 21 patients. The outcome of the patients at the first and the last visits are presented schematically in Figure-1.

The comparison of patients grouped according to the outcome at the last visit is presented in Table-5. Male and female patients had similar outcome. It was seen in the comparison of different geographical groups regarding outcome that complete recovery was the most prevalent in Southern Anatolian region (54.9%), partial recovery in Marmara-2 region (35.6%) and ESKD in Central Anatolian region (17.1%). Recovery rate was found to be lower in patients who were in ICU compared to others while death rate was higher. The percentage of patients who died or became dialysis dependent were higher in patients with stage-3 AKI compared to patients with stage-1 or -2 AKI. The recovery rate decreased and the risk of death and ESKD increased as the number of SIRS criteria increased. The outcome was worse in patients with sepsis, hypertension, CKD, heart failure and malignancy.

The risk of ESKD was higher in Central Anatolian region, in patients with stage-3 AKI and those with underlying CKD (Table-6). Cox regression analysis was performed to determine the risk of development of ESKD (Figure-2). Being in Marmara-1 (HR: 1.8, 95% CI: 1.213–2.684; $p = 0.004$) and Central Anatolian (HR: 1.785, 95% CI: 1.070–2.979; $p = 0.027$) regions, having elevated basal creatinine level (HR: 1.216, 95% CI: 1.130–1.309; $p < 0.001$), presence of heart failure (HR: 1.590, 95% CI: 1.013–2.495; $p = 0.044$), glomerulonephritis (HR: 1.956; 95% CI: 1.041–3.675; $p = 0.037$), stage-2 AKI (HR: 2.968; 95% CI: 1.560–5.649; $p = 0.001$) and CKD (HR: 1.776; 95% CI: 1.190–2.650; $p = 0.005$) were found to increase the risk of ESKD; while being in the Marmara-2 (HR: 0.390; 95% CI: 0.170–0.891; $p = 0.025$) and Southern Anatolian (HR: 0.587; 95% CI: 0.359–0.959; $p = 0.034$) regions, report of dehydration (HR: 0.649, 95% CI: 0.428–0.985; $p = 0.042$) or postrenal factors (HR: 0.361, 95% CI: 0.158–0.825; $p = 0.016$) as the cause of AKI and presence of stage-1 AKI were associated with decreased risk of ESKD.

The comparison of subgroups according to death rate is presented in Table-7. It was higher in patients from Eastern Anatolian region, those in ICU, patients with prerenal, renal and postrenal factors together, those with stage-3 AKI, sepsis, increased number of SIRS criteria, liver cirrhosis, heart failure and malignancy and those without CKD. Cox regression analysis (Figure-2) revealed that advanced age (HR: 1.027; 95% CI: 1.017–1.037; p

< 0.001), the number of days between hospitalization and AKI diagnosis (HR: 1.023; 95% CI: 1.013–1.032; $p < 0.001$), being in ICU (HR: 1.554; 95% CI: 1.035–2.333; $p = 0.034$), diagnosis at the emergency clinic (HR: 6.285; 95% CI: 4.174–9.463; $p < 0.001$), stage-3 AKI (HR: 1.563; 95% CI: 1.037–2.355; $p = 0.033$), body temperature above 38°C or below 36°C (HR: 2.528; 95% CI: 1.889–3.382; $p < 0.001$), heart rate above 90/min (HR: 2.742; 95% CI: 2.028–3.707; $p < 0.001$), presence of tachypnea (HR: 1.875; 95% CI: 1.399–2.513; $p < 0.001$), leukocytosis or leukopenia (HR: 1.365; 95% CI: 1.247–1.494; $p < 0.001$), SIRS criteria (HR: 3.142; 95% CI: 2.353–4.195; $p < 0.001$), sepsis (HR: 3.142; 95% CI: 2.353–4.195; $p < 0.001$), respiratory disorders (HR: 1.986; 95% CI: 1.470–2.683; $p < 0.001$), cerebrovascular events (HR: 1.976; 95% CI: 1.145–3.409; $p = 0.014$), hepatological diseases (HR: 2.360; 95% CI: 1.108–5.028; $p = 0.016$) or infectious diseases (HR: 1.470; 95% CI: 1.093–1.976; $p = 0.011$) or cardiovascular surgery (HR: 2.190; 95% CI: 1.120–4.281; $p = 0.022$) as the cause of hospitalization, presence of liver cirrhosis (HR: 2.338; 95% CI: 1.195–4.574; $p = 0.013$), malignancy (HR: 1.811; 95% CI: 1.317–2.490; $p < 0.001$) and heart failure (HR: 1.791; 95% CI: 1.282–2.500; $p = 0.001$) were the factors that increase the risk of death. Glomerulonephritis (HR: 0.307; 95% CI: 0.114–0.827; $p = 0.02$) or genitourinary system disease as the etiology (HR: 0.583; 95% CI: 0.432–0.785; $p < 0.001$) and underlying CKD (HR: 0.698; 95% CI: 0.507–0.963; $p = 0.028$) were found to decrease the risk of death. Multivariate analysis was performed including parameters related to death rate in univariate analysis as well as demographic parameters. Increasing age (HR: 1.025; 95% CI: 1.013–1.038; $p < 0.001$), increasing interval between the admission and diagnosis of AKI (HR: 1.017; 95% CI: 1.006–1.029; $p = 0.002$), presence of heart failure (HR: 1.773; 95% CI: 1.226–2.565; $p = 0.002$), liver cirrhosis (HR: 2.504; 95% CI: 1.235–5.077; $p = 0.011$), sepsis (HR: 2.537; 95% CI: 1.664–3.868; $p < 0.001$) and malignancy (HR: 1.982; 95% CI: 1.376–2.856; $p < 0.001$) were associated with increased risk of death. Being in Central Anatolian region (HR: 0.476; 95% CI: 0.239–0.947; $p = 0.035$), gastrointestinal losses as etiology (HR: 0.511; 95% CI: 0.292–0.895; $p = 0.019$), genitourinary system disease as cause of hospitalization (HR: 0.644; 95% CI: 0.450–0.922; $p = 0.016$), presence of CKD as comorbidity (HR: 0.636; 95% CI: 0.434–0.931; $p = 0.020$) were associated with better survival.

Mortality analysis of patients who needed KRT and those who did not are presented in Figure-3. Cumulative 6-month survival was higher in patients who did not need KRT as compared to those who needed IHD (79.3% vs. 68.8%; $p < 0.001$), CKRT (79.3% vs. 31.3%; $p < 0.001$) and IHD plus CKRT (79.3% vs 39.9%; $p < 0.001$). The 6-month survival rates of patients with stage-1, -2 and -3 AKI were 43.7%, 63.7% and 55.7% (Figure-4). The difference between stage-1 and stage-2 AKI patients was statistically significant ($p = 0.030$).

Discussion

AKI defines a clinical situation with heterogeneous etiology, clinical presentation and both renal and patient survival. AKI incidence is highly dependent on the study population. For example, Srisawat et al. [9] studied critically ill patients in ICUs and reported that 32% of the study population ($n = 15132$) developed AKI. Another study reported this ratio as 12.7% [10]. We have planned to gain data of patients with AKI diagnosed by nephrology specialists at emergency clinics, inpatient wards or ICUs. A sufficiently large number of cases with AKI ($n = 776$) have been included in our study to comment on the etiological factors, geographical differences and outcome. But unfortunately, we could not comment on AKI incidence since we did not have the data about the number of patients admitted to the related centers during the study period.

Many disease conditions are known to be responsible for the development of AKI. The frequency of AKI may differ according to the features of the studied population and also the way of physician's approach. Nephrological approach in patients with high risk will be lifesaving in this field. Training the physicians about how to recognize and evaluate these risky patients to protect from developing AKI carries matter. To clarify the different features between countries, International Society of Nephrology (ISN) designed Snapshot Study [11], which was a multinational study including 3664 patients from different countries with varying degrees of income. Hypotension or shock was the most common etiological factor in high income countries, while this was dehydration in lower income countries in which sepsis and AKI related to pregnancy were more frequent [11]. In a study conducted in Malawi, community acquired AKI was detected in 12.7% of Admissions within a pre-specified period of three months. A significant number of patients (43.8%) were seropositive for HIV. The most frequent causes of AKI were reported to be HIV related sepsis and hypovolemia mostly due to gastroenteritis. Toxins, urinary obstruction and primary renal parenchymal diseases were less prevalent [10]. The investigators from Karachi studied the hospital acquired AKI and they found that the most common causes of AKI were sepsis, gastroenteritis, surgical and obstetric complications [3]. Another study conducted in Singapore analyzed 422 cases of AKI. The most common etiological factors were prerenal followed by sepsis, ischemic acute tubular necrosis [12]. Lombardy et al. [13] studied causes of AKI in 2864 patients. They reported that AKI was more period in winter period (RR: 1.16; 95% CI: 1.05–1.29; $p = 0.003$) and AKI risk was found to be associated with lower air temperature and higher humidity [13]. In our study, the most frequent cause of prerenal AKI was dehydration, heart failure and sepsis. This prompts the necessity of early evaluation and supportive care of patients with symptoms that may cause dehydration. With the advance of treatment options for ischemic heart disease, the survival is prolonged and we face more and more patients with cardiorenal syndrome. There is need for education of both the primary care physicians and also the patients about the use of diuretic especially about the correct indication and correct dose to prevent both hypervolemia and dehydration.

Since the primary function of the kidneys are concentration and excretion of toxic metabolites and drugs, kidneys should be the main organ affected by drug toxicity. It has been reported that nephrotoxicity was responsible 8–60% of all AKI cases depending on the population and definition of AKI (14). In our population interestingly the use of nephrotoxic agent came out the most prominent cause of renal AKI (72.1%). This result is found to be true for all parts of the country. So, it is important to alert all the physicians about nephrotoxicity of the medications especially who is practicing in ICUs.

Infectious diseases are commonly associated with AKI. Krairoun et al. (15) studied 1716 patients admitting to the emergency clinic with suspected infectious disease. Of these patients, 10.8% had AKI and the mortality rate was 12.4% which was 4.2% for patients without AKI [15].

Sepsis is also commonly associated and/or confounded with AKI [16]. Deleterious inflammatory events, hypovolemia, exposure to nephrotoxic agents are some of the many potential causes of AKI seen in patients with sepsis. Infections are among the frequent causes of AKI in our study like many of the previous studies, and the percentage of patients with sepsis was quite high. Timely and adequate treatment of infections may prevent development of AKI.

One of the major risk factors for AKI is known to be the presence of CKD. About one third of the patients included in our study had CKD. This necessitates careful evaluation of these patients.

There was some regional variation in the etiology of AKI regarding prerenal and renal factors. Dehydration and heart failure were more frequent in Marmara-2 region while sepsis and dehydration was more prevalent in Southern Anatolia region. This cannot be explained simply because of many possible factors acting on that like the change in population characteristics including age and gender, climate differences, the predominant population of patients cared in the hospital meaning cardiovascular hospitals, cancer centers, etc. Another factor may be related to the physicians. The characteristics of the patients may change if the physician is responsible for inpatients, outpatients or emergency clinic or consultation. These factors apply also for the differences between the causes of hospitalization and co-morbidities of patients related to region.

We concluded that the diversity of the type of KRT regarding the geographical regions detected in our study may be related to the individual characteristics of the patients included into the study and technical facilities or the differences of practice of the clinicians providing data to the study.

Data about the renal and patient survival is so different in the literature. Again, the study population, risk factors, socio-economic factors may play a role. In one study, the overall mortality of AKI patients in ICUs was reported to be 27%, which was correlated with the severity of AKI [9]. The mortality rate was higher in lower income countries in the ISN Global Snapshot Study [11]. 22% of patients needed dialysis in this study and mortality was higher among them. Age, concomitant organ dysfunctions, sepsis and oliguria were other factors related to increased mortality and presence of CKD was associated with decreased mortality. In the study by Evans et al. [10], mortality was increasing with advancing stage of AKI, age above 40 years, stage of AKI and history of nephrotoxin exposure were found to increase the risk of mortality related to AKI.

In the study conducted by Singapore, KRT was needed in 27% of patients and in-hospital and six-month mortality was reported to be 20.3% and 9.4%, respectively. Stage-3 AKI was associated with higher mortality rate [12]. Another study from India reported that 220 of the 1150 patients admitted to a general ward in a year had AKI. The in-hospital mortality of AKI patients was reported to be 19.09% while this was 1.8% in those without AKI. Hematological malignancies, need for inotropic agents and serum creatinine concentration at the time of admission were the independent predictors of death. Underlying CKD and hospital acquired AKI were not related to death rate [17]. In our study, the mortality rates at the 1st week and at the 6th month were 8.6% and 24.1%, respectively. This is an alarming finding for all the clinicians that they should follow up these patients at long term also. Increasing stage of AKI was associated with both patients and renal survival, a finding which is common for most of the reports in the literature. Using the staging system proposed by KDIGO may let the clinicians to determine patients with the highest risk.

Besides mortality, AKI is associated also with worse renal outcomes. In a recent study involving 5548 patients having anesthesia for the first time, all stages of AKI has been found to be related to progression to CKD [18]. In our study, ESKD ensued in 74 patients (9.5%). Being in Marmara-1 and Central Anatolian regions, having elevated basal creatinine levels, presence of heart failure, glomerulonephritis, stage-2 AKI and CKD were found to increase the risk of ESKD; while being in Marmara-2 and Southern Anatolian regions, report of dehydration or postrenal factors as the cause of AKI were associated with decreased risk of ESKD.

Regional variations may be related to different risk factors, etiologies and clinical practices. Dehydration and postrenal causes seem to cause AKI that is potentially reversible. CKD is a well-known risk factor for AKI as is shown in our study. Advanced age, being in ICU, diagnosis at the emergency clinic, stage-3 AKI, presence of SIRS

criteria and sepsis, respiratory, cerebrovascular, hepatological or infectious diseases or cardiovascular surgery, cirrhosis, malignancy and heart failure were related to increased mortality in our study. Most of these factors are similar to current literature. In a study from Lithuanian University, 575 cases with severe AKI requiring KRT were analyzed [19]. The lowest mortality was in patients with postrenal AKI and highest with renal causes. Older age, systolic blood pressure below 120 mmHg, multiple organ dysfunction, pH < 7.3, oliguria, hepatorenal syndrome, cardiac surgery and sepsis was associated with very high mortality rates. The risk of AKI has been reported substantially high in patients with liver cirrhosis and the mortality rate is also high [20]. This finding is consistent with our results. Glomerulonephritis as the etiology and underlying CKD were associated with decreased mortality. The first may be due to potential reversibility of the disorder with treatment of glomerulonephritis. The positive effect of preexisting CKD is an interesting finding that may be speculated to be due to less clinical implication of hyperkalemia in patients with CKD.

The mortality was higher in patients who needed CKRT. This is an expected finding considering the indications for CKRT instead of conventional hemodialysis, the most common one being hemodynamic instability.

Conclusion

The most common etiology of AKI in our study was dehydration. 58.9% of patients had at least one renal etiology among which nephrotoxin exposure was the most frequent. At the 6th month, 33.6% of patients needed RRT, 29.5% had complete recovery, 34.1% had partial recovery, ESKD ensued in 9.5% and 24.1% of patients died. The geographical region differed regarding the etiology and outcome may be related to the individual characteristics of the patients included or the differences in the practice patterns of physicians providing data to the study. Physicians dealing with AKI should be aware of the characteristics of AKI patients and their outcomes in their country and region to prevent AKI and treat those patients more efficiently.

Limitations

The main limitation of our study is the lack of information about the number of patients admitted to the centers during the study period. So, we cannot comment on the incidence of AKI. Besides, the long duration for patient inclusion may have caused this selection bias.

Declarations

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Competing interest statement: The authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee at which the studies were conducted (Ethical approval was gained from 'The Ethics Committee of Kocaeli University', No: 2017/92IRB) with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors's contributions: MG, IY, BD, MRI designed the study. MG and IY gatered information from the centers, made the analysis and wrote the paper, IY supervised the study. ST, BD, SGB, SB, SP, SD, UD, AD, MS, IK, EA, ABH, MRA, ZT helped planning of the study, followed up the participants, provided data of patients. All authors reviewd the manuscript.

References

1. KDIGO Clinical Practice Guideline for Acute Kidney Injury. *Kidney Int.* 2012;2(Suppl 1):19.
2. Lafrance JP, Miller DR. Acute kidney injury associates with increased long-term mortality. *J Am Soc Nephrol.* 2010 Feb;21(2):345–52.
3. Iram H, Ali M, Kumar V, Ejaz A, Solangi SA, Junejo AM, Solangi SA. Un Nisa N. Frequency of Risk Factors and Outcome of Hospital-Acquired Acute Kidney Injury. *Cureus.* 2020 Dec 9;12(12):e12001.
4. Talabani B, Zouwail S, Pyart RD, Meran S, Riley SG, Phillips AO. Epidemiology and outcome of community-acquired acute kidney injury. *Nephrol (Carlton).* 2014 May;19(5):282–7.
5. Rathore AS, Chopra T, Ma JZ, Xin W, Abdel-Rahman EM. Long-Term Outcomes and Associated Risk Factors of Post-Hospitalization Dialysis-Dependent Acute Kidney Injury Patients. *Nephron.* 2017;137(2):105–12.
6. Gameiro J, Marques F, Lopes JA. Long-term consequences of acute kidney injury: a narrative review. *Clin Kidney J.* 2020 Nov 19;14(3):789–804.
7. Bone RC. Toward an epidemiology and natural history of SIRS (systemic inflammatory response syndrome). *JAMA.* 1992 Dec 23–30;268(24):3452–5.
8. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, Sevransky JE, Sprung CL, Douglas IS, Jaeschke R, Osborn TM, Nunnally ME, Townsend SR, Reinhart K, Kleinpell RM, Angus DC, Deutschman CS, Machado FR, Rubenfeld GD, Webb SA, Beale RJ, Vincent JL, Moreno R. Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med.* 2013 Feb;41(2):580–637.
9. Srisawat N, Sileanu FE, Murugan R, Bellomod R, Calzavacca P, Cartin-Ceba R, Cruz D, Finn J, Hoste EE, Kashani K, Ronco C, Webb S, Kellum JA, Acute Kidney Injury-6 Study Group. Variation in risk and mortality of acute kidney injury in critically ill patients: a multicenter study. *Am J Nephrol.* 2015;41(1):81–8.
10. Evans RD, Hemmilä U, Craik A, Mtekateka M, Hamilton F, Kawale Z, Kirwan CJ, Dobbie H, Dreyer G. Incidence, aetiology and outcome of community-acquired acute kidney injury in medical admissions in Malawi. *BMC Nephrol.* 2017 Jan;14(1):21. 18(.
11. Mehta RL, Burdmann EA, Cerdá J, Feehally J, Finkelstein F, García-García G, Godin M, Jha V, Lameire NH, Levin NW, Lewington A, Lombardi R, Macedo E, Rocco M, Aronoff-Spencer E, Tonelli M, Zhang J, Remuzzi G. Recognition and management of acute kidney injury in the International Society of Nephrology 0by25 Global Snapshot: a multinational cross-sectional study. *Lancet.* 2016 May 14;387(10032):2017–25. doi: 10.1016/S0140-6736(16)30240-9.

12. Teo SH, Lee KG, Koniman R, Tng ARK, Liew ZH, Naing TT, Li H, Tan RY, Tan HK, Choong HL, Foo WYM, Kaushik M. A prospective study of clinical characteristics and outcomes of acute kidney injury in a tertiary care Centre. *BMC Nephrol.* 2019 Jul;26(1):282. 20(.
13. Lombardi G, Gambaro G, Pertica N, Naticchia A, Bargagli M, Ferraro PM. Seasonality of acute kidney injury in a tertiary hospital academic center: an observational cohort study. *Environ Health.* 2021 Jan;15(1):8. 20(.
14. Khairoun M, Uffen JW, Ocak G, Koopsen R, Haitjema S, Oosterheert JJ, Kaasjager K. The incidence, mortality and renal outcomes of acute kidney injury in patients with suspected infection at the emergency department. *PLoS One.* 2021 Dec 8;16(12):e0260942.
15. Poston JT, Koyner JL. Sepsis associated acute kidney injury. *BMJ.* 2019 Jan 9;364:k4891.
16. Chandiraseharan VK, Kalimuthu M, Prakash TV, George T, Rajenesh A, Jayaseelan V, Sudarsanam TD. Acute kidney injury is an independent predictor of in-hospital mortality in a general medical ward: A retrospective study from a tertiary care centre in south India. *Indian J Med Res.* 2020 Oct;152(4):386–392.
17. Privratsky JR, Krishnamoorthy V, Raghunathan K, Ohnuma T, Rasouli MR, Long TE, Sigurdsson MI. Postoperative Acute Kidney Injury Is Associated With Progression of Chronic Kidney Disease Independent of Severity. *Anesth Analg.* 2022 Jan;134(1)(1):49–58.
18. Paškevičius Ž, Skarupskienė I, Balčiuvienė V, Dalinkevičienė E, Kušleikaitė-Pere N, Petrulienė K, Žiginskienė E. Mortality Prediction in Patients with Severe Acute Kidney Injury Requiring Renal Replacement Therapy. *Medicina (Kaunas).* 2021 Oct 9;57(10):1076.
19. Pena Polanco NA, Martin P, Carrion AF. Advances in the Management of Renal Dysfunction in Patients With Cirrhosis. *Gastroenterol Hepatol (N Y).* 2021 May;17(5):211–220.

Tables

Table-1: The names of the regions, centers and the number of patients included by each region

Region	Center	n (%)
Marmara-1 region	Bezmialem Vakif University, Faculty of Medicine	251 (32.3)
	Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine	
	University of Health Sciences, Dr. Lutfi Kirdar City Hospital	
	Maltepe University, Faculty of Medicine	
	Marmara University, Faculty of Medicine, Pendik Training and Research Hospital	
	University of Health Sciences, Sisli Hamidiye Etfal Training and Research Hospital	
Marmara-2 region	Golcuk State Hospital	106 (13.7)
	Kocaeli University, Faculty of Medicine	
Central Anatolian region	Erciyes University, Faculty of Medicine	83 (10.7)
	Gazi University, Faculty of Medicine	
	Meram University, Faculty of Medicine	
Southern Anatolian region	Çukurova University, Faculty of Medicine	229 (29.5)
	Mersin University, Faculty of Medicine	
	Pamukkale University, Faculty of Medicine	
Eastern Anatolian region	Batman Regional State Hospital	107 (13.8)
	Fırat University, Faculty of Medicine	

Table-2: The etiological distribution of AKI in regions.

Table-3: Causes of hospitalization and comorbidities.

	Marmara-1	Marmara-2	Central Anatolia	Southern Anatolia	Eastern Anatolia	Total	p
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Prerenal	164 (65.3)	99 (93.4)	53 (63.9)	170 (74.2)	64 (59.8)	550 (70.9)	p<0.001
Dehydration	104 (41.4)	78 (73.6)	42 (50.6)	83 (36.2)	33 (30.8)	340 (43.8)	
Heart failure	32 (12.7)	41 (38.7)	8 (9.6)	52 (22.7)	21 (19.6)	154 (19.8)	
Burn	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	
Gastrointestinal loss	31 (12.4)	17 (16.0)	23 (27.7)	37 (16.2)	13 (12.1)	121 (15.6)	
Liver cirrhosis and ascites	8 (3.2)	2 (1.9)	1 (1.2)	4 (1.7)	2 (1.9)	17 (2.2)	
Sepsis	39 (15.5)	6 (5.7)	10 (12.0)	76 (33.2)	17 (15.9)	148 (19.1)	
Renal	112 (44.6)	74 (69.8)	44 (53.0)	165 (72.1)	62 (57.9)	457 (58.9)	p<0.001
Ischemia	19 (7.6)	41 (38.7)	9 (10.8)	29 (12.7)	21 (19.6)	119 (15.3)	
Nephrotoxic agent	66 (26.3)	28 (26.4)	25 (30.1)	102 (44.5)	32 (29.9)	253 (32.6)	
Aminoglycoside	2 (0.8)	3 (2.8)	1 (1.2)	2 (0.9)	2 (1.9)	10 (1.3)	
Colistin	1 (0.4)	2 (1.9)	0 (0.0)	2 (0.9)	3 (2.8)	8 (1.0)	
Radiocontrast material	28 (11.2)	3 (2.8)	3 (3.6)	19 (8.3)	9 (8.4)	62 (8.0)	
NSAIDs	15 (6.0)	12 (11.3)	5 (6.0)	48 (21.0)	12 (11.2)	92 (11.9)	
RAS blocker	8 (3.2)	1 (0.9)	12 (14.5)	52 (22.7)	6 (5.6)	79 (10.2)	
Chemotherapeutic drugs	7 (2.8)	7 (6.6)	3 (3.6)	0 (0.0)	1 (0.9)	18 (2.3)	
Others	12 (4.8)	9 (8.5)	14 (16.9)	35 (15.3)	6 (5.6)	76 (9.8)	
Glomerulonephritis	12 (4.8)	8 (7.5)	4 (4.8)	15 (6.6)	0 (0.0)	39 (5.0)	
Vasculitis	5 (2.0)	0 (0.0)	7 (8.4)	5 (2.2)	0 (0.0)	17 (2.2)	

Diabetes mellitus	21 (8.4)	14 (13.2)	1 (1.2)	63 (27.5)	5 (4.7)	104 (13.4)	p=0.068
Tubulointerstitial nephritis	9 (3.6)	6 (5.7)	8 (9.6)	5 (2.2)	7 (6.5)	35 (4.5)	
Postrenal	41 (16.3)	16 (15.1)	15 (18.1)	19 (8.3)	14 (13.1)	105 (13.5)	
Stone disease	12 (4.8)	2 (1.9)	4 (4.8)	1 (0.4)	4 (3.7)	23 (3.0)	
Malignancy	14 (5.6)	7 (6.6)	6 (7.2)	8 (3.5)	6 (5.6)	41 (5.3)	
Vesicoureteral reflux	1 (0.4)	0 (0.0)	1 (1.2)	1 (0.4)	1 (0.9)	4 (0.5)	
Prostatic disease	16 (6.4)	9 (8.5)	4 (4.8)	9 (3.9)	3 (2.8)	41 (5.3)	
Retroperitoneal fibrosis	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.9)	2 (0.3)	

	Marmara-1	Marmara-2	Central Anatolia	Southern Anatolia	Eastern Anatolia	Total	p
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Cause of hospitalization							
Respiratory diseases	49 (19.5)	40 (37.7)	7 (8.4)	54 (23.6)	24 (22.4)	174 (22.4)	<0.001
Cardiovascular diseases	34 (13.5)	56 (52.8)	10 (12.0)	66 (28.8)	26 (24.3)	192 (24.7)	<0.001
Cerebrovascular diseases	9 (3.5)	5 (4.7)	1 (1.2)	12 (5.2)	10 (9.3)	37 (4.8)	0.086
Hematological diseases	8 (3.1)	11 (10.4)	8 (9.7)	20 (8.7)	2 (1.9)	49 (6.3)	0.006
Immunosuppressive state	5 (1.9)	6 (5.7)	5 (6.0)	38 (16.6)	0 (0)	54 (7.0)	<0.001
Gastroenterological diseases	48 (19.1)	22 (20.7)	27 (32.5)	30 (13.1)	11 (10.3)	138 (17.8)	<0.001
Hepatological diseases	5 (2.0)	0	0 (0)	7 (3.1)	0 (0)	12 (1.5)	0.078
Genitourinary system diseases	94 (37.4)	57 (53.8)	62 (74.7)	122 (53.3)	55 (51.4)	390 (50.3)	<0.001
Infectious diseases	50 (19.9)	23 (21.7)	15 (18.1)	113 (49.3)	35 (32.7)	236 (30.4)	<0.001
Cardiovascular surgery	3 (1.2)	8 (7.5)	1 (1.2)	7 (3.1)	1 (0.9)	20 (2.6)	0.006
Major non-cardiac surgery	17 (6.8)	10 (9.4)	5 (6.02)	13 (5.7)	2 (1.9)	47 (6.1)	0.222
Minor non-cardiac surgery	5 (2.0)	1 (0.9)	0 (0)	4 (1.7)	1 (0.9)	11 (1.4)	0.678
Comorbidities						702 (90.5)	
Diabetes Mellitus	91 (36.2)	29 (27.3)	19 (22.9)	93 (40.6)	34 (31.8)	266 (34.3)	0.019
Hypertension	132 (52.6)	68 (64.1)	41 (49.4)	127 (55.4)	66 (61.7)	434 (55.9)	0.139
Chronic kidney disease	83 (33.1)	38 (35.8)	14 (16.9)	91 (39.7)	35 (32.7)	261 (33.6)	0.006
Ischemic heart disease	54 (21.5)	46 (43.4)	12 (14.4)	84 (36.7)	29 (27.1)	225 (29.0)	<0.001
Chronic obstructive pulmonary disease	20 (7.9)	4 (3.8)	3 (3.6)	17 (7.4)	5 (4.7)	49 (6.3)	0.366

Liver cirrhosis	9 (3.6)	1 (0.9)	0 (0)	7 (3.1)	1 (0.9)	18 (2.3)	0.193
Malignancy	51 (20.3)	20 (18.9)	15 (18.1)	35 (15.3)	12 (11.2)	133 (17.1)	0.262
Heart failure	27 (10.7)	25 (23.6)	11 (13.2)	52 (22.7)	16 (14.9)	131 (16.9)	0.002
Others	66 (26.3)	17 (16.0)	13 (15.7)	92 (40.2)	21 (19.6)	209 (26.9)	<0.001

*Chi square test

Table-4: The frequencies of kidney replacement therapies in the regions

RRT	Marmara-1 n (%)	Marmara-2 n (%)	Central Anatolia n (%)	Southern Anatolia n (%)	Eastern Anatolia n (%)
None	155 (64.3)	79 (77.5)	40 (48.8)	155 (68.6)	72 (69.2)
HD	71 (29.5)	18 (17.6)	42 (51.2)	68 (30.1)	30 (28.8)
PD	0 (0)	1 (0.9)	0 (0)	0 (0)	0 (0)
CRRT	6 (2.5)	0 (0)	0 (0)	1 (0.4)	1 (1.0)
HD+PD	0 (0)	2 (2.0)	0 (0)	1 (0.4)	0 (0)
HD+CRRT	9 (3.7)	2 (2.0)	0(0)	1 (0.4)	1 (1.0)

Table-5: Subgroup analysis according to the outcome at the last visit

		Complete recovery		Partial recovery		Death		ESKD		
		N	%	N	%	N	%	n	%	P
Gender	Female	111	32.2	128	37.1	78	22.6	28	8.1	0.215
	Male	118	28.8	137	33.4	109	26.6	46	11.2	
Regions	Marmara-1	66	27.4	81	33.6	60	24.9	34	14.1	<0.001
	Marmara-2	18	17.6	56	54.9	22	21.6	6	5.9	
	Central Anatolia	32	39.0	26	31.7	10	12.2	14	17.1	
	Southern Anatolia	91	40.3	65	28.8	58	25.7	12	5.3	
	Eastern Anatolia	22	21.2	37	35.6	37	35.6	8	7.7	
The place of diagnosis	Inpatient clinic	113	32.3	127	36.3	75	21.4	35	10.0	<0.001
	Intensive care unit	22	17.5	24	19.0	77	61.1	3	2.4	
	Emergency clinic	83	33.5	99	39.9	34	13.7	32	12.9	
Etiology	Prerenal	65	27.7	76	32.3	76	32.3	18	7.7	0.035
	Renal	46	27.2	71	42.0	27	16.0	25	14.8	
	Postrenal	14	35.9	11	28.2	11	28.2	3	7.7	
	Prerenal+postrenal	10	34.5	12	41.4	5	17.2	2	6.9	
	Prerenal+renal	82	33.6	79	32.4	58	23.8	25	10.2	
	Renal+postrenal	4	40.0	5	50.0	1	10.0	0	0.0	
	All	8	33.3	8	33.3	8	33.3	0	0.0	
Staging	Stage-1	52	29.4	87	49.2	30	16.9	8	4.5	<0.001
	Stage-2	73	29.0	103	40.9	55	21.8	21	8.3	
	Stage-3	104	32.0	75	23.1	101	31.1	45	13.8	
SIRS criteria number	0	151	31.5	184	38.3	95	19.8	50	10.4	<0.001
	1	34	40.5	33	39.3	10	11.9	7	8.3	
	2	22	36.1	17	27.9	13	21.3	9	14.8	
	3	17	22.4	21	27.6	34	44.7	4	5.3	
	4	5	9.3	10	18.5	35	64.8	4	7.4	
Sepsis	Yes	40	23.3	36	20.9	84	48.8	12	7.0	<0.001
	No	189	32.4	229	39.3	103	17.7	62	10.6	
DM	Yes	77	29.7	88	34.0	67	25.9	27	10.4	0.911
	No	152	30.6	177	35.7	120	24.2	47	9.5	

HT	Yes	107	25.2	169	39.8	105	24.7	44	10.4	0.002
	No	122	37.0	96	29.1	82	24.8	30	9.1	
CKD	Yes	56	22.0	109	42.7	52	20.4	38	14.9	<0.001
	No	173	34.6	156	31.2	135	27.0	36	7.2	
Ischemic cardiac/vascular disease	Yes	58	26.5	81	37.0	63	28.8	17	7.8	0.163
	No	171	31.9	184	34.3	124	23.1	57	10.6	
COPD	Yes	12	26.1	15	32.6	15	32.6	4	8.7	0.647
	No	217	30.6	250	35.3	172	24.3	70	9.9	
Cirrhosis	Yes	4	23.5	3	17.6	9	52.9	1	5.9	0.077
	No	225	30.5	262	35.5	178	24.1	73	9.9	
Malignancy	Yes	30	23.4	36	28.1	53	41.4	9	7.0	<0.001
	No	199	31.7	229	36.5	134	21.4	65	10.4	
Heart Failure	Yes	35	27.1	41	31.8	46	35.7	7	5.4	0.009
	No	194	31.0	224	35.8	141	22.5	67	10.7	

*Chi square test

Table-6: Factors related to the risk of end stage kidney disease

		N	%	p
Gender	Female	38	11.0	0.117
	Male	61	14.9	
Regions	Marmara-1	45	18.7	<0.001
	Marmara-2	6	5.9	
	Central Anatolia	18	22.0	
	Southern Anatolia	20	8.8	
	Eastern Anatolia	10	9.6	
The place of AKI diagnosis	Inpatient clinic	49	14.0	0.087
	Intensive care unit	9	7.1	
	Emergency clinic	37	14.9	
Etiology	Prerenal	32	13.6	0.205
	Renal	29	17.2	
	Postrenal	4	10.3	
	Perenal+postrenal	2	6.9	
	Prerenal+renal	31	12.7	
	Renal+postrenal	0	0.0	
	All	0	0.0	
Staging	Stage-1	11	6.2	<0.001
	Stage-2	25	9.9	
	Stage-3	63	19.4	
Number of SIRS criteria	0	63	13.1	0.367
	1	7	8.3	
	2	12	19.7	
	3	11	14.5	
	4	6	11.1	
Sepsis	Yes	23	13.4	0.909
	No	76	13.0	
Diabetes Mellitus	Yes	38	14.7	0.359
	No	61	12.3	
Hypertension	Yes	58	13.6	0.621

	No	41	12.4	
CKD	Yes	45	17.6	0.008
	No	54	10.8	
Ischemic cardiovascular disease	Yes	22	10.0	0.111
	No	77	14.4	
Chronic obstructive pulmonary disease	Yes	7	15.2	0.663
	No	92	13.0	
Cirrhosis	Yes	3	17.6	0.479
	No	96	13.0	
Malignancy	Yes	19	14.8	0.524
	No	80	12.8	
Heart failure	Yes	12	9.3	0.159
	No	87	13.9	

*Chi square test

Tablo-7: The comparison of subgroups according to death rate

		Death		
		N	%	p*
Gender	Female	78	22.6	0.207
	Male	109	26.6	
Regions	Marmara-1	60	24.9	0.007
	Marmara-2	22	21.6	
	Central Anatolia	10	12.2	
	Southern Anatolia	58	25.7	
	Eastern Anatolia	37	35.6	
The place of AKI diagnosis	Inpatient clinic	75	21.4	<0.001
	Intensive care unit	77	61.1	
	Emergency clinic	34	13.7	
Etiology	Prerenal	76	32.3	0.007
	Renal	27	16.0	
	Postrenal	11	28.2	
	Perenal+postrenal	5	17.2	
	Prerenal+renal	58	23.8	
	Renal+postrenal	1	10.0	
	All	8	33.3	
Staging	Stage-1	30	16.9	0.001
	Stage-2	55	21.8	
	Stage-3	101	31.1	
Number of SIRS criteria	0	95	19.8	<0.001
	1	10	11.9	
	2	13	21.3	
	3	34	44.7	
	4	35	64.8	
Sepsis	Yes	84	48.8	<0.001
	No	103	17.7	
Diabetes Mellitus	Yes	67	25.9	0.613
	No	120	24.2	

Hypertension	Yes	105	24.7	0.954
	No	82	24.8	
CKD	Yes	52	20.4	0.047
	No	135	27.0	
Ischemic cardiovascular disease	Yes	63	28.8	0.104
	No	124	23.1	
COPD	Yes	15	32.6	0.204
	No	172	24.3	
Cirrhosis	Yes	9	52.9	0.018
	No	178	24.1	
Malignancy	Yes	53	41.4	<0.001
	No	134	21.4	
Heart failure	Yes	46	35.7	0.002
	No	141	22.5	

*Chi square test

Figures

Figure 1

End point of patients during first and last controls

Figure 2

Factors for the risk of ESKD and death determined by Cox regression analysis

Figure 3

Mortality analysis of patients who needed KRT and those who did not.

Figure 4

Mortality analysis of patients with different stages of acute kidney injury.