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Community-Acquired Acute Kidney Injury: A Nationwide Survey in China

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Background: This study aimed to describe the burden of community-acquired acute kidney injury (AKI) in China based on a nationwide survey about AKI.

Study Design: Cross-sectional and retrospective study.

Setting & Participants: A national sample of 2,223,230 hospitalized adult patients from 44 academic/local hospitals in Mainland China was used. AKI was defined according to the 2012 KDIGO AKI creatinine criteria or an increase or decrease in serum creatinine level of 50% during the hospital stay. Community-acquired AKI was identified when a patient had AKI that could be defined at hospital admission.

Predictors: The rate, cause, recognition, and treatment of community-acquired AKI were stratified according to hospital type, latitude, and economic development of the regions in which the patients were admitted.

Outcomes: All-cause in-hospital mortality and recovery of kidney function at hospital discharge.

Results: 4,136 patients with community-acquired AKI were identified during the 2 single-month snapshots (January 2013 and July 2013). Of these, 2,020 (48.8%) had cases related to decreased kidney perfusion; 1,111 (26.9%), to intrinsic kidney disease; and 499 (12.1%), to urinary tract obstruction. In the north versus the south, more patients were exposed to nephrotoxins or had urinary tract obstructions. 536 (13.0%) patients with community-acquired AKI had indications for renal replacement therapy (RRT), but only 347 (64.7%) of them received RRT. Rates of timely diagnosis and appropriate use of RRT were higher in regions with higher per capita gross domestic product. All-cause in-hospital mortality was 7.3% (295 of 4,068). Delayed AKI recognition and being located in northern China were independent risk factors for in-hospital mortality, and referral to nephrology providers was an independent protective factor.

Limitations: Possible misclassification of AKI and community-acquired AKI due to nonstandard definitions and missing data for serum creatinine.

Conclusions: The features of community-acquired AKI varied substantially in different regions of China and were closely linked to the environment, economy, and medical resources.

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INDEX WORDS: Acute kidney injury (AKI); community-acquired AKI; incidence; etiology; mortality; China; nationwide survey; serum creatinine; decreased kidney perfusion; per capita gross domestic product; health disparities; regional variation; renal replacement therapy (RRT).

Acute kidney injury (AKI) is associated with high mortality and morbidity worldwide.[1-3] In 2013, to improve the diagnosis and treatment of AKI worldwide, the International Society of Nephrology (ISN) launched the "0by25" global target, that is, zero death of patients with untreated acute kidney failure by 2025.[4] As part of the global initiative, the ISN Acute Kidney Failure 0by25 China Consortium conducted a nationwide survey in the hospitalized population and reported a substantial burden of AKI in China.[5]

Hospital-acquired AKI has been researched for decades, whereas community-acquired AKI has been much less studied.[1,6] Because the causative factors of community-acquired AKI originate in the communities in which patients live or work, environmental and lifestyle differences could potentially affect the incidence and patterns of community-acquired AKI.[1] Therefore, uncovering the local features of community-acquired AKI is necessary for formulating site-specific preventive and therapeutic maneuvers.

China is the world's largest developing country, with a broad land area and considerable variations in climate, cultural habits, and economic development. Because the Chinese national survey on AKI covered 22 provinces/municipalities/autonomous regions and included both academic hospitals in large cities and local hospitals in counties/rural areas across the

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country,[5] the information that has been collected should enable better understanding of the influences of local factors on AKI. In a published study, we described the features of AKI in terms of the entire country[5]; here, we conducted a further analysis of 4,136 patients with community-acquired AKI, exploring the incidence, causes, and outcomes across different social-environmental regions.

METHODS

Participants and Survey Protocol

The study was approved by the Ethics Committee of Peking University First Hospital, and the requirement for informed consent was waived due to the retrospective nature of the study (2014 [729]). The survey protocol has previously been described in detail.[5] Altogether in 2013, there were 2,223,230 hospitalized adults (aged ≥ 18 years) from 22 academic hospitals and 22 local hospitals in Mainland China who were screened for suspected AKI based on changes in serum creatinine (Scr) levels through the Laboratory Information System. Because evaluating the entire sample would be challenging and considering the possibility of seasonal variations in AKI, medical records of patients with suspected AKI who were hospitalized during January 2013 and July 2013 were retrieved to confirm the diagnoses of AKI. The detailed survey protocol was as follows.

First, we identified AKI based on change in Scr levels during hospitalization. The criteria included the 2012 KDIGO AKI definition: an increase in Scr level by 0.3 mg/dL within 48 hours or by 50% within 7 days (not including urine output criteria).[7] For those who had no repeat Scr assay within 7 days and those recovering from AKI, we expanded the criteria as follows: an increase or decrease in Scr level of 50% during the hospital stay, using the lowest or the highest Scr value during hospitalization as the comparator. Patients who had preexisting chronic kidney disease (CKD) stage 5 and those who underwent nephrectomy or kidney transplantation were excluded. Those who had peak Scr values < 0.6 mg/dL or Scr level changes that could not be attributed to AKI (such as amputations) were also excluded.[8]

We then identified community-acquired AKI when the patient met any of the following criteria: (1) an increased Scr level at admission and a trend of decreasing Scr levels during the hospital stay; or (2) an increased Scr level at admission and an Scr level that continued to increase or remained at a high level during the hospital stay, with preadmission Scr values establishing the existence of AKI; or (3) normal kidney function upon admission with Scr levels that began to increase and AKI that could be defined within 2 days after hospitalization combined with causal factors that were determined (by the nephrologists among the investigators) to be present prior to admission based on review of medical records.

Sociodemographic status, comorbid conditions (hypertension, diabetes mellitus, cardiovascular diseases, etc), diseases or conditions that could cause kidney hypoperfusion (dehydration from vomiting/diarrhea/excessive sweating/extensive burns, cardiorenal syndrome, etc), nephrotoxic medications (antibiotics, radiocontrast agents, nonsteroidal anti-inflammatory drugs, Chinese herbs, etc), environmental or other nephrotoxins (pesticide, snake bite, bee sting, etc), and critical illnesses (sepsis, multiple organ dysfunction, shock, disseminated intravascular coagulation, acute respiratory distress syndrome, endotracheal intubation ventilator therapy, and terminal malignancy), AKI classification (decreased kidney perfusion, intrinsic kidney disease, and urinary tract obstruction), peak AKI staging (1-3 according to KDIGO criteria),[7] renal replacement therapy (RRT) indications (Table S1, available as online supplementary material),[9,10] RRT modalities, referral to nephrology providers, all-cause in-hospital death, and recovery of kidney function at discharge were collected. Appropriate RRT treatment was defined as the receipt of RRT by a patient with a valid indication for treatment.[9,10] RRT rate was taken as the ratio of the number of patients who received RRT to the number of patients who had an indication for RRT.

Definitions of Associated Indicators

Baseline Scr level was defined as the lowest Scr value that was available within 3 months prior to admission and throughout the hospital stay. For patients who had no reliable Scr record before admission and no evidence of baseline CKD, a back-estimation of the baseline Scr level was performed based on the 4-variable MDRD (Modification of Diet in Renal Disease) Study equation with the assumption of an estimated glomerular filtration rate of 75 mL/min/1.73 m^2, following the recommendations of the 2012 KDIGO AKI clinical practice guideline.[7,11]

Recovery of kidney function at discharge was classified as follows: full recovery, Scr level decreased to below the threshold Scr level, which was defined as ± 10% of the baseline Scr level; partial recovery, Scr level decreased by ≥25% from the peak level but remained above the threshold; and failure to recover, the patient was dialysis dependent or Scr level decreased by <25% from the peak level. Treatment withdrawal refers to patients with AKI who were recorded as severely ill but were discharged because they gave up further treatment in the hospital due to economic or personal reasons.

We considered AKI to have been recognized by the physician in charge when there was documentation of increased Scr levels, concerns about decreased kidney function or a decrease in urine output, or related treatment adjustments. Timely recognition was considered to occur when the patient was recognized as having AKI by his or her physician within 3 days after AKI could be diagnosed and before AKI had progressed to a more severe stage; otherwise, the case was classified as delayed recognition. AKI was considered nonrecognized when the physicians in charge did not recognize that the patient met AKI criteria during his or her hospital stay.

Statistical Analysis

The community-acquired AKI rate was the ratio of detected community-acquired AKI cases to the total number of adult admissions during the same period. We also calculated the ratio of community-acquired AKI cases to all confirmed AKI cases. Data from the 2013 report of the National Health and Family Planning Commission of the Peoples' Republic of China and the National Bureau of Statistics of the People's Republic of China were used for the standard population and the stratified criteria for the per capita gross domestic product (GDP).[12-14] Proportions were stratified according to hospital type (academic vs local), geographic region (by tertile of northern latitude, ie, south, middle, and north China), and economic development (by tertile of per capita GDP). We also compared clinical characteristics, diagnoses, treatment, and prognoses for community-acquired AKI among the different hospital types and areas with different latitudes and per capita GDPs. Categorical variables were described as count and proportion. Continuous variables were described as mean ± standard deviation or median and interquartile range, as appropriate. Comparisons between groups were made using 1-way analyses of variance or Kruskal-Wallis tests for continuous variables and χ^2 tests for categorical variables.

Logistic regression models were used to analyze the associations of all-cause in-hospital mortality with the relevant covariates. Odds ratios with 95% confidence intervals and P values from Wald χ^2 tests are reported. Covariates included in multivariable logistic regression models were age (per 10 years older), sex (male vs female), hypertension (yes vs no), CKD (yes vs no), diabetes