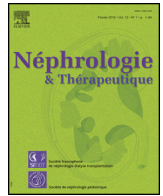




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Original article

Changes of etiology, incidence and outcomes of severe acute kidney injury during a 12-year period (2001–2012) in large university hospital

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ABSTRACT

Background. – Despite improvement in the quality of critical care, the incidence and mortality of acute kidney injury (AKI) continues to rise. The aim of our study was to analyze the changes during a 12-year period in etiology, incidence and outcomes of severe AKI, which required dialysis, in a large single centre. **Methods.** – We performed retrospective analysis of all the patients ($n = 3215$) with severe AKI hospitalized and dialysed in the hospital of Lithuanian university of health sciences Kauno Klinikos (HLUHS KK) during the period of 2001–2012.

Results. – During a 12-year period, the incidence of severe AKI increased from 154 to 597 cases/p.m.p. The mean age of the patients increased from 58.2 ± 19.2 years in 2001 to 65.7 ± 17 years in 2012 ($P < 0.001$). The number of men ($n = 2012$; 62.6%) was significantly higher than that of women ($n = 1201$; 37.4%; $P < 0.001$). The causes of severe AKI were renal ($n = 1128$; 35.1%), prerenal ($n = 642$; 20%), obstructive ($n = 310$; 9.6%) and in 12.7% of the patients-multifactorial. Overall, the most frequent cause of AKI was acute tubular necrosis ($n = 1069$; 33.2%). The renal replacement therapy (RRT) was discontinued due to improved kidney function in 45.3% of cases. 8.1% of the patients remained dialysis dependent. The mortality rate was 44%.

Conclusions. – During a 12-year period, the number of the patients with severe AKI increased three times with the predominance of men and elderly people. There was an observed increase in multifactorial causes of severe AKI; however, ATN remained dominant over the decade. The mortality rate remained high, almost half of the patients died, less than 10% remained dialysis dependent, the rest had the improvement of renal function.

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1. Introduction

AKI is an abrupt decline in kidney function. Despite improvement in the quality of critical care, the incidence and mortality of AKI continues to rise [1–4]. The rates of AKI in hospitalized patients have been reported to be between 3.2% and 20% [5,6]. AKI is a common complication in intensive care unit (ICU) patients and is associated with high mortality, prolonged length of ICU stay and increased post-hospital morbidity [3,7,8]. Depending on the definition used, AKI has been shown to affect from 1% to 25% of ICU patients and has led to mortality rates from 15% to 60% [9,10].

Many risk factors have been identified for the development of AKI including hypotension, pulmonary disease, sepsis, hypovolemia, liver failure, older age, hypertension, preexisting renal disease, heart failure and many medications [1,11–13]. Different risk factors for the development of AKI in the ICU have been assessed in diverse populations, including post-surgical, trauma and other patients. Some recent studies suggest that the AKI and chronic kidney disease (CKD) are not distinct entities but are rather closely interconnected – CKD is a risk factor for AKI, AKI is a risk factor for the development of CKD [14].

The causes of AKI are frequently categorized as prerenal, intrinsic renal and postrenal. The most common form of intrinsic renal failure in the ICU is acute tubular necrosis (ATN) [11].

Although ATN is classified as ischemic or nephrotoxic, these etiologies frequently coexist and in many cases are multifactorial. Severe sepsis and septic shock are the most common causes of mortality in non-coronary ICU patients and are the risk factors for

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the development of AKI [15]. Several studies have reported that sepsis-induced AKI is associated with both short and long-term risk of death [3,8,16].

Severe AKI is a kidney injury requiring RRT. RRT is indicated for the management of specific problems such as volume overload, hyperkalemia, acidosis and symptoms of uremia. Severe AKI is an independent marker of poor prognosis and not merely a reflection of the severity of underlying diseases. Severe AKI occurs in 2–7% of all hospital admissions and between 4% and 15% of patients admitted to the ICU develop AKI requiring RRT [17,18].

The increased incidence of AKI is most likely due to a trend of admitting older, more severely and more chronically ill patients to hospitals [19]. Although AKI is among the most common medical problems in hospitalized patients, much remains unknown about its epidemiology, changes of patients age structure, outcomes, etc. In Lithuania, with three millions of population, there are nine hospitals where RRT is performed in the cases of severe AKI. The biggest part of these patients is accumulated in our university hospital. The goal of our investigation was to analyze trends in the changes of etiology, incidence and outcomes of the patients with severe AKI during a 12-year period.

2. Material and methods

We performed retrospective analysis of all the patients with severe AKI hospitalized and dialysed in the hospital of Lithuanian university of Health Sciences Kauno Klinikos (HLUHS KK) during 2001–2012. This hospital is the largest multiprofile hospital in Lithuania with 2000 beds providing nephrological services for all Kaunas region. The population of Kaunas region has decreased over 12 years from –698,561 inhabitants in 2001 to –596,227 inhabitants in 2012.

The definition and staging of AKI are based on the Risk, injury, failure, loss, end-stage renal disease (RIFLE) and Acute kidney injury network (AKIN) criteria. Analysing our data, we used AKIN criteria, and the patients who received some kind of RRT were classified as AKIN3.

The indications to start dialysis treatment in the cases of severe AKI were clinical symptoms of uremia, hypervolemia, hyperkalemia, metabolic acidosis, hyponatremia, high levels of serum creatinine ($> 600 \mu\text{mol/L}$) and urea ($> 30 \text{ mmol/L}$). The indications for slow continuous RRT were refractory arterial hypotension and pronounced hyperhydration and/or hypercatabolism.

In the registry of HLUHS KK nephrology department, the following data on patients with severe AKI has been collected: their age, sex, causes of severe AKI, outcomes and departments in which they were treated. The analysis of the data has been performed with the software “Statistical package for social sciences” (SPSS). The average of parametric values ($\bar{x} \pm \text{SD}$) has been calculated. Employing Kolmogorov-Smirnov test, the distribution of quantitative values has been established. Comparing the quantitative values which do not satisfy the laws of the normal distribution the tests of comparison of non-parametric values have been performed. The difference between two independent groups has been established employing Mann-Whitney-Wilcoxon test. The relation between the qualitative values has been evaluated following the criterion of Pearson chi square. The difference between the compared groups is statistically significant when $P < 0.05$.

The study was approved by the Kaunas regional biomedical research ethics committee and the informed consent was waived due to the retrospective nature of the study.

3. Results

Three thousand two hundred and fifteen patients with severe AKI were dialysed in our hospital in the period of 2001–2012. One hundred and eight patients were treated with RRT in 2001. In 2012,

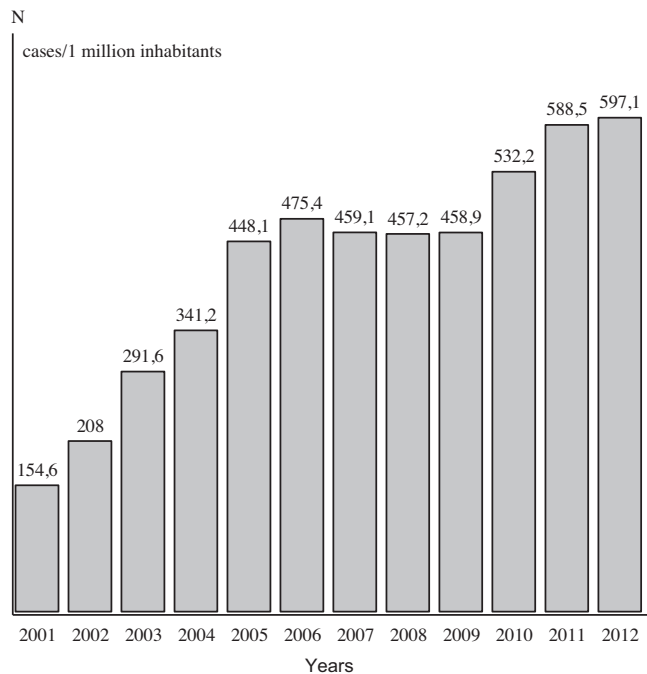


Fig. 1. Incidence of severe acute kidney injury in Kaunas Region in 2001–2012.

this number increased to 356. As the patients with severe AKI from all Kaunas Region were treated in HLUHS KK, we have calculated the incidence of severe AKI per year. The results show a significant increase from 154 to 597 severe AKI cases/1 million inhabitants during the period of observation ($P < 0.05$) (Fig. 1).

The number of men with severe AKI ($n = 2012$; 62.6%) was significantly higher than that of women ($n = 1201$; 37.4%) ($P < 0.001$). The mean age of the patients was 62.1 ± 17.4 (range: 1–102) years. During the investigated period, 71 children with severe AKI were treated by RRT. The mean age of children was 10.5 ± 5.3 years. The mean age of the patients with severe AKI during the investigated period increased. While in the 2001–2004 period, the mean age of the patients had been 60.8 ± 17.0 years, it increased to 62.8 ± 16.9 years in the 2005–2008 period and to 64.9 ± 16.8 years in the 2009–2012 period ($P < 0.001$). That was determined by the fact that during the investigated period the number of the patients older than 80 increased significantly and the number of the patients younger than 40 decreased significantly. More than 50% of the patients were 60–80 years old (Fig. 2). Women were significantly older than men (64.0 ± 17.7 versus 61.0 ± 17.1 years, respectively; $P < 0.001$).

The causes of severe AKI were renal ($n = 1128$; 35.1%), prerenal ($n = 642$; 20%), obstructive ($n = 310$; 9.6%) and in 12.7% of the patients – multifactorial. In 22.6% of the cases ($n = 726$), the causes of severe AKI remained unknown. Overall the most frequent cause was ATN ($n = 1069$; 33.2%). Glomerular diseases (2.1%), interstitial nephritis (1.2%) and vascular causes (0.9%) compose only a small part of all the causes. The most frequent causes of prerenal AKI were hypovolemia (12.7%), decreased cardiac ejection fraction (3.7%) and hepatorenal syndrome (3.2%). During the investigated period, the number of polietiological severe AKI increased significantly from 8.9% in 2001–2004 to 15.5% in the 2009–2012 period ($P < 0.05$). The number of prerenal and renal causes during the 12-year period decreased significantly. In the period of 2001–2004, renal causes amounted to 36.5%, whereas it decreased to 30.6% in the period of 2009–2012 ($P < 0.05$). The number of prerenal causes of severe AKI decreased from 24.0% in 2001–2004 to 21.2% in 2005–2008 and to 16.7% in the 2009–2012 period ($P < 0.05$).

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