

ผลกระทบและอุบัติการณ์ของภาวะไตวายฉับพลัน : ข้อมูลการศึกษาระยะเวลา 1 ปีของโรงพยาบาลศูนย์แห่งหนึ่งในประเทศไทย

วรพจน์ เตรียมตระการผล, วิจิตรา คงคา

แผนกอายุรกรรม โรงพยาบาลเจ้าพระยาอภัยภูเบศร

Impact and Incidence of Acute Kidney Injury (AKI) : A One-year Period of Study at a Center Hospital in Thailand

Worapot Treamtrakanpon, Wichitra Khongkha

Department of Medicine, Abhaibhubejhr Hospital

หลักการและวัตถุประสงค์: สถานการณ์ทั่วโลกพบว่าภาวะไตวายฉับพลันเป็นภาวะที่พบได้บ่อยและมีความรุนแรงสูง ปัจจุบันระบาดวิทยาของภาวะไตวายฉับพลันในประเทศไทยยังขาดข้อมูลที่ชัดเจน การศึกษานี้เป็นการศึกษานำร่องถึงข้อมูลระบาดวิทยาของภาวะไตวายฉับพลันในโรงพยาบาลศูนย์แห่งหนึ่งในภาคตะวันออกของประเทศไทย

วิธีการศึกษา: ทำการศึกษาในผู้ป่วยไตวายฉับพลันที่วินิจฉัยตามเกณฑ์ AKIN ที่เข้ารับการรักษาตัวในโรงพยาบาลเจ้าพระยาอภัยภูเบศรในช่วงเดือนตุลาคม พ.ศ.2554 – กันยายน พ.ศ.2555 ทั้งหมดและมีการติดตามข้อมูลผลการทำงานของไตของผู้ป่วยอย่างน้อย 3 เดือนหลังจำหน่ายเพื่อหาสาเหตุ และศึกษาลักษณะของไตวาย รวมถึงผลลัพธ์ที่เกิดขึ้นกับผู้ป่วยในที่เกิดภาวะไตวายฉับพลัน

ผลการศึกษา: อุบัติการณ์ของไตวายฉับพลันในโรงพยาบาลคิดเป็นร้อยละ 2.21 (หรือ 681 รายใน 1 ปี) ส่วนใหญ่ของผู้ป่วยไตวายฉับพลัน (ร้อยละ 83) ได้รับการวินิจฉัยในวันแรกของการนอนโรงพยาบาล พบร้อยละ 78.1 ของผู้ป่วยไตวายมีปัสสาวะมากกว่า 400 มิลลิลิตรต่อวัน ชนิดของไตวายฉับพลันที่พบบ่อย 3 อันดับแรกได้แก่ ภาวะ ischemic ATN (ร้อยละ 46.7) prerenal AKI (ร้อยละ 20.4) และ septic induced AKI (ร้อยละ 11.9) ผู้ป่วยไตวายฉับพลันที่ได้รับการรักษาตัวในแผนกผู้ป่วยหนักร้อยละ 42.1 และได้รับการบำบัดทดแทนไตร้อยละ 4.8 อัตราการตายของผู้ป่วยไตวายฉับพลันคิดเป็นร้อยละ 41.1 ร้อยละ 3.8 ของผู้ป่วยถูกส่งต่อไปยังโรงพยาบาลที่มีศักยภาพสูงกว่า ผลการทำงานของไตของผู้ป่วยหลังการติดตามพบว่าส่วนใหญ่มีการฟื้นตัว

Background and Objective: Acute kidney injury (AKI) is a common and serious condition in global countries. The epidemiologic study of AKI in Thailand is currently insufficient. A pilot study as the initiative attempt for the beginning of the epidemiologic data collection in the eastern part of Thailand was set.

Methods: All of Abhaibhubejhr hospital inpatient data during Oct 2011 – Sep 2012 were collected. The AKI patients were defined and classified by AKIN criteria and the renal outcomes were followed for at least 3 months or longer. The purpose of this study was to evaluate the causes, the characteristics and the outcome of AKI in hospitalized Thai patients.

Results: The incidence of AKI was 2.21%. Most of the AKI patients (83%) were diagnosed at the first day of the admission. There were predominantly non-oliguric AKI (78.1%). The three most common causes of AKI were ischemic ATN (46.7%), prerenal AKI (20.4%) and sepsis induced AKI (11.9%). The mortality rate of AKI patients were 41.1% and 3.8% of patients were transferred to academic hospital. Regarding the renal outcome, there were mostly fully recovery (65.1%) or partial recovery (33%), however 1.9% of patients were dialysis dependent. The most common comorbid conditions in AKI patients were septic shock (47%) and congestive heart failure (12.9%). Among true AKI (481 cases),

*Corresponding author: Worapot Treamtrakanpon, Department of Medicine, Abhaibhubejhr Hospital

Phone: 085-318-5640 Email: treamtrakanpon@yahoo.com

อย่างเต็มที่ (ร้อยละ 65.1) อีกร้อยละ 33 พื้นที่บางส่วนที่เหลือร้อยละ 1.9 ได้รับการบำบัดทดแทนไตถาวร โรคร่วมสำคัญที่พบบ่อยในผู้ป่วยได้แก่ ภาวะติดเชื้อ (ร้อยละ 47) และภาวะหัวใจล้มเหลว (ร้อยละ 12.9) จากจำนวนผู้ป่วยไตวายฉับพลันที่ไม่เคยตรวจพบโรคไตมาก่อนทั้งสิ้น 481 ราย จัดอยู่ใน AKIN ระยะที่ 1, 2 และ 3 ร้อยละ 19.5, 31 และ 49.5 ตามลำดับ ผู้ป่วย AKIN ระยะที่ 3 มีความเสี่ยงสูงในการนอนรักษาตัวในห้องผู้ป่วยวิกฤติ ได้รับการบำบัดทดแทนไตบ่อยกว่ารวมถึงมีอัตราการเสียชีวิตสูงกว่าผู้ป่วย AKIN ระยะที่ 1 และ 2 โดยภาพรวมผู้ป่วยไตวายฉับพลัน มีอัตราการเสียชีวิตมากขึ้น 16.84 เท่า อัตราการเข้าห้องไอซียูมากขึ้น 7.81 เท่า และระยะเวลาในโรงพยาบาลนานขึ้น 2.61 เท่า เมื่อเทียบกับผู้ป่วยที่ไม่มี AKI

สรุป: ไตวายฉับพลันเป็นภาวะที่พบบ่อยและรุนแรงในประเทศไทย ไตวายฉับพลันที่เกิดจากความผิดปกติของระบบไหลเวียนเลือดไปเลี้ยงไต ซึ่งได้แก่ ischemic ATN, prerenal AKI และ septic induced AKI เป็นสาเหตุที่พบบ่อยของไตวายฉับพลัน

19.50%, 35% and 49.5% of the patients were classified as AKIN stage 1, 2 and 3, respectively. As expected, severe AKI (AKIN stage 3) patients had higher prevalence of intensive care unit (ICU) admission, renal replacement therapy (RRT) and higher mortality rate compared with other groups. Overall, inpatient with AKI had greater mortality risk (RR 16.84; 95%CI 14.94-18.97), ICU admission rate (RR 7.81; 95%CI 7.00-8.70) and length of stay (2.61 times) compared with inpatient without AKI.

Conclusion: AKI is a common and serious condition in our country. Hemodynamically-mediated AKI (ischemic ATN, prerenal AKI and sepsis induced AKI) are the major causes of AKI in hospitalized patients.

Keywords: Acute kidney injury (AKI), AKIN (Acute Kidney Injury Network) criteria, Renal replacement therapy (RRT)

Definition: RRT was the modality that replaced non-endocrine kidney function in patient with renal failure and was occasionally used for some form of poisoning.

ศรีนครินทร์เวชสาร 2559; 31 (2): 178-184. ♦ Srinagarind Med J 2016; 31 (2): 178-184.

Introduction

Although there is an increasing incidence of acute kidney injury (AKI) in global countries and knowledge of the causes and mechanisms of disease is growing, few preventive and therapeutic options exist. Even small acute changes in kidney function can result in both short-term and long-term complications, including chronic kidney disease, end-stage renal disease, and death. Development or progression of chronic kidney disease after one or more episode of acute kidney injury could have striking socioeconomic and public health outcomes for all countries. Concerted international action encompassing many medical disciplines is needed to aid early recognition and management of AKI.

For many years, varying definitions of AKI have appeared in the literature, making comparisons between

studies difficult. In 2007, the Acute Kidney Injury Network (AKIN) classification and staging systems have advanced the field, allowing improved comparisons between study populations. Current epidemiologic findings demonstrate the strong association between AKI and hospital mortality. Other outcomes, such as length of hospital stay, readmission rate, development of end stage kidney disease and long term (1–10 years) mortality, are also affected by severe and less severe episodes of AKI during ICU.¹

In Thailand, the epidemiologic study of AKI is currently insufficient and the nephrology consultation system is not available for every hospital. The aims of this study were therefore to describe the real incidence of AKI in a typical general hospital setting in an unselected patient population and describe the

associated short and long-term outcomes in our country. Also we decided to compare the clinical data of AKI by various AKIN stage and by AKI consultation system.

Materials and Methods

The retrospective observational database study was carried out by recruiting all of the new AKI patients, regardless of age group and ward admission, hospitalized in Abhaibhubejhr hospital during October 1st 2011–September 30th 2012. The AKI episodes were defined and classified by AKIN criteria. The AKI patient data were collected during their hospital stay and their renal outcome were followed for at least three months or longer. Patient medical record form and electronic hospital database was reviewed by single investigator.

Statistical analysis

Categorical variables are expressed as percentage of number of cases. Comparisons between the outcomes of AKI patients who had consulted with nephrologist or not were performed using the Student's *t*-test. The burden of AKI was demonstrated in relative risk with 95% confidence intervals (CIs) and when compared between AKIN stages, ANOVA had been used. A two-tailed *p* <0.05 was considered significant.

Results

During the study period, 681 inpatients or equal to 2.21% of total hospitalization had AKI and 0.71% of them were admitted in ICU (Figure 1). There was no difference between genders. AKI stage 3 was found in higher percentage than AKI stage 1 and 2. There was predominantly non-oliguric AKI over oliguric AKI. Most of the AKI patients (81%) were diagnosed on the first day of the admission. The other 16%, AKI developed as a complication and the rest (3%) was the main cause of admission respectively. UA and ultrasound were infrequently performed in clinical practice. However the nephrologist consultation system was available in the hospital, only 14% of patients had been consulted. The

Table 1 Characteristics of AKI in Abhaibhubejhr hospital

Characteristics	Percent
Background	
- Male/female	53/45
- AKI/AKI on top CKD	71/29
- AKI stage: 1/ 2/ 3	19.5/ 31/ 49.5
- Oliguric/nonoliguric	22/78
AKI development	
- Main cause of admission*	3
- Co-disease**	81
- Complication***	16
Investigation	
- Urinary analysis	28
- Ultrasound	9
Nephrologist consultation	14
Main disease	
- Septic shock	47
- Heart failure	13
- Others	40

*It means that the patient was admitted form KUB symptoms eg. edema and hematuria form acute glomerulonephritis, anuria from obstructive uropathy

**It means that the patient was admitted form non KUB symptoms and also found the AKI condition eg. duodenal ulcer bleeding with rising of serum creatinine at admission date

*** It means that the patient developed AKI after admission by other condition eg. AKI after severe sepsis or abdominal paracentesis, cardio-renal syndrome type 1, toxic ATN (drugs). If high percentage was found, the hospital should take action on the prevention of AKI.

main problems of hospitalized patients with AKI were septic shock and heart failure (Table 1).

The three major causes of AKI were ischemic ATN (47%), prerenal AKI (20%) and sepsis induced AKI (12%) (figure 2). The other cause of AKI was toxic ATN (11%), postrenal AKI (6%) and glomerulonephritis (1%). The other causes of other AKI was hepatorenal syndrome, myeloma cast nephropathy, malignant hypertension and unknown.

Mostly AKI patients were admitted in major ward.

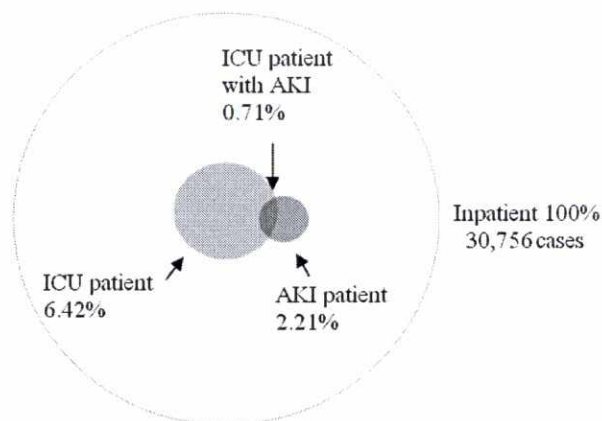


Figure 1 The incidence of AKI patients in Abhaibhubejhr hospital during October 2011 to September 2012.

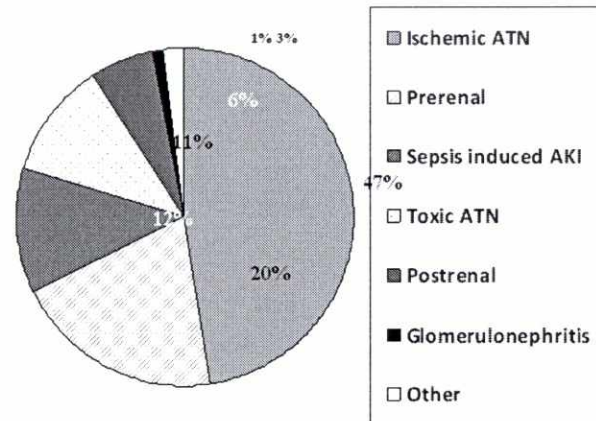


Figure 2 The causes of AKI

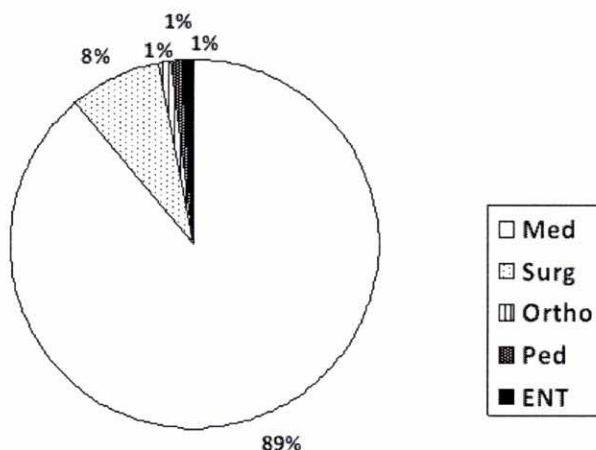


Figure 3 Hospitalized AKI patients classified by specialty care

89% was admitted in medicine ward and 8% in surgery ward. Few patients were found in orthopedic, pediatric and ENT wards. (Figure 3)

Unless renal replacement therapy (RRT) was initiated in only 6% of AKI patients during the study, the renal outcome was poor. Roughly 40% of them, renal function was not fully gained. About 40% was dead and 40% need ICU. Of surviving patients, 2% remains dialysis dependent at 3 months after hospital discharge. (Table 2)

Comparing the case that were consulted nephrologist and those that not consulted nephrologist, the first group spent their time in ICU and overall

Table 2 AKI outcome

AKI outcome	Percent
Need RRT/ Not need RRT	6/94
Need ICU/ Not need ICU	58/42
Renal recovery	
- Full	65
- Partial	33
- Dialysis dependence	2
Patient recovery	
- Survive	55
- Dead	41
- Referred	4

hospital stay longer than the latter group. However, the patient survival and renal recovery rate of the first group was better than the latter group. (Table 3)

Morbidity and mortality of the AKI patients was higher than those without AKI (Table 4 (1)). The Patients with AKI development had chance to be dead and chance to admit ICU around 17 and 8 times above those without AKI development. The length of stay in patients with AKI was also longer than the other. After we classified the severity of AKI patients by AKIN criteria, patient who categorized in AKIN stage 3 had greater risk of in-hospital death, ICU admission, and required the longer time of treatment in hospital. (Table 4 (2-3)).

Table 3 AKI outcome between the group that had nephrologist consultation and the group that handle by general medicine doctors (not consulted).

Nephrologist consultation		Consulted	Not consulted	p-value
Renal recovery rate	%	58	28	0.04*
Patient survival rate	%	73	56	0.051
ICU admission rate	%	56	44	0.109
Length of stay	days	16.17	12.73	0.228

Table 4 (1) Burden of AKI overall

	AKI (n=481)	Non AKI (n=30,275)	Relative risk	95% confidence interval
- Mortality rate	41%	2.43%	16.84	14.97-18.97
- ICU admission rate	58%	6.53%	7.81	7.00-8.70
- Length of stay (mean;days)	24	6.6	3.6	-

Table 4 (3) Burden of AKI categorized by AKIN stages displayed in percent and mean

		AKIN 1	AKIN 2	AKIN 3	p-value
Mortality rate	%	39.36	40.27	57.57	0.002*
ICU admission rate	%	32.98	38.26	54.62	0.000*
Length of stay	days	17.02	29.53	31.93	0.040*

Table 4 (2) Burden of AKI categorized by AKIN stages displayed in relative risk compare with non AKI group

	AKIN 1	AKIN 2	AKIN 3	Non AKI
Mortality risk	14.63	14.97	21.40	1x
ICU admission	5.68	6.59	9.40	1x
Length of stay	3.40	5.91	6.39	1x

Discussion

This is the first study to define the incidence of hospitalized AKI in Thai population. The incidence of AKI was detected at 2% with in contrast to other studies the incidence was too low. This may be due to our study included all types of patients, while many studies show the data specified in critically ill patient, ICU unit and cardiac center. AKI was not commonly found in some major wards such as obstetric or pediatric wards as well as some minor wards such as eye or psychiatric wards.

Table 5 Comparative studies about AKI incidence by new AKI criteria.

Author	Hoste et al ²	Ratanarat et al ⁸	Cruz DN. et al ⁹	Yue JF ¹⁰	Treamtrakon W.
- Journal	CCM 2008, Meta-analysis	JMAT 2009, Thailand	NEIPHROS 2007, Italy	Zonghua Yi Xue Za Zhi 2011, China	2013, Thailand
- Incidence of AKI (%)	2-3	-	-	-	2.21
- AKI definition	RIFLE	RIFLE	RIFLE	AKIN	AKIN
- ICU patients with AKI (no;%)	81,387 up 60	121 47	234 10.8	191 35.5	287 9
- RRT in ICU patients with AKI (%)	5	29	3.3	-	9
- Mortality of ICU patients with AKI (%)	50-60	51.16	30-42	48	53.85
- Dialysis dependent in ICU patients with AKI (%)	5-20	-	-	-	4

However, the large retrospective data of USA reported in 2001⁽²⁾, the average incidence of hospitalized AKI had the averaged range as ours. (Table 5)

It's interesting that the incidence of AKI in ICU was high, nearly 30%, similar to the other publish literatures. Patients with AKI on ICU admission also had high mortality and need urgent renal replacement therapy. (Table 5) We also found that mortality of AKI patients treated with RRT remains constantly high, according to many studies published in several years ago. However, the outcomes after RRT improved during a 10-yr period³, several others report showed, in large multicenter data-bases, that patients are now more severely ill than 10–15 years before.⁴ Mortality of ICU patients treated with RRT depends heavily on associated organ dysfunctions and comorbidity, but for a general ICU population, mortality is approximately 50–60%.

AKIN criteria seem to be a good predictor of hospitalized patient's outcome. The patient with AKI had overall outcome worse than the patients without AKI. Patients in AKIN stage 3 had significantly less chance to survive, more chance to admit in ICU ward, and greater time staying in hospital than patients in the other two stages.

Ischemic ATN was the most common cause of AKI in our study followed by prerenal AKI and sepsis induced AKI. These three causes were termed as hemodynamic mediated AKI that covered 79% of overall causes of AKI. Septic shock and heart failure were the common comorbidities of patients with AKI as same as the other studies.⁵⁻⁷ This was the reason why the hemodynamic mediated AKI was the major common cause of AKI. Patients with the condition of septic shock or congestive heart failure should receive special attention for AKI. Early detection and prompt renal supportive care could ameliorate sequelae of AKI events.

Related to Thai herb, AKI patients who had document of Thai traditional medicine used was relatively high, about 28.6% (not shown in the figure). However, the data was collected from a few patients (less than 10% of total data). Further study should be designed for answer the risk of AKI from the Thai herb used.

In our country, nephrologist was not the first doctor to take action with AKI from general wards. In routine, typical case of AKI, AKI that was not need renal replacement treatment (RRT), or AKI with good response to volume resuscitation was handled by general medicine doctors. The study showed that only 14% of patients had been consulted nephrologist. Moreover, the percentage of fully completed investigations to diagnosis cause of AKI such as ultrasound and urinary analysis was too low (table1). These may be that almost all doctors were not recognized the burden of AKI and they didn't handle it carefully. The patients with AKI that consulted nephrologist had more severe clinical baseline than the patients with AKI that were not consulted nephrologist, however the clinical outcome in the first group was better than the latter. These data supported that the AKI consultation system should be cultivated and initiated in the public health system.

Conclusion

AKI is indeed a big problem of our country. Hemodynamically-mediated AKI is the major cause of AKI in hospitalized patients. Patients with the condition of septic shock or congestive heart failure should receive special attention for AKI. AKIN criteria was useful for early detection and predicting severity of AKI. If nephrologist is available, the AKI consulting system should be set to decrease the sequelae of AKI.

Acknowledgements

This work was presented in abstract form at the annual meeting of the Royal College of Physicians of Thailand 2013, Pattaya, Thailand, April 26, 2013 and the annual Nephrology Meeting of Thailand 2013, Pattaya, Thailand, August 1, 2013

We are grateful to Dr.Asada Leelahavanichkul for proofreading our abstract.

Reference

1. Jose Antonio Lopes, Sofia Jorge. The RIFLE and AKIN classifications for acute kidney injury: a critical and comprehensive review. Clin Kidney J [In depth Review] 2013;

- 6: 8-14.
2. Liangos O, Wald R, O'Bell JW, Price L, Pereira BJ, Jaber BL. Epidemiology and outcomes of acute renal failure in hospitalized patients: a national survey. *Clin J Am Soc Nephrol* 2006; 1: 43-51.
3. Desegher A, Reynvoet E, Blot S, J De waele, S Claus, Hoste. E. Outcome of patients treated with renal replacement therapy for acute kidney injury. *Crit Care* 2006; 10(Suppl 1): 296.
4. Bagshaw SM, George C, Bellomo R. Changes in the incidence and outcome for early acute kidney injury in a cohort of Australian intensive care units. *Crit Care* 2007; 11: R68.
5. Hata N, Yokoyama S, Shinada T, Kobayashi N, Shirakabe A, Tomita K, et al. Acute kidney injury and outcomes in acute decompensated heart failure: evaluation of the RIFLE criteria in an acutely ill heart failure population. *Eur J Heart Fail* 2010; 12: 32-7.
6. Singh TB, Rathore SS, Choudhury TA, Shukla VK, Singh DK, Prakash J. Hospital-acquired acute kidney injury in medical, surgical, and intensive care unit: A comparative study. *Indian J Nephrol* 2013; 23: 24-9.
7. Zarbock A, Gomez H, Kellum JA. Sepsis-induced acute kidney injury revisited: pathophysiology, prevention and future therapies. *Curr Opin Crit Care* 2014; 20: 588-95
8. Ratanarat R, Hantaweepant C, Tangkawattanakul N, Permpikul C. The clinical outcome of acute kidney injury in critically ill Thai patients stratified with RIFLE classification. *J Med Assoc Thai* 2009; 92 (Supl 2): S61-7.
9. Cruz DN, Bolgan I, Perazella MA, Bonello M, de Cal M, Corradi V, et al. North East Italian Prospective Hospital Renal Outcome Survey on Acute Kidney Injury (NEiPHROS-AKI): targeting the problem with the RIFLE Criteria. *Clin J Am Soc Nephrol* 2007; 2: 418-25.
10. Yue JF, Wu DW, Li C, Zhai Q, Chen XM, Ding SF, et al. [Use of the AKIN criteria to assess the incidence of acute renal injury, outcome and prognostic factors of ICU mortality in critically ill patients]. *Zhonghua Yi Xue Za Zhi* 2011; 91: 260-4.

